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PERFORMANCE ANALYSIS OF VIDEO ON DEMAND AND VIDEO STREAMING ON THE NETWORK MPLS TRAFFIC ENGINEERING

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ABSTRACT: Video on Demand (VoD) and video streaming is a type of service used on multimedia networks through the internet (www) to make things easier users access the broadcast that is life. This requires a reliable network for the video to be displayed get maximum results, where this research implemented using MPLS-TE (Multi-Protocol Label Switching-Traffic Engineering). The key feature of MPLS is its TE, which plays a vital role in minimizing the congestion by efficient load balancing and management of the network resources. Due to lower network delay, efficient forwarding mechanism, enhancing the speed of packet transfer, scalability and predictable performance of the services provided by MPLS technology makes it more suitable for implementing real-time applications such as VoIP and video streaming. This paper evaluated the performance measures such as transfer time, delay, throughput using OSPF as routing protocol and tunneling to determine the inside path the process of different types of traffic (video on demand, video streaming) in their movement in a network MPLS-TE. Test results from Quality of Service (QoS) analysis taken minimum delay value in the reference journal MPLS-VPN which reached 9.0 while the maximum value in MPLS-TE obtained on the analysis that is with the value 0.015.

Keywords: MPLS, TE, MPLS TE, Video Streaming, QoS

1. INTRODUCTION

Technological advances are currently growing very rapidly. The presence of various technologies to meet the needs of human life becomes easier because today technology brings positive implications in the history of human life and a proof of the development of the human ability to use his mind in managing information. Technology not only provides information in the form of text and images in general, but now Technology has been able to involve aspects of multimedia (Video and Audio) is the service of Video On Demand (VoD) and Video Streaming which can be accessed via the web (WWW) which aims to facilitate the user in accessing information.

The increasing number of audio and video streaming applications in real time in everyday use, it takes a reliable network in delivering these streaming data packets. WAN connections are an expensive item in an ISP budget. Traffic engineering enables ISPs to route network traffic to offer the best service to their users in terms of throughput and delay. By making the service provider more efficient, traffic engineering reduces the cost of the network. Currently, some ISPs base their services on an overlay model. In the overlay model, transmission facilities are managed by Layer 2 switching. The routers see only a fully meshed virtual topology, making most destinations appear one hop away. If you use the explicit Layer 2 transit layer, you can precisely control the ways in which traffic uses available bandwidth. However, the overlay model to overcome these demands was built an MPLS-based network is expected to be Improve the performance of IP-based networks [1].

A traffic engineering problem on the Internet consists of setting up paths between the edge routers in a network to meet traffic demands while achieving low congestion and optimizing the utilization of network resources. In practice, the usual key objective of traffic engineering is to minimize the utilization of the most heavily used link in the network or the maximum of link utilization. As the maximum link utilization qualitatively expresses that congestion sets in when link utilization increases higher, it is important to minimize the link utilization throughout the network so that no bottleneck link exists [2]. Traffic engineering is essential for service provider and Internet service provider (ISP) backbones. Such backbones must support a high use of transmission capacity, and the networks must be very resilient so that they can withstand link or node failures. MPLS traffic engineering provides an integrated approach to traffic engineering. With MPLS, traffic engineering capabilities are integrated into Layer 3, which optimizes the routing of IP traffic, given the constraints imposed by backbone capacity and topology. To tackle the problem of low delay, high throughput and packet loss during the delivery of multimedia applications, it is necessary to think of improved methods to use more effectively the available network resources. MPLS and MPLS-TE (MPLS Traffic Engineering) are some processes that provide this functionality.

2. RELATED WORKS

2.1 MPLS

MPLS can be considered a technology that has brought an oriented connection for IP protocol. Therefore, network services and applications can exploit all of the advantages of MPLS. In other words, MPLS is a connection-oriented technology that uses a label swapping technique with IP network routing [3].

A label is a small, fixed index, which identifies a Forward Equivalence Class; a group of IP packets that are forwarded over the same path with the same packet treatments. With MPLS, the packet is faster than with use IP address because MPLS uses labels to quickly check the next hop that leads to the destination without going to the network layer to analyze the packets along the path.

MPLS consists of routers: Label Switching Routers (LSR) and Label Edge Routers (LER). These routers use labels to quickly send packets to the destination. In fig. 1, An LSR is a router that forwards both conventional IP packets and MPLS labeled packets. An LER is an LSR at the edge of the MPLS network to add and remove labels. An LER connects between the MPLS domain and the non-MPLS domain such as IP network. A flow of packets coming from a non-MPLS domain is first assigned a label at an incoming LER and its forward along the path as an old label is replaced with a new label at LSRs on the path. Therefore, a label is used to reach the next node. Although the exchange of label is required on the path, and the search of the network layer is not required at LSRs routers due to transmission of the link layer with labels. In routers LERS the labels are completely removed and the packets are transmitted directly to other networks. MPLS label switched paths are an essential element in delivering end-to-end QoS. Without them, it is not possible to control the path of packet flows from requested packet treatments.

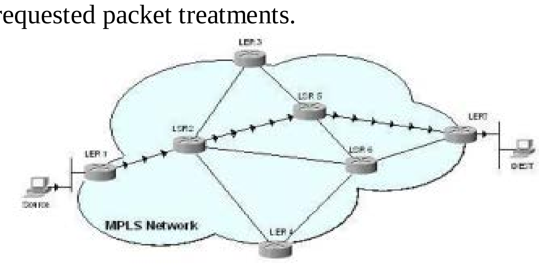

Fig. 1. MPLS

In a centralized scheme, global optimization is used to compute the routes used by the label switched paths (LSPs) based on the traffic demand; these LSPs are then implemented in the network to enable better load balancing, see [4,5] for example. A distributed traffic engineering scheme can be implemented in a number of different ways. For example, in the scheme described in [6], each ingress-egress node pair can send traffic over a number of different paths and a distributed optimization algorithm is used to determine the proportion of traffic to be sent over each possible paths [7]. MPLS has emerged as the key integration technology for carrying voice, video, and data traffic over the same network, and it is technology which plays an important role in the next generation networks by providing Quality of Service (QoS) and TE (traffic engineering). In an MPLS network, LSPs (Label Switched Path) are installed from an ingress node to an egress node prior to starting of transmission. Each LSP can be specified with features that include time constraints and reliability. Therefore, the connection-oriented applications can take advantage of the "virtual connections" set by MPLS that satisfy some constraints. Since the LSPs are stackable, traffic from different flows sharing some common characteristics can be aggregated on an LSP. These characteristics may include common egress and identical QoS and protection requirements [8][9].

2.2 Traffic Engineering in MPLS Networks

The modern networks are converged networks; they carry voice, video and normal data by using the same network resources. Since some user data traffic such as voice, video or data. Transactions are more important and less tolerant to delay, high throughput, they are preferentially treated based on their delivery requirements such as bandwidth and maximum affordable delay.

The provision of traffic engineering through conventional IP networks is really a challenging task. In this type of networks, IP packets are forwarded while considering the Open shortest path first (OSPF) protocol which chooses the shortest path from source to destination. Although the selection of the shortest paths may save network resources, however, they may lead to problems [10]. To tackle the problem of low delay and packet loss during the delivery of multimedia applications, it is necessary to think of improved methods to use more effectively the available network resources. MPLS-TE is some process that provides this functionality [11]. Although the original idea behind the development of MPLS was to facilitate fast packet switching, currently its main goal is to support traffic engineering and provide quality of service [12]. Traffic engineering is mainly needed when the goal is to achieve the performance objectives such as traffic placement on specific links and optimization of network resources.

For MPLS traffic engineering applications, the control plane consists of the legacy IP routing and signaling protocols along with the extensions that have been incorporated into them to support the new requirements imposed by traffic engineering (ISIS-TE, OSPF-TE, RSVP-TE, CR-LDP, BGP). The two main subsystems of the MPLS-TE control plane are (1) the signaling protocol with all pertinent extensions, e.g., RSVP-TE or CR-LDP [13,14]; and (2) the routing protocol with applicable extensions, e.g., OSPF-TE. As an example, the signaling protocol RSVP-TE consists of extensions to the IETF's RSVP protocol to support the establishment of parameterized explicit label switched paths in MPLS networks

2.3 Internet Quality of Service (QoS)

Originally, the Internet was developed for transferring file and accessing remote machines. Therefore, the Internet was not expected to transfer multimedia data at large data rate. Today, many different types of applications in Internet demand more secure more reliable and faster services. Both non-real time and real-time applications require some kinds of QoS, such as high reliability, bounded delay and jitter, high throughput and high security. The most common and major QoS problem in the backbone network is unevenly distributed traffic. MPLS-TE can distribute traffic evenly and optimize network utilization TE ensures that all available network resources are optimally used during times of failure or traffic routing, which is needed when congestion happens. Network congestion is not easily solved by IP because of its characteristics: connectionless and best effort service. As results, bursts of traffic appear unexpectedly, routers are easily congested, and packets are dropped. Therefore, the current Internet has poor reliability, unbounded delay and jitter, and varied throughput [13].

3. METHOD

Fig. 2 above can be explained that there is a red line that shows the tunnel process that is configured on Router 1 with IP loopback interface of Router 5 = 6.6.6.6, and also apply alternative paths or known on configuration is IP explicit path to determine which path or router which must be passed by the package.

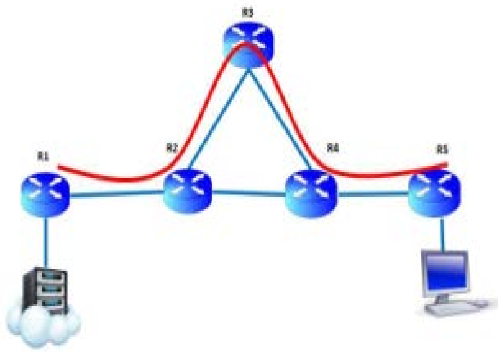

Fig 2. Tunnel Process

In Fig. 3 to configure the routing protocol, it must first be done first setting IP Address. It is intended for all devices has a unique address. After setting the IP Address next is the configuration of routing protocol which for this research writer using OSPF (Open Shortest Path First) as routing protocol. after that will activate MPLS Traffic Engineering function tunnel on each tunnel on router no 1, RSVP IP configuration bandwidth and IP explicit path and enable the path to be traversed by the package. For complete OSPF protocol routing configuration that can be done by going into the router system. Next, All the gateways which are connected to the router are registered in the routing table.

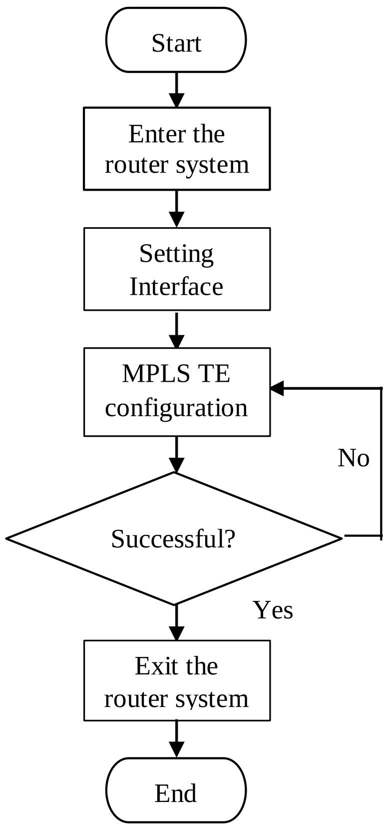

Fig. 3 MPLS TE Configuration System

3.1 VOD

VOD system allows users to select and watch that video to be accessed within the network as part of an interactive system as shown in fig. 4 VOD can utilize streaming process, progressive downloading, or download.

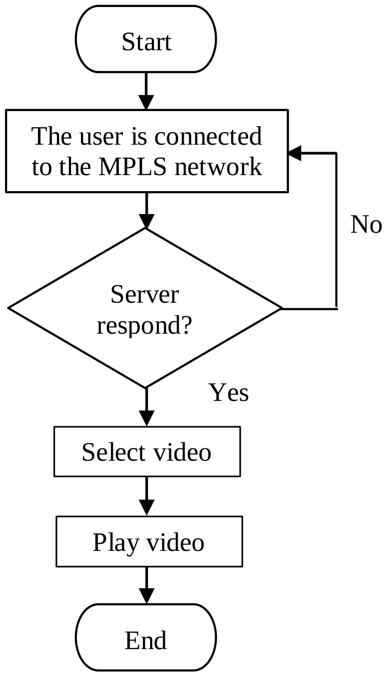

Fig. 4 Flow of VOD

The VOD system also allows users to exercise control over RTSP protocol, such as pause, fast forward, fast rewind, slow forward. However, on a system that uses the streaming method, this will burden the server and requires greater bandwidth usage

3.2. Video Streaming

Video Streaming is a service that allows the server to Broadcast a video that can be accessed by the client. Streaming video service enables users to access their videos in real time or recorded previously. The contents of this video can be submitted in three ways:

- Live Video - The server comes with a Web Camera that allows for Shows an event directly. Although this is related to "broadcast" video, this video is actually transmitted using multicast IP protocol.
- Scheduled Video - A previously recorded video is sent from a Server at a predetermined time. Scheduled This video also uses IP multicast protocol.
- Video-On-Demand - Authorized users can access previously recorded videos from the server whenever they want to see them the VOD system also allows users to control the RTSP (Real Time Streaming Protocol), such as pause, fast forward, fast rewind, slow forward.

The flow of Video Streaming as shown in fig. 5

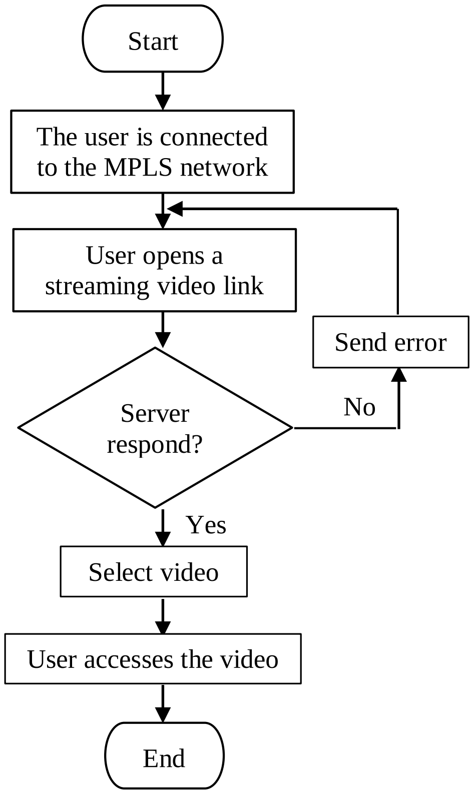

Fig. 5 Flow of Video Streaming

4. PERFORMANCE ANALYSIS

Fig. 6 can be explained that there are 2 pieces of computer client, and 1 server computer and server computer in this research writer using Xampp as the Video Supplier (server) for 2 computers client on this network. In addition, there are also 5 pieces router and 1 piece of switch used to implement configuration MPLS-TE for the server computer to the client can be connected to each other through the MPLS-TE network. The way it works is the client access video on the server through to the 5 routers that exist on the simulation, to the host computer via the loopback adapter on the host computer. After that, the client computer will perform video playback accessed on the server

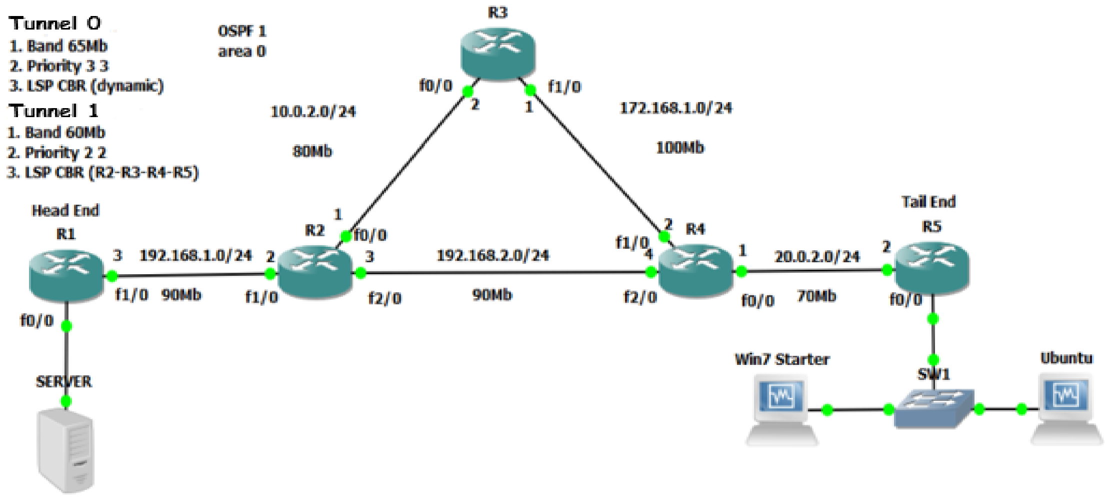

Fig. 6 MPLS TE Network Topology

4.1. Time Transfer Parameter Analysis

Table 1. Transfer Time Video (Mbit/sec)

Video	Video Size (MB)	∑ Testing									
		1	2	3	4	5	6	7	8	9	10
1	8,3	1196,7	1231,1	1256,8	1279,3	1301,3	1337,2	1362,5	1391,6	1412,7	1468,3
2	12,5	2574,9	2608,5	2626,7	2643,9	2685,9	2735,5	2776,9	2808,1	2834,8	2913,5
3	13,2	13,5	239,8	259,6	575,2	617,2	650,3	687,6	735,2	770,2	822,7
4	14,9	2668,6	2700,4	2735,2	2767,3	2806,2	2849,6	2886,8	2922,3	2962,9	3002,2
5	20,4	945,1	993,1	1026,9	1026,9	1098,4	1126,4	1160,4	1199,8	1225,4	1263,1
6	20,6	808	838,1	866,9	895,9	931,8	962,9	988,6	1014,8	1036,4	1062,7
7	23,7	48,7	91,6	145,8	188,7	214,8	244,9	392,2	428,4	460,2	493,9
8	27,5	127,1	127,1	20	20,1	127,5	127,5	127,5	127,1	127,5	127,5
9	100	3042,4	3067,3	3087,8	3113,2	3135,9	3170,4	3201,1	3240,7	3276,1	3305,2
10	448	199,6	230,7	268,2	338,4	391	422,1	479,7	526	568,3	617,5

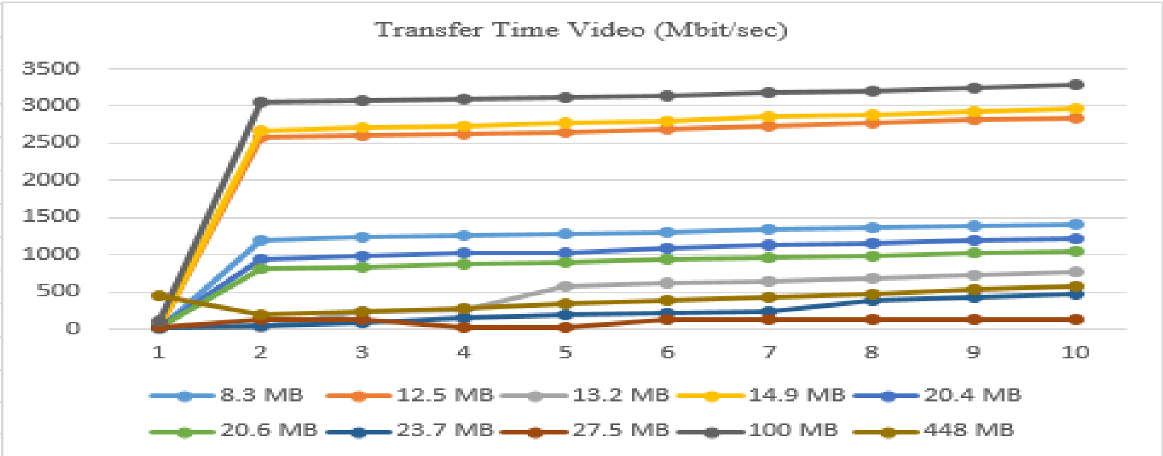

Fig. 7 Transfer time of video streaming

Transfer time is the total time required for Delivery of all packets from the server (host) to the client stated in the second unit.

$$\textit{Transfer time} = \frac{\textit{size of files}}{\textit{Bandwidth}} \quad (1)$$

Method of taking parameters done as follows: client performs play file from server (host computer) through web browser application. Then network analysis using Wireshark application. Perform filtering of data packets with conditions on his research uses LDP (Label Distribution Protocol), can also use another provision. Calculate parameters that have been analyzed by the application Wireshark. Video testing has been done 3 times on each file type (resolution) and file size, MPLS-TE obtained from the average data transfer time value as in Table 1.

Based on fig. 7 the average results obtained indicate that video quality has an effect on transfer time value. The bigger the better the image quality the greater the value of the transfer time gained.

4.2 Throughput

The main aspect of throughput is that it revolves around the availability of sufficient bandwidth for an application.

This determines the amount of traffic that applications can get across the network. Another important aspect is an error (generally related to link error rate) and losses (generally related to buffer capacity).

$$throughput = \left(\frac{total\ no.of\ bytes\ received}{simulation\ time}\right) * (8/1000)\ kbps \qquad (2)$$

Throughput is total packets successfully delivered to individual destinations over total time divided by total time.

Testing data that has been done each type of video and video size obtained from the average of the throughput value as in the following table 2. In the fig. 8 shows that the higher the video quality than the higher its throughput value.

Table 2. Throughput Video with MPLS TE, (Mbit/sec)

Video	Video Size (MB)	∑ Testing									
		1	2	3	4	5	6	7	8	9	10
1	8.3	29	29	29	29	29	29	29	29	29	29
2	12.5	27	27	27	27	27	27	27	27	27	27
3	13.2	28	28	28	18	18	18	18	18	18	18
4	14.9	22	22	23	23	23	23	23	23	23	23
5	20.4	26	26	26	26	26	26	26	26	27	26
6	20.6	26	26	26	26	26	27	27	26	27	26
7	23.7	27	30	28	29	28	28	29	29	30	30
8	27.5	23	23	23	22	24	24	23	23	23	23
9	100	27	27	27	27	27	27	27	27	27	27
10	448	31	30	30	30	29	29	28	28	28	28

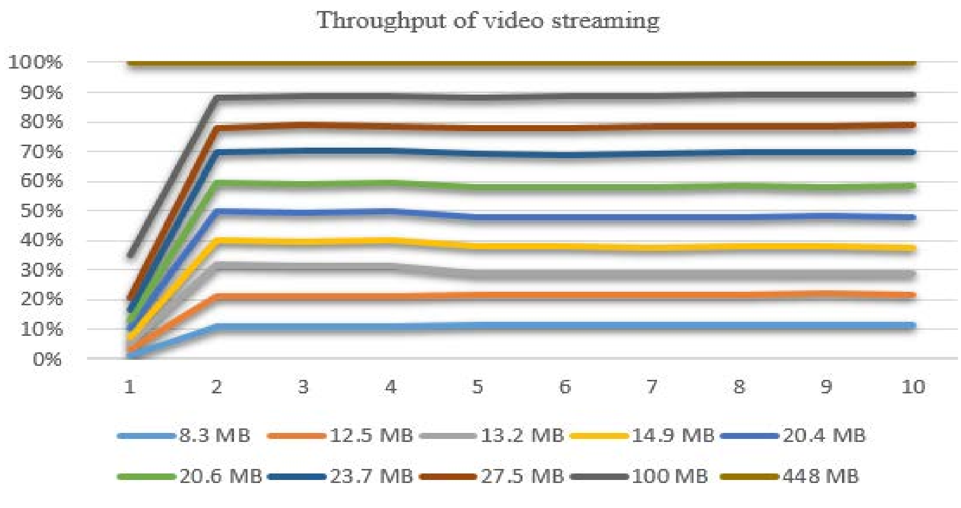

Fig. 8 Throughput of video streaming

4.3 Delay

Streaming video requires a bounded end to end delay so that packets can arrive at the receiver in time to be decoded and displayed. If a video packet does not arrive in time, the playout process will pause, which is annoying to human eyes.

A video packet that arrives beyond its delay bound (say, its playout time) is useless and can be regarded as lost. Since the Internet introduces time-varying delay, to provide continuous playout, a buffer at the receiver is usually introduced before decoding [15].

$$\boldsymbol{Delay}\ (\boldsymbol{second}) = \frac{\boldsymbol{transfer\ time}}{\boldsymbol{total\ byte}} \quad (3)$$

For analysis, this, to determine the delay parameter value with how to divide the transfer time value by the number of bytes of data packets as in the following table 3

Table 3. Delay Video with MPLS TE (second)

Video	Video Size (MB)	Delay
1	8.3	0.015
2	12.5	-0.013
3	13.2	0.018
4	14.9	0.033
5	20.4	0.020
6	20.6	0.015
7	23.7	0.015
8	27.5	0.012
9	100	0.001
10	448	-0.156

5. CONCLUSION

MPLS-Traffic engineering is one good method, to be able to determine the route on the network and very helpful if practiced on the network large scale. This is configured in the path option section or which is better known as the explicit-path IP configuration where the route to next hop on already specified on router R1.

Results from the tests and observations made for quality QoS performance on the simulated network still in the permitted standard. It is visible in results as follows: Delay generated from the MPLS-TE network topology with Different background traffic has a smaller value with a maximum value of 0.015469875 compared to the delay generated from the MPLS VPN network topology in the Journal of reference ie get a minimum value of 9.0. From the analysis results obtained value delay on MPLS- TE obtains the maximum value at that 1.0. The throughput value generated from the MPLS-TE network topology with Different background traffic yields a greater value than the throughput value generated from the MPLS VPN network topology. The value of throughput is inversely proportional to the value of packet loss, so the value of packet loss resulting from MPLS-TE network topology is smaller than the topology MPLS VPN network.

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