



Comparative Performance Analysis of MPLS Network & IP Network

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Abstract: MPLS is an emerging technology in the area of Computer Networking. IP Networks have many drawbacks as all traffic follows the shortest path computed by shortest path algorithm which soon gets congested, Complex routing tables which are time consuming. MPLS has been proposed to speed up the traffic flow in the network using labels. This paper deals with the simulation of MPLS on NS-2 and result based on various parameters such as throughput of the network, Number of dropped packets, Packet loss rate is calculated which is compared to the traditional IP network

Keywords: MPLS, IP, Network Simulator (NS2), LER, LSP

I. Introduction

MPLS [4] is a forwarding mechanism which forward the data packet based on labels rather than long network address, avoiding complex lookups in routing table. It makes use of labels to create virtual link for data transmission between data nodes. It is a packet switching technology having features of circuit switching due to the introduction of the virtual channels using labels. The connection oriented features make the transmission faster through speeding up of the address lookup during routing. The packets of various network protocols are similarly treated in the MPLS network. Every packet entering the MPLS network is encapsulated into an MPLS packet with an additional header containing the labels. OSI model places MPLS layer between Data Link Layer and Network layer.

Figure 1: MPLS Layer in OSI Model

Network Layer(IP)	3
MPLS Layer	2.5
Data Link Layer(FR/ATM)	2
Physical Layer(optical-electrical)	1

The structure of MPLS consists of various routers that support MPLS and are known as Label Switching Routers LSRs. The LSRs which are in the periphery of the MPLS Network are called Edge LSRs or Label Edge Routers (LERs) and must be capable of accepting packets from all types of networks. The end-to-end virtual path that is set up with the use of labels is known as LSP (Label switched path) [3]. An LSP starts at the ingress node and terminates at the egress node passing through several intermediate routers.

Ingress LSR receives a packet that is not labeled yet, it insert a label in front of the packet and send it on link. Egress LSR receives labeled packets, remove the label and send them on link.

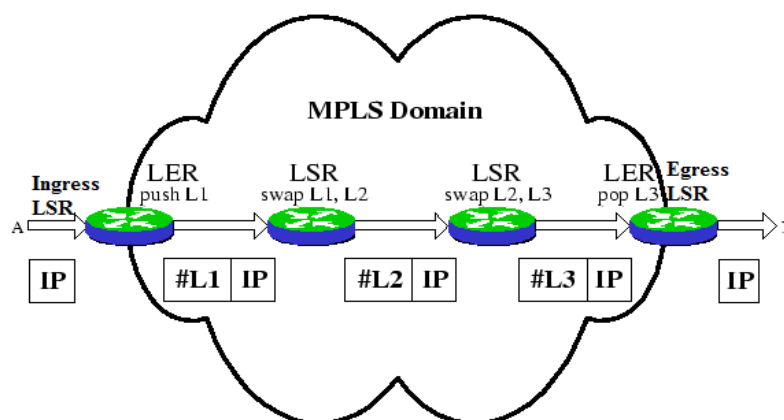


Figure 2: MPLS Network

II. Simulation and Performance Analysis

In order to evaluate the performance of MPLS technology, the simulation has been run two times for different topologies.

A. Firstly we simulate the IP and MPLS network behavior on a simple topology as shown in Figure 3 (without MPLS) Figure 4(with MPLS). There are two traffic flow requests are being made.

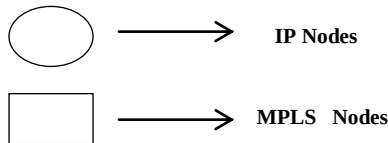


Table 1: Traffic Flow Requests

Traffic Flow	Source Node	Destination Node
1	4	5
2	6	7

Figure 3: Network Topology without MPLS

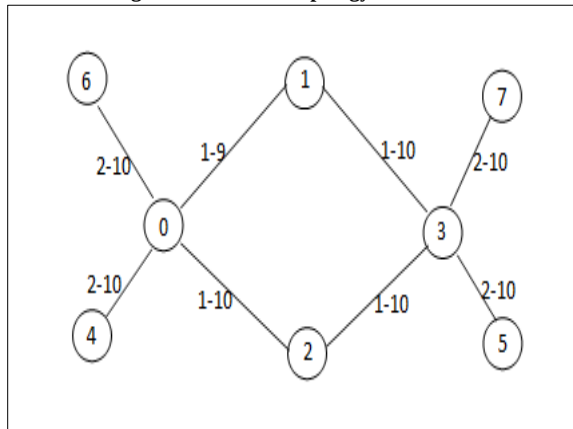
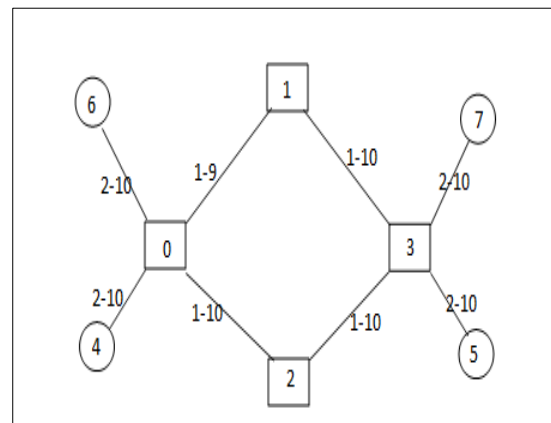


Figure 4: Network Topology with MPLS



In traditional IP Network path (via node 0_2_3) is not utilized, while path (via 0_1_3) is over utilized as shown in Fig 5. Packets are lost due to congestion at Node 0 in traditional IP Network, while in MPLS no congestion will take place.

As traffic engineering is applied in MPLS Network, which will provide alternative path for traffic flow. We have considered Node 0 as ingress node and Node 3 as egress node. Traffic follows the alternative path (via node 0_2_3) as an explicit path shown in Fig 6.

Figure 5: Simulation of IP Network

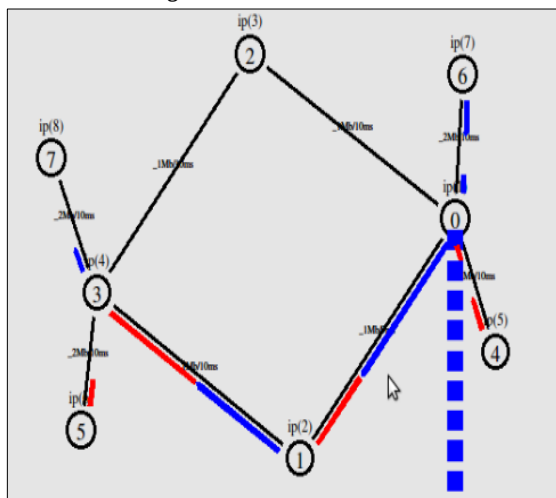
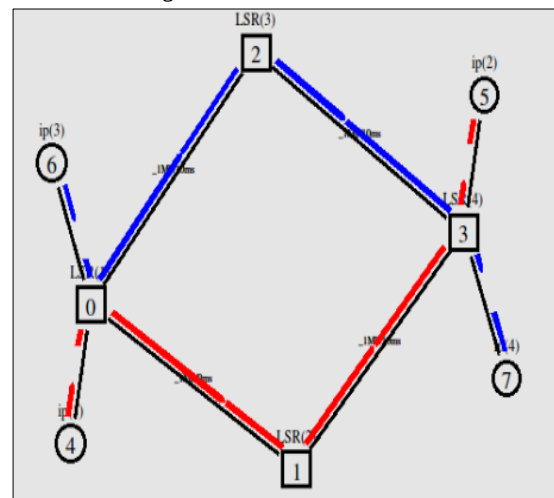
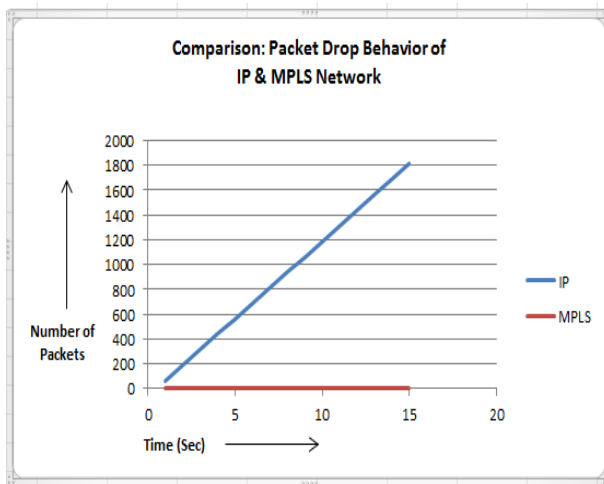
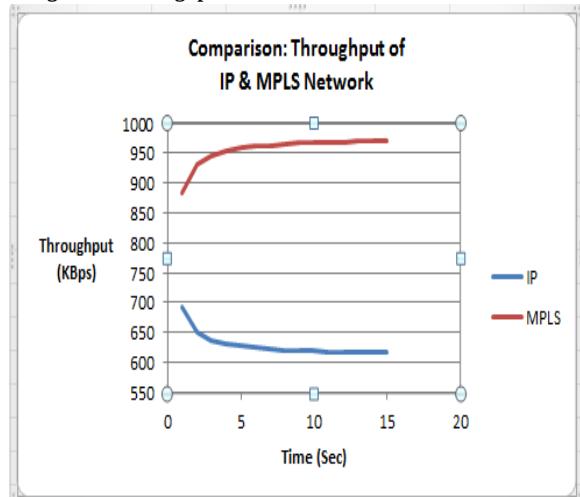


Figure 6: Simulation of MPLS Network

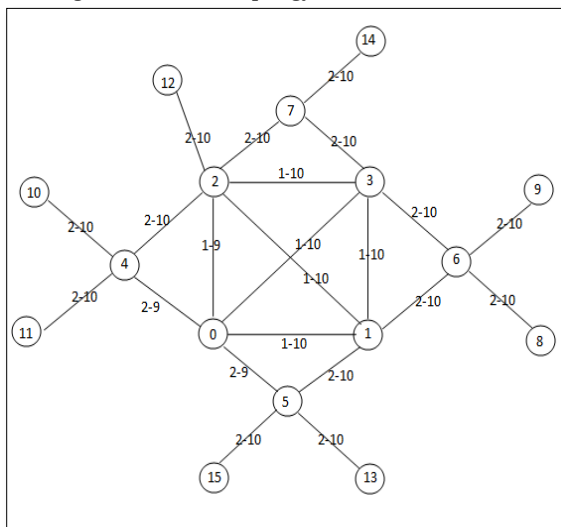
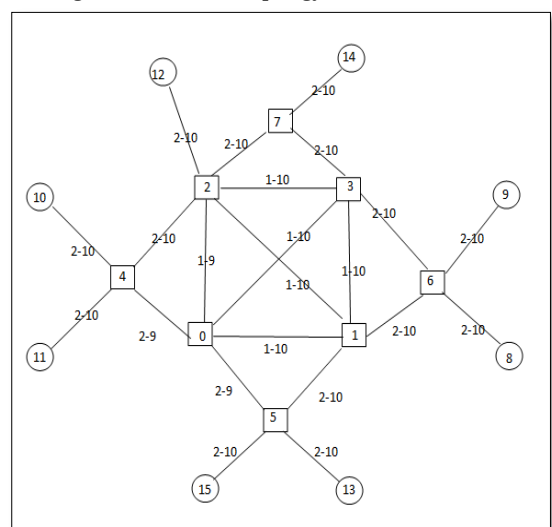


We graphically analyzed comparative packet drop behavior, throughput of IP & MPLS network. In IP Network packet drop is increasing with time, while in MPLS no packet drop occurred.

As shown in Figure 8 throughput is increasing with time in MPLS Network, while in IP Network it is decreasing with time because of congestion.

Figure 7: Packet drop behavior of IP & MPLS Network

Figure 8: Throughput of IP & MPLS Network


B. As in 1st simulation there is no packet drop in MPLS Network. We created another Network Topology and simulation is carried out on that. Figure 9 & 10 represent the network topologies.

Figure 9: Network Topology without MPLS

Figure 10: Network Topology with MPLS


In this simulation there are 5 traffic requests are being made which are shown in table 2.

Table 2: Traffic Flow Requests

Traffic Flow	Source Node	Destination Node
1	13	14
2	11	9
3	12	8
4	15	14
5	10	8

It is shown in Figure 11 & 12 that packets are dropped in MPLS Network as well as in IP Network. Congestion has taken place at Node 0 in both networks.

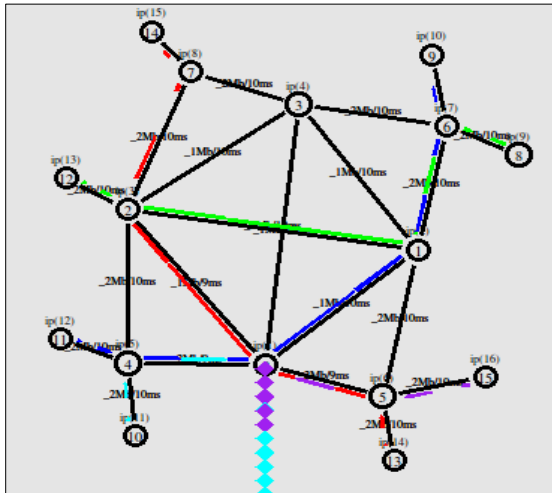
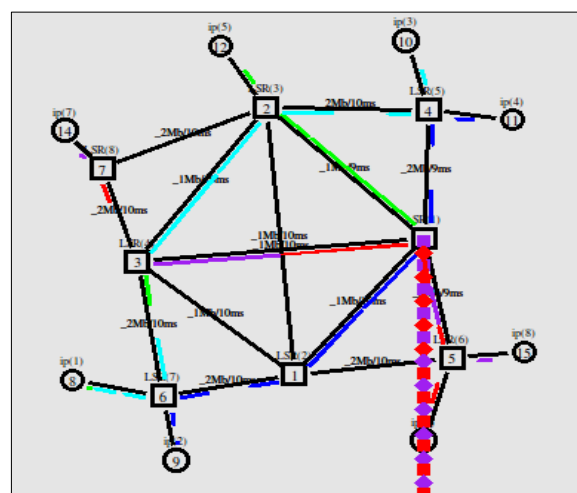
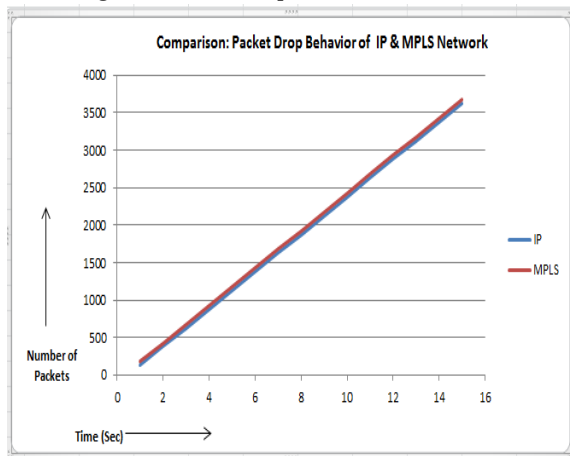
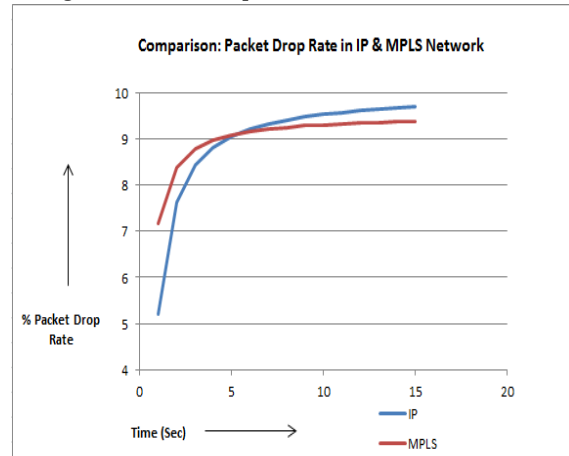
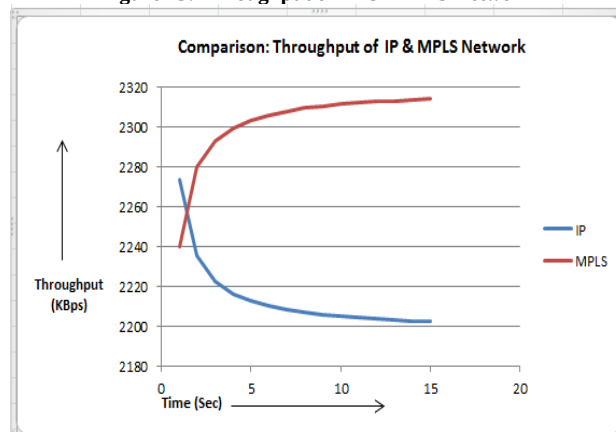
Figure 11: Simulation of IP Network

Figure 12: Simulation of MPLS Network


Figure 13 is representing that MPLS has higher packet drop than IP so there is a need to calculate packet drop rate in order to make comparison between them. As Figure 14 shows that at 1 sec MPLS has 7.16% packet drop rate and IP has 5.21%. It means that MPLS has higher packet drop than IP. In both networks packet drop rate increases with time and at 6 sec packet drop rate of MPLS (9.15%) becomes down than IP(9.21%). At 15 sec MPLS has 9.38% packet drop which is better than IP Network having packet drop 9.69% at 15 sec.

Figure 13: Packet drop behavior of IP & MPLS Network

Figure 14: Packet drop rate of IP & MPLS Network


Throughput of IP Network is decreasing with time whereas increasing in MPLS Network. Graph of IP cuts the graph of MPLS which represent a point before which throughput of IP is higher and after that throughput of MPLS is higher.

Figure 15: Throughput of IP & MPLS Network


III. Conclusion

The paper deals with traffic flow over both IP and MPLS network. In Simulation Network topology and other simulation parameters are chosen common. IP network has a problem of congestion which can be solved in MPLS by setting explicit path. MPLS reduce the loss of packets and improve the QoS. The obtained results show that the packet drop behavior and throughput are improved in MPLS.

IV. References

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