Throughput Analysis of SSP, SWP and MLS Routing Algorithms in Core Networks

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Abstract
Routing Algorithm plays a vital role in the performance improvement of the network in core network.. Therefore in this research paper the simulation performance is analyzed and compared for SSP(Single Shortest Path), SWP(Single widest Path) and MLS(Multi-path Link State) adaptive routing algorithms in core networks for a particular topology used in the paper.

Keywords:
Shortest Path, Widest Path, Adaptive Routing, Multi-path routing, Throughput comparison

1. Introduction

It is the network layer where the routing protocols plays a vital role in calculating, choosing the relevant paths and transferring the packets on the chosen paths. There are certain routing algorithms[1] which plays very important role in today's internet like link-state and distance vector routing algorithms. The example of link state and distance vector routing protocol is Open shortest path first (OSPF) and Routing Information Protocol (RIP) respectively. The Link state and distance vector routing algorithms may be further classified as single shortest path (SSP), single widest path (SWP) and multi-path link state routing algorithm (MLS). In this paper the throughput and convergence time of SSP, SWP, MLS routing protocols is evaluated and compared. The paper is divided into sections. Section 1.0 gives the background of routing protocols. Section 2.0 gives the concept of SSP, SWP, MLP routing algorithms. Section 3.0 gives the proposed adaptive routing algorithm. Section 4.0 gives topology used. Section 5.0 gives the simulation results. Section 6.0 conclude the paper. Section 7.0 gives the references used.

2. Background of Routing Algorithms

Routing algorithms[3][4] are classified as adaptive and non-adaptive types. Non-adaptive routing algorithms are also known as forwarding tables or static routing algorithms, while the adaptive routing algorithms are dynamic in nature and automatically adjust to changes in the network topology or traffic. Dynamic routing algorithms are used in all modern routers, but some amount of programming is required to customize the routes according to the priority. Adaptive routing algorithm base their routing decisions upon current state of the system. In packet-switched mesh topology network the routing tables are created dynamically by obtaining neighbor and route information from other routers. Routers are constantly updated because routes are added or removed or may fail due to break in link. Convergence is the part of routing table update process. Convergence is complete when all routers in the network have updated their routing tables based on the information from other routers due to change in topology of network.

3. Concept Of Ssp, Swp and Mls Routing Algorithms

The routing algorithms are classified as Single Shortest path , Single Widest Path and Equal cost multi-path. In case of single shortest path and Single widest path routing algorithms all packets are forwarded to a single next hop where as in case of equal cost multi-path routing algorithm packets [5] are forwarded to each of several next hops in proportions specified by the routing parameters. Here we assume two types of traffic i.e. one tolerates out of order packet delivery(e.g. UDP) and the other does not tolerate(e.g. TCP).

The adaptive routing algorithm which is the simplest and default routing algorithm chosen by packet when routed from source node to destination node. But for large amount of data packets transmission it has bandwidth limitation and drops the packets and performance degrades. So if there is a widest path available between the source and destination router then by adding some software routine, the data may be routed from source to destination router on the widest path available and packet drops may be reduced and performance may be improved. Further if the incoming data is large as compared to the capacities of o/p links of routers then the packet drops will be observed so if there is a provision of equal cost multi-paths between the source router & destination router then by making the use of available resources the performance of the network may be improved by using the equal cost multi-path link state routing algorithm[8].

4. Proposed Adaptive Routing Algorithm

The Paessler traffic grapher[6] is an easy to use software that monitors the bandwidth usuage of leased lines, routers and firewalls via SNMP, packet sniffing or

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netflow. So packet sniffing helps in deciding to select a particular routing algorithm in the network for better performance. The proposed adaptive routing algorithm is given here.

1. Start
2. Let P1=MLS, P2=SWP, P3=SSP
3. Monitor and measure current incoming traffic using PRTG software.
4. Based on current Incoming traffic.
   If Incoming Traffic<=L1 or L2 Mbps
   Run P3
   Else if Incoming Traffic>L1 AND <L2 Mbps
   Run P2
   Else
   Run P1
5. Continue the above steps till routing completes
6. Stop.

Here P1,P2,P3 are routing algorithms and L1 & L2 are the bottleneck links of path1 & path2 of the network or Path costs of Path1 & Path2 of the network under consideration.

5. Topology

The topology used for experimental purpose have 11 nodes and 13 links shown in fig. 1 . The bandwidth and delays of links are shown in Table1.

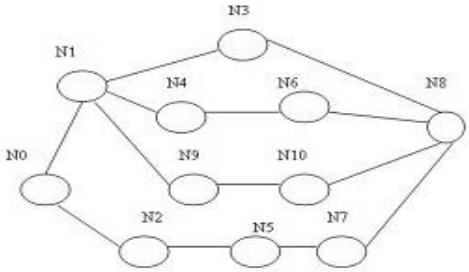

Fig. 1: Experimental Topology

Sr.No.	Link	Bandwidth(Mbps)	Delay(Ms)
1	n0-n1	3.0	0.3
2	n0-n2	3.0	0.3
3	n1-n3	1.0	0.84
4	n1-n4	2.0	0.5
5	n1-n9	3.0	0.3
6	n3-n8	2.0	0.5
7	n4-n6	2.0	0.5
8	n9-n10	3.0	0.3
9	n6-n8	2.0	0.5
10	n10-n8	3.0	0.3
11	n2-n5	2.0	0.5
12	n5-n7	2.0	0.5
13	n7-n8	2.0	0.5

Table1: Bandwidth and delays of the links used in the Fig.1

6. Simulation Results

The simulation study was performed on Network Simulator(NS2)[9]. The Simulation results are evaluated and compared for single shortest path (SSP), Single widest path (SWP) and equal cost multi-path link state (MLS) routing algorithms using the topology of fig.1. The user datagram protocol (UDP)[2] is used for transport of data from source node to destination node(router) because some services like DNS, which could use TCP usually use UDP for efficiency. UDP is also used for broadcast messages since a connection oriented approach is not appropriate. The convergence time evaluated for SSP, SWP, MLS using the network simulator 2 (NS2) is shown in Table2. The buffer size at a router is changed (increased) to reduce the congestion or packet drop in the network. The throughput analysis for SSP and SWP with respect to buffer size is shown in fig.2.

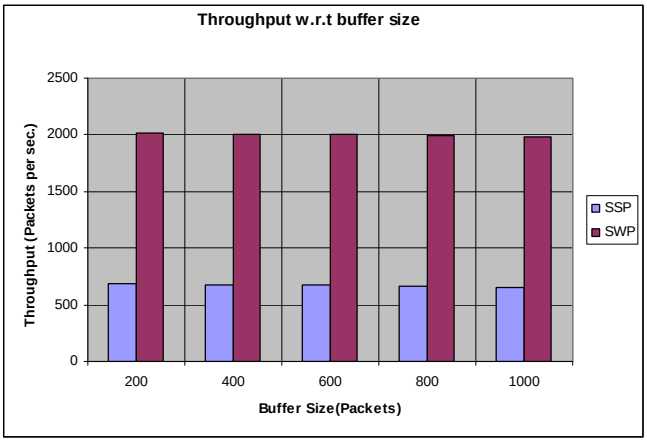

Fig.2 : Throughput analysis of SSP and SWP w.r.t buffer size

The throughput comparison of SSP, SWP and MLS routing algorithms with respect to offered load is shown in fig.3.

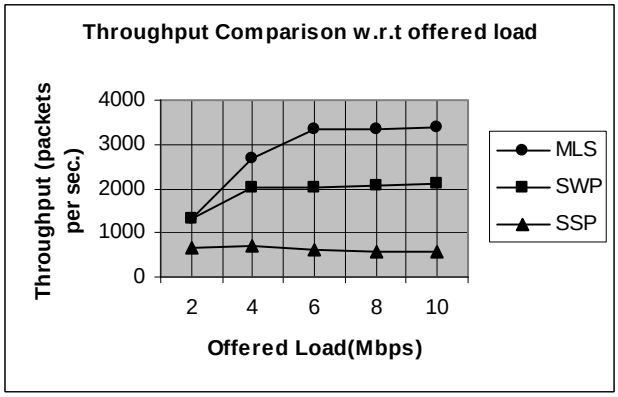

Fig.3 : Throughput Comparison with respect to offered load

From Fig.3 It is clear that the throughput of SWP & MLS are equal at 2Mbps offered load and greater than the throughput of SSP. As the incoming traffic(offered load) is increased at the source node(N0), the throughput of MLS routing algorithm is improving as compared to SWP & SSP as is shown in the fig. 3.

Sr.No.	Name of Routing Algorithm	Convergence Time(Sec.)
1	Single Shortest Path (Link State)	0.04
2.	Single Widest Path(Link State)	0.31
3.	Equal Cost Multi-path link state	0.21

Table 2: Convergence Time

7. Conclusion

The throughput and packet drop parameters of adaptive routing algorithm decides the suitability of a particular algorithm in a particular environment. The simulation results are evaluated for each of the routing algorithm(SSP, SWP, MLS) by changing the offered loads as well as buffer size at bottleneck links. It is concluded that the equal-cost multi-path adaptive link state routing algorithm gives better throughput by taking buffer size of 200 packets at bottleneck links for the topology used in fig.1 as compared to SSP and SWP routing algorithms. It is apparent from the simulation results that packet loss or congestion in the network may be reduced by using big size buffers at the bottleneck links but at the cost of throughput due to more waiting or delay time [5] of packets in the system. Therefore it is suggested that the congestion in the network may be reduced and throughput may be improved by using the equal cost multi-path adaptive link state routing algorithm as per the requirement of the environment as compared to Single Shortest Path and Single Widest Path routing algorithms.

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