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Comparative Study between OSPF and MPLS network using OPNET Simulation

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Abstract: - This paper presents a performance comparison between the Open Shortest Path First (OSPF) and Multi-Protocol Label Switching (MPLS) protocols using network simulator OPNET V14.5. The article describes the behavior of MPLS and OSPF protocols and important parameters for each protocol. The network simulator OPNET is employed to simulate throughput, delay, and utilization parameters of the network on each protocol.

Keywords: - *MPLS; OSPF; OPNET. Throughput, Delay andUtilization*

I. INTRODUCTION

The Open Shortest Path First (OSPF) protocol is a well-known, widely used, and link-state routing protocol in the interior gateway routing protocol (IGRP). Both the MPLS and OSPF protocols provide capability of addressing IP traffic management when it comes to large networks.

The brief list of specification of the OSPF and MPLS protocols are presented below:

A. Open Shortest Path First (OSPF) Category

The OSPF protocol is based on link state routing which means that every node in the network constructs a *map* of the network connectivity in the form of a graph. This graph shows which nodes are connected to which other nodes and then each node independently calculates the next best logical *path* from it to every possible destination in the network. The collection of best paths will then form the node's routing table [1]. The OSPF protocol is based on the short path first algorithm known as class inter domain routing (CIDR) to address models. There is no concept of hop count in the OSPF protocol as its structure is hierarchical. The procedure for generating shortest path tree is that every router sends a local and external link state information to each other. Hence ensuring that every router be able to calculate shortest path within the autonomous system (AS). If any changes happens within the AS then a recalculation process starts.

The OSPF uses a shorted path first algorithm in order to build and calculate the shortest path to all known destinations. The shortest path is calculated with the use of the Dijkstra algorithm [2]. The algorithm can be briefly described as follows:

- Upon initialization or due to any change in routing information, a router generates a link-state advertisement.
- This advertisement represents the collection of all link-states on that router.
- All routers exchange link-states by means of flooding.
- Each router that receives a link-state update should store a copy in its link-state database and then propagate the update to other routers.
- After the database of each router is completed, the router calculates a Shortest Path Tree to all destinations.
- The router uses the Dijkstra algorithm in order to calculate the shortest path tree. The destinations, the associated cost and the next hop to reach those destinations form the IP routing table.

In the case that no changes has taken place in the OSPF network, such as cost of a link or a network being added or deleted, the OSPF is then considered to be very quiet. Any changes that occur are communicated through link-state packets, and the Dijkstra algorithm is recalculated in order to find the shortest path [3].

B. Multiprotocol label switching (MPLS)

The Multiprotocol label switching (MPLS) is a framework that provides for the efficient designation, routing, forwarding and switching of traffic flows through the network. In the OSI model it lies between layer 2 (data link layer) and layer 3 (network layer) and that is why it is often called layer 2.5 protocol. The MPLS protocol is a versatile solution to address the problems faced by present day networks-speed, scalability, quality-of-service (QOS), management and traffic engineering. The MPLS is used by Internet Service Provider (ISP) and as a backbone to Internet Protocol (IP) to provide guaranteed efficient bandwidth and Quality of Service (QoS) provisioning in the network. The MPLS is a protocol that is end to end and its objective to give the router a robust power of communication. In the MPLS, the forwarding of packets is done based on a short fixed value known as a "label", inserted into a packet. All packets are labeled before being forwarded and consequently, at down-stream routers, the analysis of the packet's network layer header is not required, rather decisions on where to forward packets are made by using the inserted label [4].

III. METHODOLOGY

OPNET 14.5 network simulator has been employed to simulate four scenarios with MPLS and OSPF protocols for IP routing. To analyze the traffic between source and destination, three parameters including the throughput, delayand utilization have been considered to evaluate the network performance.

IV. RESULTS AND DISCUSSION

We used OPNET simulation to discuss QoS in OSPF and MPLS network. The parameters are: Email and HTTP after that we measured some parameters throughput, delay, and utilization

A. Throughput

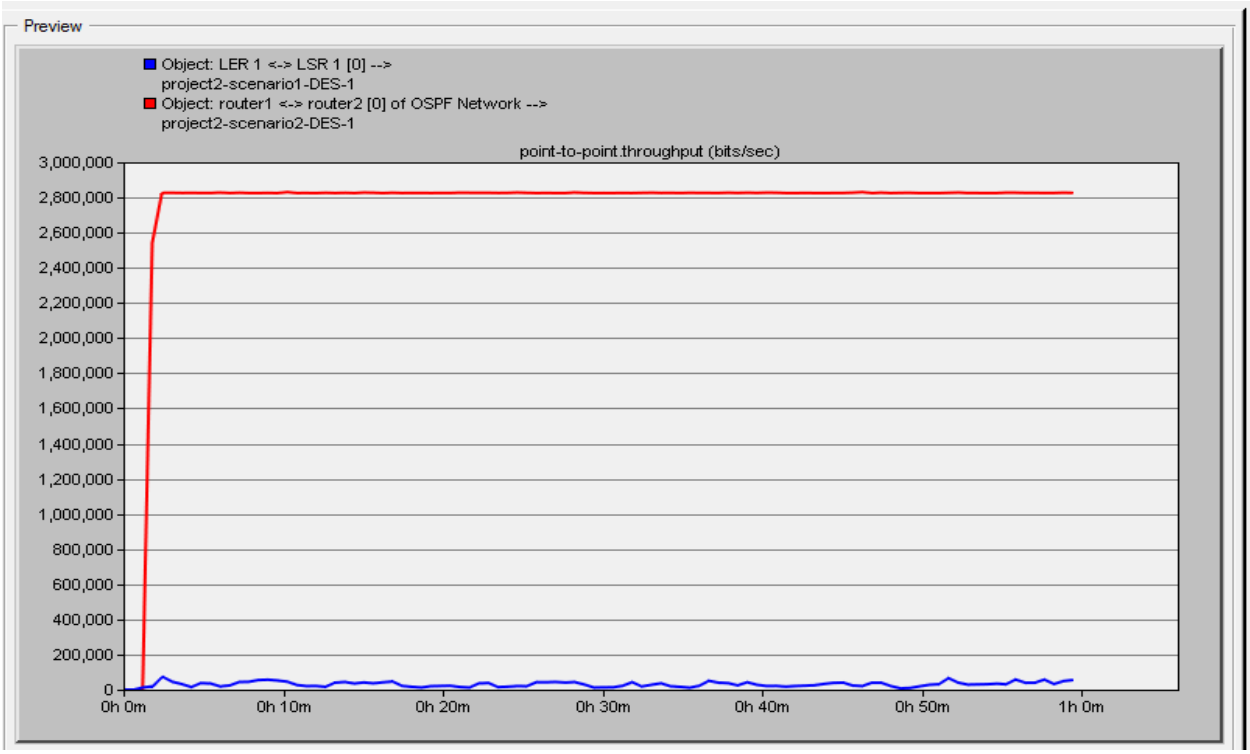

Figure (1): Throughput simulations of MPLS and OSPF.

Figure 1. shows a comparison of throughput simulated between the MPLS and OSPF protocols. From the simulations, the OSPF (shown in red) shows much higher throughput when compared to the MPLS (shown in blue).

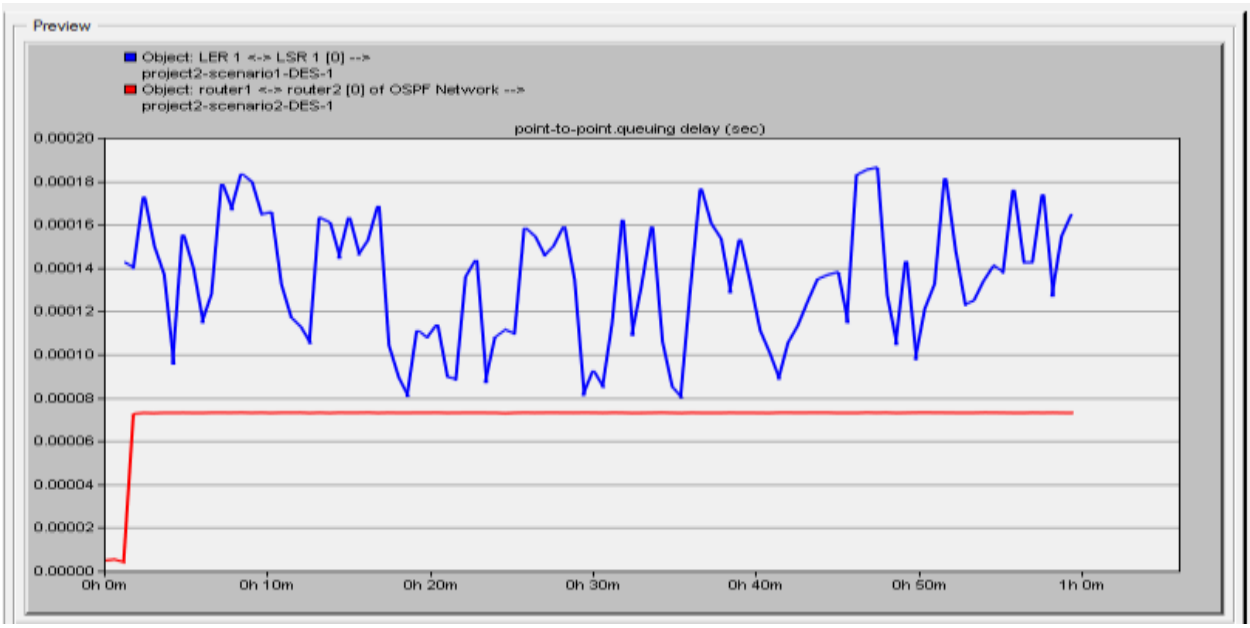

Figure (2): Delay simulations of MPLS and OSPF.

Figure 2 represent the simulations of delay between the OSPF (shown in red) and the MPLS (shown in blue). The simulations shows MPLS shows higher delay than OSPS protocol, about ~ 50% increase.

B. Utilization

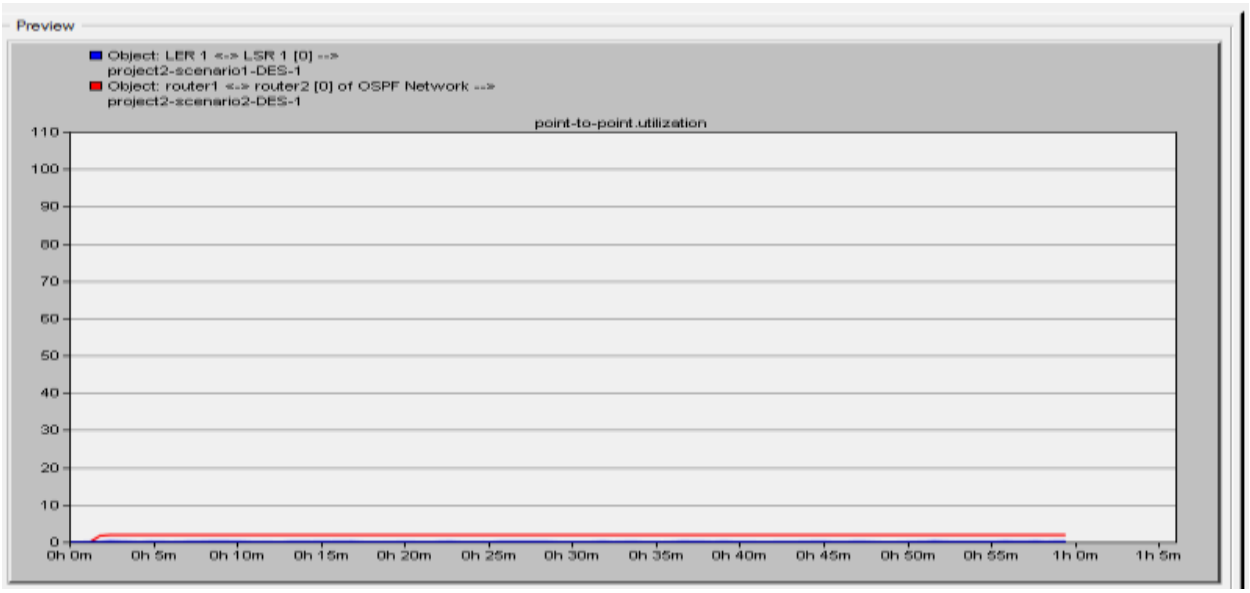

Figure (3): Utilization simulations of MLPS and OSPF.

Figure. 3 shows utilization simulation of the MPLS and OSPF protocol. The OSPF (shown in red) is demonstrating higher utilization level when compared to the MPLS (shown in blue).

V. CONCLUSIONS

A comparison of MPLS and OSPF protocols is presented. The details of both protocols are listed. The OPNET network simulator is used to compare protocol performance in the aspects of throughput, utilization,and delay It is found that the OSPF protocol is showing higher throughput ranges than the MPLS protocol. Furthermore, the OSPF also presented higher utilization values when compared to the MPLS protocol. A 50% higher delay is noticed for the MPLS compared to the OSPF protocol. Both systems shows significantly .

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