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Performance Comparison of Real-Time Video Conferencing In MPLS and IP Networking Environment

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Abstract

Modern techniques in networking have evolved a diverse range of opportunities to resolve the challenging task of traffic engineering. With a principle focus on video conferencing that has gained popularity worldwide, we contrive to optimize video traffic by using Multiprotocol Label Switching (MPLS) rather than conventional Internet Protocol (IP) networks. MPLS can be a promising technology for real-time applications with low network delays and efficient utilization of network resources. To substantiate this, in this paper we model certain scenarios of both IP and MPLS networks using Optimized Networking Engineering Tool (OPNET) to simulate and provide comparative performance statistics of throughput and end-to-end packet delay. We illustrate that MPLS has the ability that makes it stand out to IP by analyzing the simulation results of both networking mechanisms.

Key Words: Index Terms—IP, MPLS, OPNET

1. INTRODUCTION

In today's technological world, real time applications are becoming very popular. There is an enormous growth in the multimedia content of voice and video traffic over the Internet. The voice and video traffic demands intelligent utilization of resources because of delay sensitivity, less Quality of Service (QoS) requirements and limited bandwidth [3]. So it is imperative to determine suitable networking mechanism which provides efficient routing of packets and best performance over both data and real time applications. (MPLS) Multiprotocol Label Switching is such a mechanism that brings lower delays in the delivery of packets over the network.

In this paper, a research work is done to compare the performance of MPLS and traditional IP networks (Open Shortest Path First) OSPF in video conferencing applications considering similar network topologies simulated in OPNET. Performance evaluation of comparing throughput & end-to-end delay shows that MPLS outperforms the traditional IP networks.

2. SURVEY OF RELATED WORKS

Performance of MPLS and Non MPLS is measured in [1] by applying traffic engineering on both the networks in the heavy traffic scenarios. It was shown that MPLS extends the improvement scale of network performance for variable heavy traffic platforms.

In study of performance evaluation[2] comparing constraint based Label Distribution Protocol (CR-LDP) and Resource Reservation Protocol (RSVP) of MPLS, simulations provided the results which confirmed that the use of CR- LDP protocol in the MPLS network would result in better performance and could overcome the drawback of scalability in Resource Reservation RSVP) protocol.

Taking File Transfer Protocol (FTP) into consideration, IP, MPLS and ATM performances are evaluated on OPNET simulator in [3] and confirmed the out performance of ATM and MPLS [4] in comparison to pure IP by judging delay and response time parameters.

3. PROBLEM STATEMENT AND MAIN CONTRIBUTION

The real time applications like video conferencing will face delay or packet loss in the traditional networks. The aim here is to reduce high latency rate and overcome packet drops. With an aim to accomplish the required quality of service, the research question was outlined as "which of these networking mechanisms, MPLS or IP would perform better in terms of throughput and delay of the received packets in video conferencing applications".

We hypothesized that MPLS would be a better performing networking mechanism compared to IP in terms of throughput and delay in video conferencing applications.

The main contribution of the paper is to evaluate the best networking mechanism for real-time video conferencing applications and to validate by OPNET Simulator that MPLS serves as a best platform against Conventional IP. Parameters chosen to analyze relative performance of video conferencing applications are throughput and end-to-end delay to accomplish higher performance and lower latency rate.

4. PROBLEM SOLUTION

4.1. Implementation

The network topology is designed and simulated by using OPNET. The MPLS network is designed using 7x Label Switching Routers (LSR) and 2x Label Edge Routers (LER). The LSR's are interconnected using PPP_DS3 Link with 44.7 Mbps speed. LER's are connected to LAN clients and video server using eth4_fddi4_tr4_switch_adv switch. The switch is connected to LAN client and video server using 10 base T Link with 10 Mbps speed. The configuration of applications is executed in profile configuration and these applications are mapped to clients and servers accordingly. MPLS parameters like Forward Equivalence Class (FEC) and Label Switched Path (LSP) are configured using MPLS configuration. CR-LDP is set as the routing protocol. In Fig.1, each packet enters at ingress label edge router and is assigned with labels that go along the LSP. The FEC determines the type of labels assigned at each LER. The addition and deletion of labels are performed at ingress and egress edge routers respectively. The parameters in the simulation are mentioned in Table I.

TABLE I
SIMULATION SETUP IN OPNET

Parameter	*Value*
Number of nodes	9
Protocol used in IP	OSPF
Protocol used in MPLS Design	CR-LDP
Frame inter arrival rate	15 frames/s
Frame size	128 x 240 pixels
Type of service	Interactive multimedia

Figure 1: MPLS Model

The IP network model is the replica of the MPLS model. The LSRs and LERs in the MPLS model are replaced by the IP Routers. And the routing protocol used is Open Shortest Path First (OSPF).

4.2. Results

The simulation is set to start at the 30th second and it is shown in an output graph. Fig.2. shows the end-to-end delay of MPLS network and the conventional IP network with end-to-end delay on vertical axis and simulation time on horizontal axis.

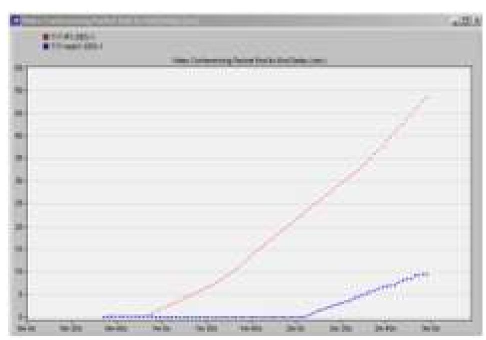

Figure 2: Video conferencing packet end-to-end delay.

The end to end delay threshold for video conferencing should be 150 ms, but it is acceptable up to 400 ms according to [5]. It is observed from the end-to-end delay graph that IP network crosses the threshold at 1 minute whereas the MPLS network crosses after 2 minute 10 seconds approximately.

In Fig. 3 green, red and blue lines indicates the average number of packets sent from source, average number of received packets in MPLS network and average number of received packets in conventional IP network respectively.

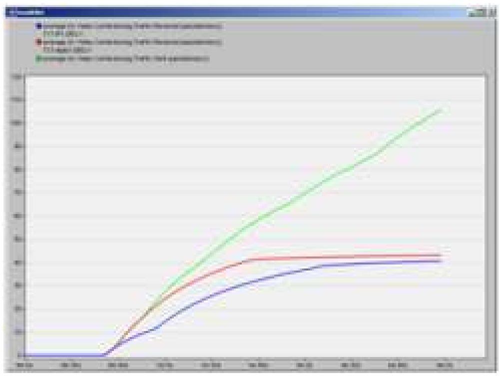

Figure 3: Video packets throughput.

Throughput is an accomplishment rate of successful content delivery over a media channel. Average number of packets sent and average number of packets received in both the networks are shown in Fig. 3. The throughput graph shows that the average number of packets received in the MPLS network is more than average number of packets received in the conventional IP network for the same number of packets sent in both the networks [6], [7].

5. CONCLUSION

The performance of MPLS and IP networks are analyzed in real time video conferencing. The routing mechanisms are configured and compared. It is concluded that MPLS mechanism performs much better than IP as the throughput is enhanced and end-to-end delay is decreased in real time video conferencing applications.

The future work of our project can be extended to performance analysis of MPLS in real time video conferencing using high definition video mode.

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