Performance Voice Over MPLS With Traffic Engineering In Respect to Quality of Services measurements

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ABSTRACT

The performance evaluation is done considering the network parameters jitter, packet end to end delay, and Mean Opinion Score (MOS) Integration of Quality of service (QoS) with the internet protocol (IP) and Multiprotocol label switching (MPLS) networks may enhance the performance of network. Various scheduling algorithms have been used for implementing QoS on a network. The simulation was done using OPNET modeler 14.5,the simulation results show that using TE along with QoS in MPLS network decrease the jitter packet delay variation and end to end packet delay for voice traffic. MPLS is a new paradigm in routing architectures which has ensures the reliability of the communication minimizing the delays and enhancing the speed of packet transfer. One important feature of MPLS its capability of providing Traffic Engineering (TE) which plays a vital role for minimizing the congestion by efficient load, balancing and management of the network resources.

Keywords: Multiprotocol Label Switching (MPLS), Quality of Service (QoS) Scheduling Algorithms, Traffic Engineering (TE), Voice Over IP (VoIP).

1. Introduction

Multiprotocol Label Switching (MPLS) is a new forwarding mechanism in which packets are forwarded based on labels. Labels correspond to the IP address of the destination node within the network (traditional IP Forwarding) , it has two major components which are control plane and data plane. Control plane exchanges the layer-3 routing information and labels, while the data plane forwards packets based on labels. The key feature of MPLS its Traffic Engineering (TE) which is for effectively managing the networks for efficient forwarding mechanism. Traffic Engineering (TE) is a mechanism put in place to control the flow of traffic in networks and it provides the performance optimization of the network resources. The main characteristics of TE are fault-tolerance, optimum resource utilization and resource reservation MPLS provides the solution to the traffic engineering problems like speed, QOS, delay, network congestion [1].

2. *Objective Of The Research*

When the packets were forwarded based on the shortest path metric, These protocols do serve the function of forwarding data packets but can easily lead to problems like Longest path is under-utilized while shortest is over-utilized leading to congestion in the network, and routing lookups are performed at every router and hop-by-hop decisions do not consider factors such as latency or Traffic congestion see figure[1] .

The main aim of this research is answer to the questions which is the most important is what is the big enhancement when the packets forwarded based on label?, and Does MPLS really solve the traffic engineering problem?, and Which scheduling algorithm for QoS implementation in MPLS-TE network has better performance?. So MPLS developed solutions for all problems.

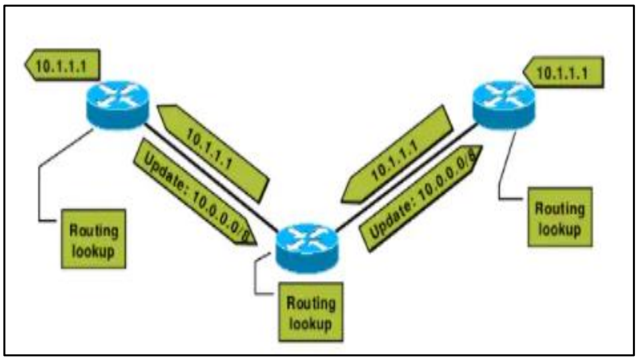

Figure [1] Traditional IP Routing

3 *Related Works*

(1) Sulaiman and Alhafidh The title of their study is Performance analysis of Multimedia traffic over MPLS communication networks with traffic engineering analysis performance the two networks for critical applications of delay such as voice and video they concluded that MPLS-TE offers the best implementation solutions [2].

(2) Shaimaa, Al-Quzwini, and Fyath in their study which is titled Performance Evaluation of MPLS TE Signal Protocols for Voice Applications with QoS Implementation [3].

(3) Akshay and Ahlawat their study was the comparison between traditional IP networks and MPLS is made on focusing on QoS, Traffic Engineering (TE), Scalability[4].

4. MPLS NETWORK

In a MPLS network, incoming packets are assigned a "label" by a “LER (label edge router)” according to their forwarding equivalence class (FEC). Packets are forwarded along a "label switch path (LSP)" where each "LSR (label switch router)" makes forwarding decisions based solely on the contents of the label, eliminating the need to look for its IP address so that the intermediate router does not have to perform a time-consuming routing lookup as in Fig [2]. At each hop, the LSR takes off the existing label and applies a new label for the next hop. Next hop also decides how to forward the packet by reading just the label on the packet. These established paths, Label Switch Paths (LSPs) can guarantee a certain level of performance, to route around network congestion, or to create IP tunnels for network-based virtual private networks

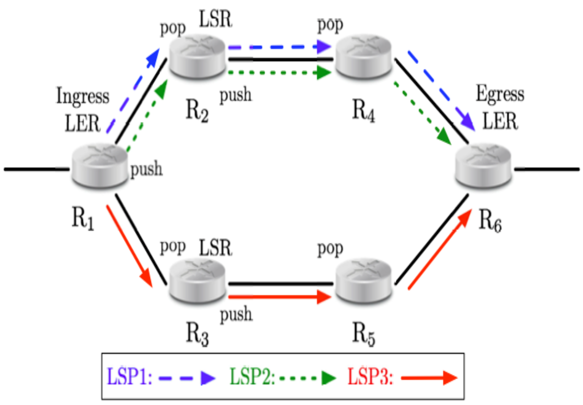

Figure [2] MPLS Forwarding

4.1 MPLS *Shim Header*

A label is actually into a special header called “Shim header” that is placed on the packet between layer 2 and layer-3 headers. The 32-bit MPLS header [5] is organized as in figure 3

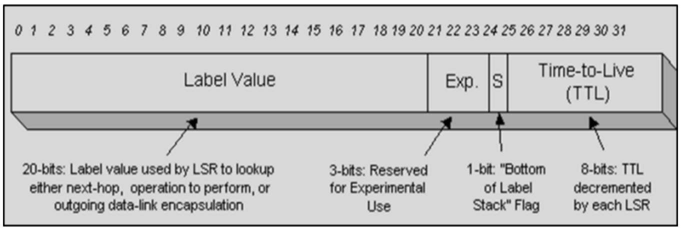

Figure [3] MPLS Header

4.2 MPLS *Architecture*

MPLS has two major component control plane and data plane. Control plane exchanges labels using protocols such as Label Distribution Protocol (LDP) and Border Gateway Protocol (BGP) [4].Data Plane Data plane is responsible a forwarding packets.

4.3 Forward *Equivalence Class (FEC)*

Set of packets where they have related characteristics which are forwarded with the same priority to the same path and obtain the same management in each node. This set of packets is having the same MPLS label. Each packet in MPLS network is assigned with FEC only once at the Ingress router [6].see figure 4

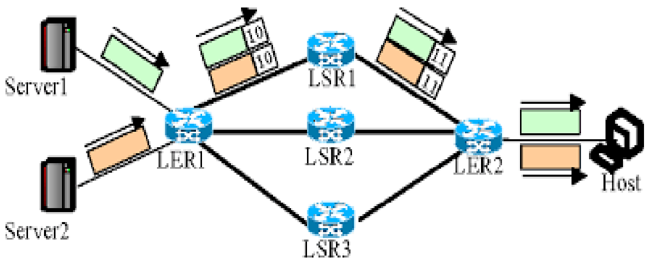

Figure [4] Forwarding Equivalence Class for MPLS

5. *Quality Of Services (QoS)*

On the network infrastructure the QoS helps manage delay, packet loss, and jitter Because while working with limited amount of bandwidth, there are four key factors that must be controlled in order we can make a high-quality VoIP phone call. these include bandwidth, delay, jitter, loss – obviously [7]

Table [1] Guidelines For VOICE Quality [8]

Network parameter	Good	Acceptable	Poor
Delay(ms)	0-150	150-300	>300
Jitter(ms)	0-30	30-50	>50

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5.1 *Queuing Schemes*

Queuing is the purpose of storing packets for a short time within the router queues before transmitting to its last destination. However, packet transmission is affected by many issues such as the service class of the packet or the level of service assurance associated with the packets class. Therefore, several queues have different precedence levels to be worked and each particular queue of bandwidth is assigned to the same output link according to its priority value [9]. In this work, we use some types of queues Priority Queuing (PQ), Weighted Fair Queuing (WFQ),custom Queuing(CQ).

6. *MPLS Traffic Engineering (TE)*

The main objective of TE is to optimize the traffic performance by efficient and reliable network operation with optimum use of network resources [10]. Traffic engineering efficiency objectives can be classified to traffic oriented and resource oriented the objective of traffic engineering (TE) can be realized through ability management which includes ability scheduling, routing control and resource network. reducing extended congestion is a primary and resource-oriented performance objective.

7. *Results and Simulation*

We have used OPNET Modeler 14.5 to create the topology as shown in Fig [5].

For the experimentation, the topology consists of 12 devices distributed across the network 5 LER Routers, and 7 LSR Routers. In this experiment we have concentrated only on performance metric of MPLS network of the voice packets. different scenarios were created, one was compared performance metric of MPLS_TE and IP model networks. The compared parameters were End-to-End Delay, jitter, voice MOS , Packet Send and Receive and another scenarios were the QoS implemented MPLS-TE network under DiffServ architecture three type WFQ, PQ and CQ were used as scheduling algorithms so, that we could also analyze which of these algorithms is best suited for voice application. MPLS Attribute Definition block is responsible for configuring the Traffic Trunks and Forward Equivalence Class (FEC) as shown in figure 5

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Figure [5] MPLS Network Components

7.1 VOIP in IP network vs. MPLS-TE network

In figure 6 the voice jitter in MPLS–TE is too small it is close to zero, because the trunk of multimedia which had the voice without any congestion also note the MPLS_TE network provide good Performance of the voice MOS and Packet end- to –end delay values by focusing on the figures 6, 7 the voice quality was good and reduced the delay very clearly Compared to traditional networks in sending packets .

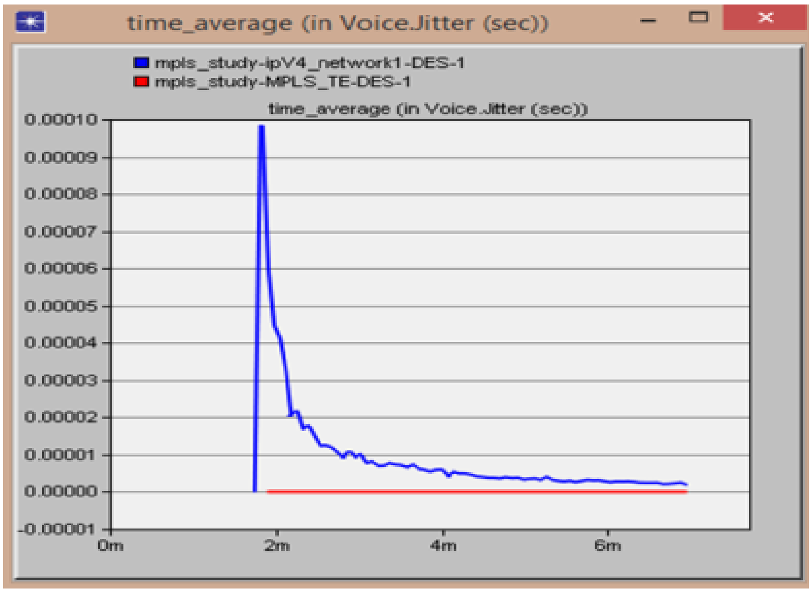

Figure [6] voice jitter for IP and MPLS-TE

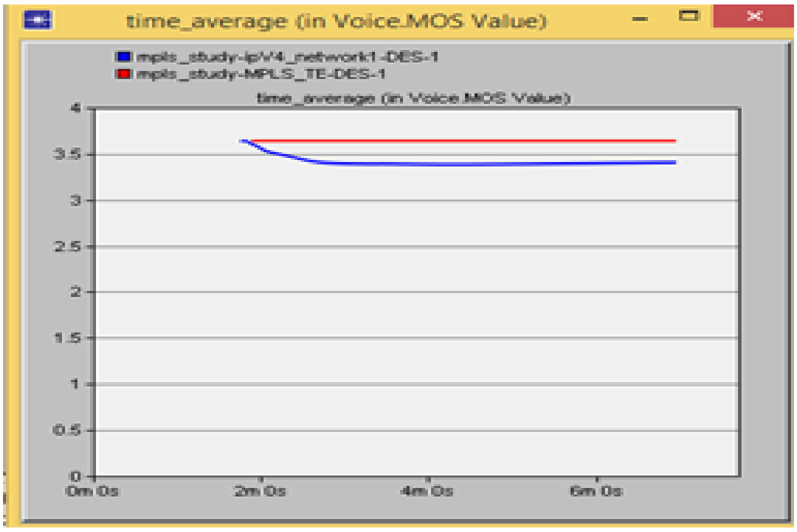

Figure [7] Voice MOS for IP and MPLS-TE

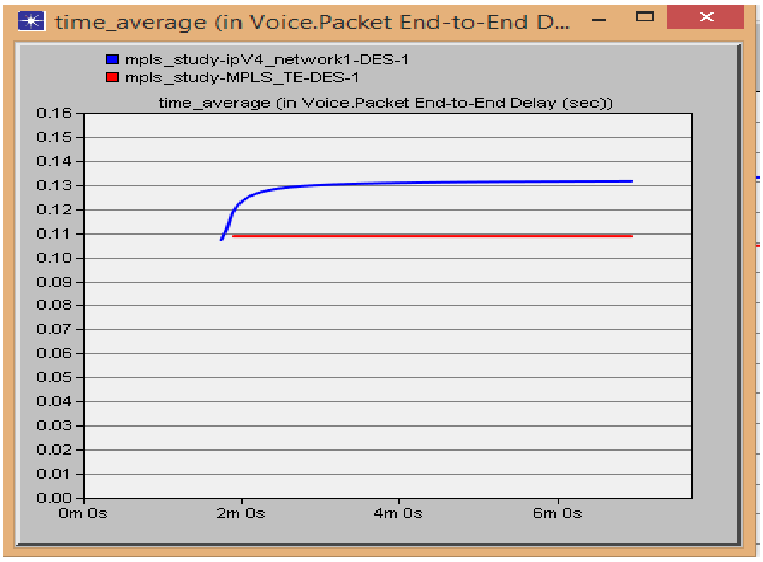

Figure [8] Voice Packet End- To –End Delay For IP And MPLS_TE

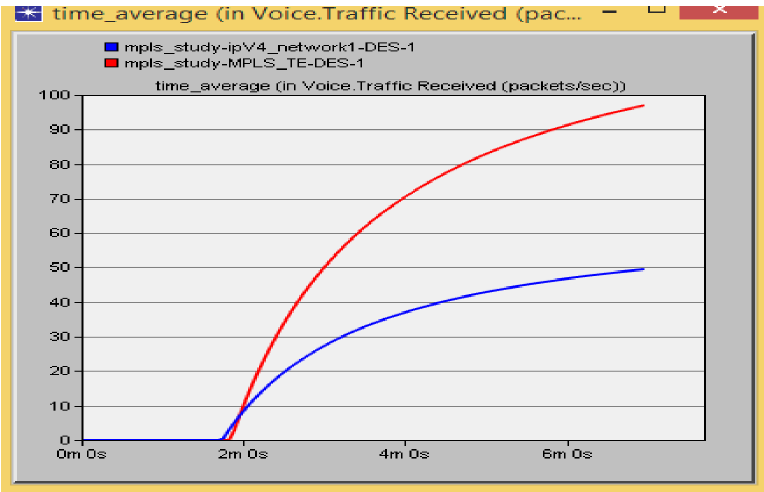

Figure [9] Traffic received for IP and MPLS_TE

When forwarding the packets based on labels in MPLS network it has reduced the delay very clearly It is clear that MPLS had lower delay than the IP in figure 8 and Figure 9 Traffic received for IP and MPLS_TE average of packet received in MPLS TE better than IP network

7.2 MPLS-TE Network With Queuing Schemes

In figure 10 MOS value for PQ is 3.5 it is acceptable value. On the other hand, the MOS values for CQ 2.5 and WFQ 1.03 which indicates that the quality of voice is poor and unacceptable if the WFQ algorithm is used. Figure 11 and figure 12 shows the average jitter and end to end delay in QOS implemented MPLS-TE networks and typical MPLS-TE network respectively. The results of QOS are PQ scheme have the low delay and the jitter, so the MPLS_TE and end to end delay controlled connectivity with PQ scheme. the WFQ scheme has very large value of the delay and jitter.

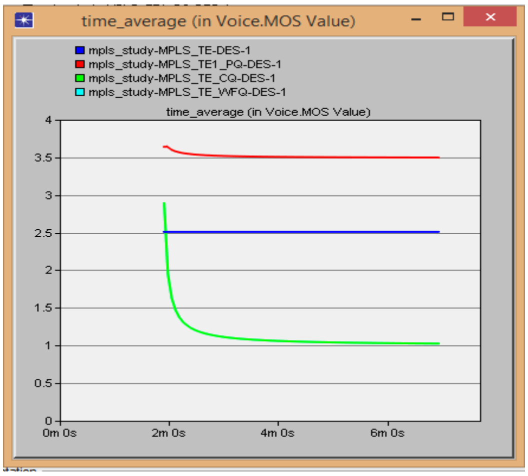

Figure 10 Voice MOS MPLS VS QOS Schemes

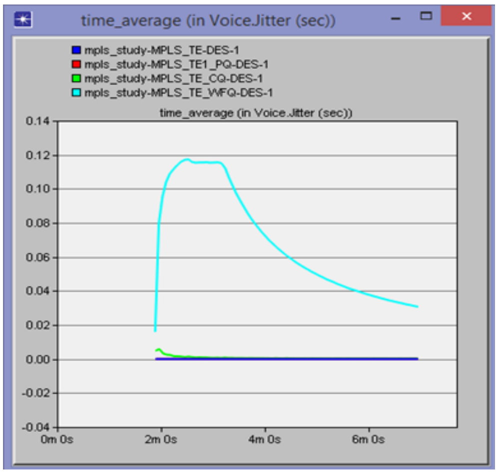

Figure 11 jitter MPLS Vs. QOS .

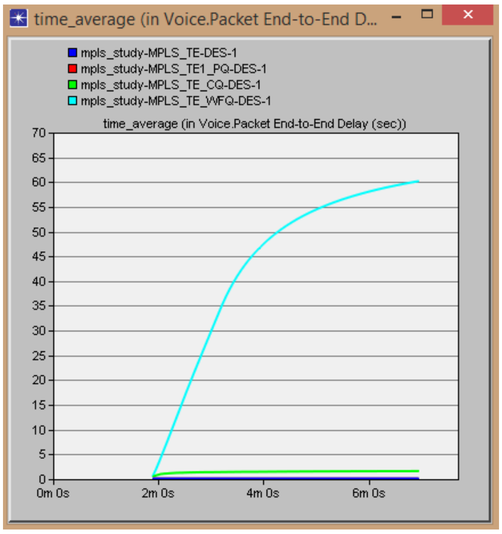

Figure 12 End to End delay MPLS_TE vs. QOS

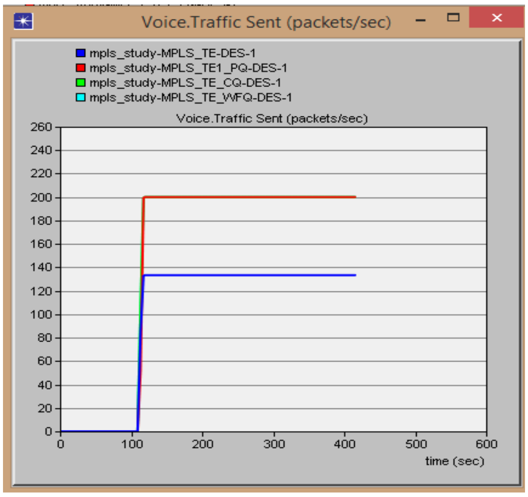

Figure 13 Traffic Sent

Figure 14 Traffic Received

The QoS schemes effected in the network even in traffic sent and traffic received, in the figures 13 ,14 the PQ QoS schemes had the highest of traffic received value

After comparing the three algorithms measuring and analyzing their performance the PQ were the best in their performance and to enhance and clarify the performance this algorithm PQ scheme has improved the performance of the network by all standards.

8 *Conclusion*

The main objective of the paper is performance variation seen in the network after and before implementation of QOS in the MPLS-TE networks were analyzed, Different scheduling algorithms were used in the process of implementing QOS to chick if they have any effect in the performance of network for voice. After this analysis of the result from the simulation and literature review, the performance was founded of MPLS_TE network better than normal IP network for voice packets which is provides a lower delay, lower jitter , Furthermore the QOS implementation of three algorithms PQ, WFQ and CQ are enhanced the performance of both network, where PQ was in the lead especially after adding the performance of traffic engineering, CQ algorithm was a very acceptable performance in most scenarios. And WFQ was a weak performance that was not acceptable.

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