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A Network Design Using MPLS For Video Streaming Services

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ABSTRACT
The design of a reliable and efficient network is crucial to support services that require large data transfers, such as video streaming. This research aims to design a network using Multiprotocol Label Switching (MPLS) technology to enhance the quality of video streaming services. MPLS is known as an effective solution for managing network traffic due to its ability to perform label-based routing, which allows for more optimal and faster path selection compared to traditional routing methods. In this study, the MPLS network design is implemented to provide better Quality of Service (QoS), focusing on parameters such as latency, jitter, and packet loss, which greatly impact the user experience in video streaming. The design method involves selecting the most efficient routes and managing priority traffic to ensure that video streaming data can be transmitted with optimal speed and stability. The results of this study show that the use of MPLS in networks for video streaming services can improve bandwidth efficiency, reduce disruptions caused by network congestion, and ensure more stable playback with minimal buffering. Therefore, MPLS-based network design becomes an effective solution to support higher-quality video streaming services.

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INTRODUCTION

In the increasingly advanced digital era, video streaming services have become very popular and have become one of the most widely consumed forms of content online. However, the quality and stability of video streaming services can be affected by the performance of the network used. One of the network technologies that is widely used to improve the performance of video streaming services is MPLS (Multiprotocol Label Switching). MPLS is a network technology that combines the advantages of routing and switching protocols. By using MPLS, data packets can be directed more efficiently through the network with the help of labels added to each packet. This allows for faster data delivery, consistent transfer speeds, and the ability to set service priorities. In the context of video streaming services, MPLS can provide benefits in overcoming common challenges, such as video quality disruptions, excessive buffering, and high delays. By using MPLS, video streaming services can stream data more smoothly, reduce playback errors, and provide a better user experience.

However, the use of MPLS for video streaming services also faces several challenges. Choosing the right configuration, bandwidth management, and network optimization are

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important factors to ensure optimal performance. Therefore, further research is needed to design and optimize MPLS networks for video streaming services. This study aims to design a network using MPLS for video streaming services with the aim of improving service quality, reducing delay time, and optimizing bandwidth usage. Thus, this study can contribute to the development of better network technology and improve user experience in accessing video streaming services.

The performance of telecommunication networks in the data delivery process is often a problem and affects the quality of services provided, thus a telecommunications network is designed by utilizing Multiprotocol Label Switching (MPLS) technology. This MPLS network is a network defined by the IETF to combine the label swapping mechanism on layer 2 with routing on layer 3 to speed up the delivery of data packets.

From previous research. Dimas Yudha Prawira has analyzed the performance of OSPF routing protocol with OSPF with MPLS using Ghrapical Network Simulator 3 (GNS3) software on video streaming services with the journal "Analysis of Multiprotocol Label Switching (MPLS) Network Performance for Video Streaming Services". From the test results, it was obtained that the performance of the OSPF (Open Shortest Path First) routing protocol with MPLS (Multiprotocol Label Switching) was better. From this study, the author wants to compare a network again but with 2 different routing techniques, namely the performance of the OSPF routing protocol with MPLS and the BGP (Boarder Gateway Protocol) routing protocol with MPLS on Video Streaming services.

Literature Review

The main concept of MPLS is the technique of placing labels in each packet sent on this network. The label will contain important information related to the routing information of a packet, including the destination of the packet and the priority of which packet should be sent first. Routing protocols on layer three of the OSI system play a role in delivering data packets in this network while MPLS is between layer 2 and layer. This network has several advantages, namely :

1. MPLS reduces the amount of processing that occurs in the IP router and improves the performance of sending data packets.
2. MPLS can also provide Quality of Service (QoS) in the backbone network by using the Differentiated Services (Diffserv) technique so that each packet service sent will receive different treatment according to its priority scale.

The working principle of MPLS is the combination of switching speed on layer 2 with routing capability and scalability on layer 3. The way it works is by inserting a label between the layer 2 and layer 3 headers on the forwarded packet. The label is generated by the Label Switching Router (LSR) which acts as a liaison between the MPLS network and the external network. The label contains information on the destination node where the packet should go next. Then the packet is forwarded to the next node, at this node the packet label will be removed and given a new label containing the next destination. Packets are forwarded in a path called LSP (Label Switching Path). The working principle mechanism of the MPLS Network is highly dependent on label swapping. Labels are exchanged according to the information previously held by the router for the purpose of transferring data packets from the sender to the recipient.

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METHOD

The design begins with the preparation of hardware and software that is adjusted to the specifications of the simulated network. Then the next step is to create a network system modeling related to the shape and components of the network. In the final stage of the design is to run a simulation of the network that has been designed according to the procedures that have been made. In the network simulation process, two networks are formed, namely a network with IP protocol routing BGP with MPLS and a network with IP protocol routing OSPF with MPLS as shown in Figure 1.

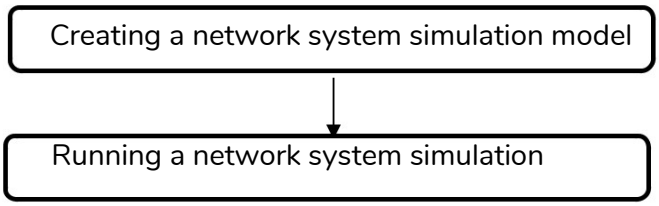

Figure 1. Network Design Block Diagram

The stages of designing an OSPF routing protocol network with MPLS are explained in a flow diagram as in Figure 2. In general, there are 4 stages of simulating an OSPF routing protocol network with MPLS, namely: Loopback interface and IP address settings, OSPF routing protocol settings, Creating Traffic Load, MPLS Setup, Test network.

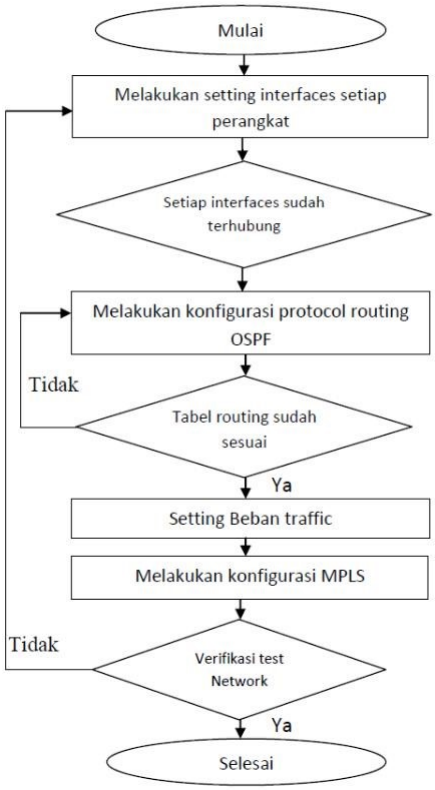

Figure 2. Protocol Network Design Flowchart

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RESULTS

Destination Result

In QoS measurement, WireShark software is used. WireShark is able to capture data packets that cross the network. Data packets that cross the network from the source with IP 192.168.1.2 to the destination IP with IP 192.168.6.2. The capture process is carried out on UDP data packets that are Decoded As into RTP data packets as in Figure 3.

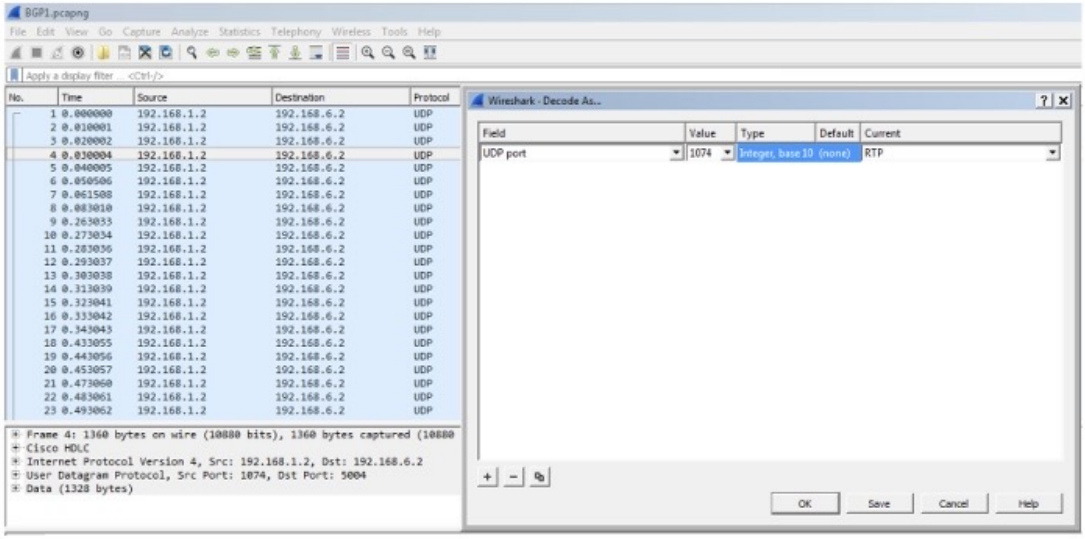

Figure 3. UDP data packets are converted to RTP in the Network.

Discussion

After conducting the network simulation process with video streaming services, throughput data between OSPF and BGP with MPLS was obtained as in Table 1.

Table 1. Throughput Value in Network Simulation Process (Mbps)

Test	OSPF with MPLS	BGPwith MPLS
1	0.22	0.29
2	0.21	0.21
3	0.25	0.24
4	0.24	0.26
5	0.23	0.25
Average	0.23	0.25

After running the FFMPEG program command, the PSNR data between OSPF and BGP with MPLS was obtained in Table 3.

Table 3. PSNR Values in Network Simulation Process (dB)

Test	OSPF with MPLS	BGPwith MPLS
1	30.5	33
2	30.4	30
3	32.2	31.9

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Test	OSPF with MPLS	BGPwith MPLS
4	31.6	32.5
5	30.6	32
Average	31.06	31.88

After running the FFMPEG program, the SSIM between OSPF and BGP with MPLS data results are obtained in Table 4.

Table 4. SSIM Values in the Network Simulation Process

Test	OSPF with MPLS	BGPwith MPLS
1	0.87	0.91
2	0.86	0.85
3	0.9	0.89
4	0.89	0.9
5	0.86	0.89
Average	0.87	0.88

CONCLUSION

From the results of the analysis and testing that has been carried out, the following conclusions can be drawn: The average throughput value on a network configured with BGP with MPLS is 0.23 Mbps, better than OSPF with MPLS which is only 0.25 Mbps. The average delay value on a network configured with BGP with MPLS is 42.08 m/s, better than OSPF with MPLS, which is 43.16 m/s. The average packet loss value on a network configured with BGP with MPLS is 1.92%, better than OSPF with MPLS, which is 3.18%. The average PSNR value on the network configured with BGP with MPLS is 31.88 dB, which is better than OSPF with MPLS, which is 31.06 dB. The average SSIM value on a network configured with BGP with MPLS is 0.88, which is better than OSPF with MPLS, which is 0.87.

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