Network Design Using Load Balancing Equal Cost Multi Path (ECMP) Method At Lexima Consultant Office

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Abstract. The development of technological advances also contributed to the advancement of Internet technology. Where the Internet is one of the needs that is considered important in all fields, this is evidenced by the number of Internet users from 2020 to 2023 having a significant increase. Lexima Consultant as one of the institutions engaged in information system creation services, of course, requires an internet connection. However, there are several obstacles faced, one of which is the absence of a load balancing and failover network system which sometimes makes the need for internet access with large bandwidth allocations to be disrupted and even cut off. Implementing the right technique at the Lexima Consultant office for sending data packets as the main factor supporting activities is certainly very much needed. In the research conducted, a load balancing technique was used using the ECMP method to optimize network performance and avoid internet network disturbances. From the research conducted, it can be concluded that the implementation of the load balancing method using the ECMP method has been able to divide connection paths and failover can run properly, so the possibility of disruption in the form of a network connection loss will be very small.

**Keywords:** Bandwith, Failover, ECMP, Lexima Consultant, Load Balancing.

1 Introduction

The development of digital technology has made progress in various fields, one of which is information and communication technology (ICT). Where the development of technology is currently growing and sophisticated. One proof of this development is the increasing number of users of Interconnected Networks (Internet), especially in Indonesia. The changes that people experience with the existence of the internet certainly have an impact on various lines of life, starting from individuals, agencies, companies, and private organizations the government also takes advantage of the sophistication of internet technology, because with the internet people are able to carry out interactions and transactions [1]. According to data released by the Asosiasi Penyelengara Jasa Internet Indonesia (APJII) in 2020, it was found that the number of Internet users in Indonesia reached 196.71 million [2]. In 2021 the number of internet users will increase by around 77.02%, which is around 210.03 million people, and in 2022-2023 it will again increase by 2.67%, which is around 215.63 million people [3]. The existence of the Internet as a means of information and communication is certainly very easy for everyone [4]. The internet can be used for various purposes in everyday life for individuals, agencies, companies, and organizations, where the internet has made it easier for everyone to disseminate and search for information [5]. Many users of Internet connections, nowadays, do not only subscribe to one Internet Service Provider (ISP), it can even be more dependent on user needs. The aim is to have quality and stable Internet access and avoid disconnection of the Internet connection when services from one of the ISPs are used. experience problems that cause internet access to be disrupted [6].

Lexima Consultant as an institution engaged in the field of information system creation services for government agencies certainly requires a quality and stable Internet network so that it can perform data input, maintenance of online-based applications, and online meeting activities which are needed at any time. Often, during this time, Internet network trouble occurs due to an unstable connection during working hours. The network system at the Lexima Consultant office currently still uses one internet connection line with the topology shown in Figure 1 below.

Internet connection at the Lexima Consultant office only comes from Indihome, because of this, weather problems are often one of the factors that impact network quality. In the absence of a load balancing and failover network system at the Lexima Consultant office, at times the office network system cannot meet the

needs in terms of internet access when work requires a large bandwidth allocation. Heavy traffic that causes overload can also cause the Internet connection to slow down and can even cause the internet connection to drop. The existence of a Failover system will be able to automatically move the gateway of a system to reduce the workload on the ISP so that the connection can return to stability [7]. Making a suitable design using the right technique to overcome this problem is very important, this is because the internet for sending data packets is a major factor in supporting activities in the Lexima Consultant office.
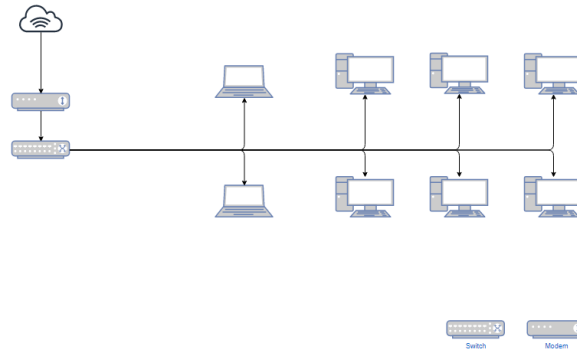
Figure 1. Network topology at the Lexima Consultant office

Load imbalance in the network in the data distribution process is the most common problem in the network, where this imbalance often occurs at peak times which causes an imbalance in distribution and can also cause failure [8]. One technique that is often used is the Load balancing technique, where this technique will divide the workload between several servers in order to improve performance and reduce response time in busy network environments [9]. One method that is often used in load balancing techniques is the Equal Cost Multi-Path (ECMP) method, wherein the ECMP method network traffic will be divided between several paths that have the same cost by dividing traffic between available paths. evenly. When the packet is received, the router will determine the path that will be used to send the packet using a hash algorithm. Of course, the ECMP method is very useful in managing redundant paths in a network and increasing the throughput of a busy network. In the use of a single line, if there is a sudden increase in data traffic, it will cause the server to become burdened which causes a decrease in performance. However, in the ECMP method network performance can be increased by utilizing the available paths by dividing data traffic evenly so that the server is not overloaded and if one path fails or is interrupted, the data packet will be diverted to another available path. The ECMP method is an effective load-balancing method for optimizing network performance, where in complex networks ECMP can help increase network availability and speed up data transmission [10]. To achieve balance, the server will dynamically calculate the ratio of server to load which results in load balancing [11]. It can be said that the use of a load balancing method is very necessary, where two or more internet provider networks can be combined in order to transmit the traffic load of each internet provider to be divided evenly. Bandwidth management is carried out in order to be able to adjust the size and size of each data packet that passes through the network in order to prevent or reduce irregular use [12].

Several previous studies have examined the load balancing method, namely, research conducted by [13] with research entitled Implementation of Load Balancing and Failover on Internet Networks Using the NTH Method. In this study, measurements were made on connection performance, Quality of Service (QoS), and Failover from 2 network ISPs. In this study the Network Development Life Cycle (NDLC) method was also used as network development, where this method consisted of 6 stages of the development process, namely (1) analysis stage, (2) design stage, (3) simulation prototype stage, (4) stage implementation, (5) monitoring stage, and (6) management stage. The conclusion from the research conducted is that the implementation of load balancing using the NTH method has been successfully implemented where failover only takes 8 seconds to be able to take over the first ISP that is experiencing a loss of connection or Request Time Out (RTO) to move to the second ISP. In addition, the QoS test results have a very satisfactory range with a throughput value of 79%, packet loss of 0.69%, delay of 55.3ms and jitter of 0.851 ms, which means that according to the TIPHON standard, it is included in the range of very good values. Furthermore, research was conducted by [14] with the title Implementation of load balancing web servers using proxy on the virtual server directorate of the Ministry of Education and Culture's Vocational High School. In this study, the load balancing method was used to divide the workload of a web server that was distributed into several server nodes, where previously the server was still only a single server used to handle 10 websites to distribute information and meet user needs. In this study, the round-robin method was used to divide the weights on the server. The research carried out resulted in a division of workload that can run in a balanced manner, where each server is given a weight so that it will be able to meet user requests.

2 Research Method
2.1 Method Of Collecting Data

In the research conducted, several methods were used to collect data, including:

a. Interview Method: The interview method was carried out by directly interviewing the director of Lexima Consultant, namely Mr. Hilman Sumantri, regarding the desired conditions and requirements regarding the network in the Lexima Consultant office.

b. Observation and Documentation Method: the observation and documentation method is carried out by directly observing and documenting the floor plan of the office space and the network topology at Lexima Consultant.

c. Literature Study Method: the literature study method is carried out by collecting references sourced from books, the internet, journals, and other documents related to the methods discussed in the research conducted.

2.2 Research Stages

There are several stages carried out in completing the research carried out, namely:

a. Plan stage: this is the stage for identifying the network in the Lexima Consultant office, regarding the technology used previously and describing the network that will be used to implement load balancing techniques with the ECMP method for bandwidth management.

b. b. Prepare stage: this is the stage used to determine network architecture concepts which will later be used to implement load balancing techniques with the ECMP method for bandwidth management in the Lexima Consultant office.

c. Design Stage: this is the stage for making network designs in the form of a physical topology that applies load balancing techniques with the ECMP method for network management at the Lexima Consultant office.

2.3 Design IP Addresses

The design of the Internet Protocol Address or IP address is a system used to assign numbers to identify devices connected to the Internet network. Where the IP address itself consists of four blocks of numbers separated by dots, in each block it has a value range from 0 to 255. The IP address design is used to make it easier for users to manage and allocate IP addresses so that the data sent is more efficient and there is no overlap [15]. The design of the IP address at the Lexima Consultant office can be seen in Table 1 below.

Table 1. Design of Lexima Consultant's office IP address

Number of Clients	Network	Range
11	192.168.1.0/28	192.168.1.1 - 192.168.1.14

The design of the IP address at the Lexima Consultant office is made so that the IP address can meet the needs of existing clients on the office network. The formula for knowing the number of Host IDs is 2y, and the variable y is the bit that has a value of 0 in the subnet mask. The subnet mask on the network is 255.255.255.240. If the subnet mask is converted to a binary number, the result is 11111111.11111111.11111111.11110000, or it can be interpreted as /28 which is the number of bits 1 in the subnet mask. So the number of Host IDs on the network is 24 = 16 with Net ID 192.168.1.0 and broadcast 192.168.1.16 and the IP range that clients can use is 192.168.1.1-192.168.1.14.

2.4 Network Topology Design

The design of the network topology in the Lexima Consultant office can be seen in Figure 2. In this study, a star topology was used which has advantages in terms of maintenance and is easy to detect network problems, and is more flexible in its development, even though its use will be more wasteful in using cables.
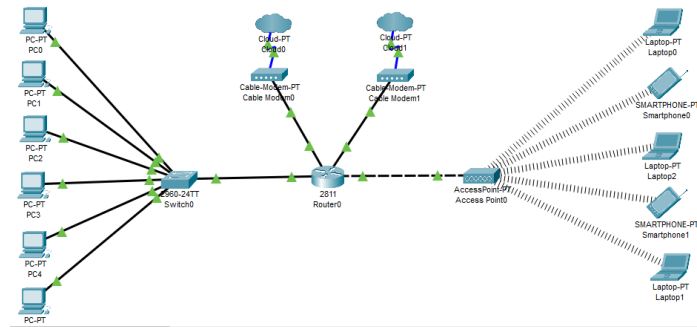
Figure 2. Lexima Consultant Office Network Topology Design

In the network design in Figure 2, there is 1 switch which is a device at the data link layer at the Open System Interconnection Layer or OSI Layer whose job is to transmit data to the Local Area Network (LAN) network and the Access Point office of Lexima Consultant. The network design uses a MikroTik router which is used for load balancing using the ECMP method, the router will carry out several activities such as routing, packet tagging, connection tagging, Dynamic Host Configuration Protocol (DHCP) Server, and Domain Name System (DNS) which in this design has two connections Internet.

2.5 Parameters And Load On Network Conditions

There are two parameters used to measure network load in the Lexima Consultant office, the parameters used are:
   a. Condition of the network is busy, the parameters used are, if there are 6 PCs, 2 laptops, and 3 smartphones in a position to access 10 websites by pinging the terminal to the server simultaneously.
   b. Network condition is quiet, the parameters used are, if there is 1 PC and 3 smartphones in a state of accessing 10 websites by pinging the terminal to the server simultaneously.

3   Result and Discussion

The initial step is to configure such as addressing the IP address and then configure PCC by setting the mangle to mark the connection by directing the client connection on both lines, namely ISP (A) and ISP (B). After the configuration is complete, a ping test will be carried out to ensure that the PCC configuration is running properly. Furthermore, after the PCC configuration is successful, a failover configuration will be performed to mark ISP (A) traffic as the main one by setting the IP route. Then a trial will be carried out by turning off one of the ISPs. If one of the ISPs is down or has a data transfer rate of 0 bps then all traffic will be diverted to the active ISP.

3.1 Simulation of How ECMP Works in Routers

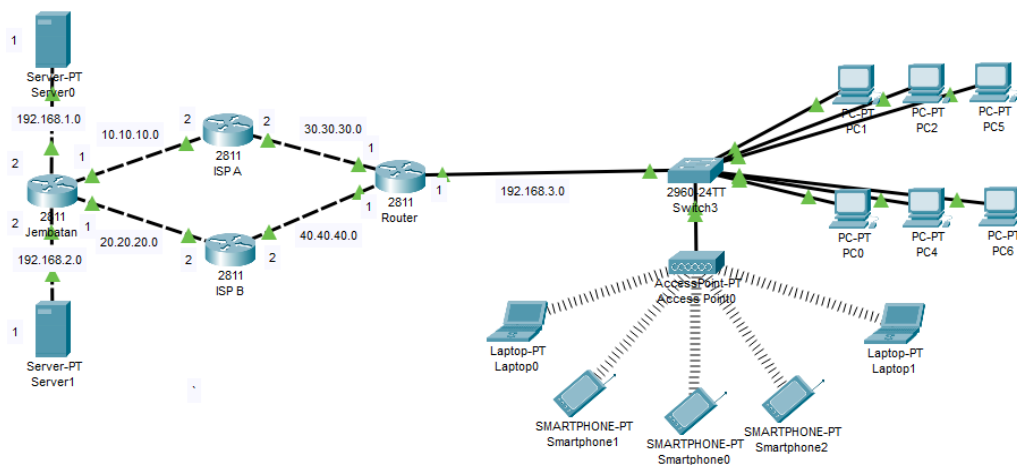How ECMP works on routers can be simulated in Figure 3 below.

Figure 3. Simulation of how ECMP works on a router

Figure 3 above is an explanation regarding the ECMP process simulation that occurs inside the router. IP 30.30.30.1, 30.30.30.2, 10.10.10.1, and 10.10.10.2 are like ISP (A) and IP 40.40.40.1, 40.40.40.2, 20.20.20.1 and 20.20.20.2 are like ISP (B) When a computer accesses the internet open for example google then the page can be accessed through ISP (A) or through ISP (B) and when Google gives a response it can also be through ISP (A) or ISP (B).

3.2   Ping And Tracert To The ISP On The Network

Figure 4. Ping and tracert PC 1 to Youtube

In Figure 4 above PC 1 is connected to a website page and the tracert command explains that when a PC sends data, the data will pass through the network switch network then enter the ISP network (A), and will then arrive at the intended website page and when the response is replied, it will still be through the ISP (A). This indicates that ECMP is running.

Figure 5. Ping ISP (B) and Tracert PC 1 to the website page

In Figure 5 above it is simulated that when the ISP (B) experiences interference. When a ping command is issued to ISP (B) on PC 1 but ISP B cannot connect while PC 1's position is opening a website page, what will happen is that the data will pass through the network switch network which will then be diverted into the ISP network (A) and when answered the data will be sent back through the ISP (A). This indicates that the Failover Function has been running.

4 Conclusion

Based on the results of experiments conducted related to the research conducted, it can be concluded that:
a. Router managed to divide the connection path into two parts, namely through ISP A and ISP B
b. Failover on the load balancing technique with the ECMP method can run well so that the internet connection at the Lexima Consultant office will most likely avoid disconnection of the network connection.
c. It is necessary to add network security such as a firewall to separate the employee's room from the supervisor's room. As well as the need for a bandwidth fix in order to make network performance more optimal.

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