Comparative Analysis And Simulation Of Internet Routing Protocols In Different Network Topologies Using Netsim

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Abstract.

Router, a networking equipment, is critical to the intelligence of the internetwork. Routers in the internet receives data packet via its interfaces in same or another neighbouring network and forward it to another or same network. To which network it should pass the data packet is the place where routing protocols comes to play. This decision is based on metrics. The main purpose of this study is to analyze the performance of the routing protocols namely RIP and OSPF on three different topologies like Ring, Star and Mesh. The simulator used is NetSim to study the behaviour and performance comparison of these protocols in various network topologies and network metric such as application throughput, packet delay is analysed in different scenarios such as link failure etc.

Keywords: NetSim, RIP, OSPF, Ring, Star and Mesh.

1. INTRODUCTION

Internet protocols is used for end-to-end communication for inter connected networks and specifies how data should be transmitted to the destination. TCP/IP comprises of four layers and all layers have its own functionalities. In this paper we are concentrating only the function of internet layer which is enabled by router. Router is a device which forward data packets to one or more router or network. When a router receives a data packet, it reads the address of destination and forward it to the path which take the packets to respective address. Here the routing table comes to the play. A routing table is a table of data stored in a router that contains routes to a particular network and associated metrics (cost or distance). Building a routing table is an important goal of a routing protocol. In this paper we focused mainly on two protocols namely RIP and OSPF. Routing Information Protocol (RIP) works on the basis of distant vector algorithm which uses hop count as a primary criterion to choose path. Open Shortest Path First Protocol (OSPF) works on the basis of link state routing algorithm in which least cost route is defined by considering various parameter such as cost of link and condition of link (up and down). This can be calculated using the formula "OSPF path cost = ((auto-cost × reference-bandwidth + interface bandwidth) -1) / interface bandwidth". A Routing table contains network destination address, netmask, gateway, interface, metrics. These protocols choose the next interface based on the metrics in the table. The first topology is the ring topology. It is the network configuration where the devices connected in a network form a circular data path like a ring. The star topology has head router to which all other routers are connected like a start. In mesh topology, each and every node has a unique path to all other nodes in a network. The work related to our study is listed in Section 2. In Section 3, details about the simulation environment which is NetSim in our case and the parameters we have considered are discussed and the results of our simulation and our inferences from the results are shown in Section 4. Finally, in Section 5, we arrived at the conclusion by comparing performances.

2. RELATED WORKS

In the previous study at [1], they have compared three protocols for an enterprise level designed topology and analysed the performance. They have concluded that EIGRP is the best protocol as it has least convergence time and better delay time compared to others. Albaour A et al. [2] have simulated for a fully connected mesh topology and claim that EIGRP has faster throughput than RIP while OSPF has the fastest throughput among them in all the stages and the distance vector-based RIP has the highest queuing delay while in the beginning EIGRP had higher queuing delay than OSPF, but then gradually declined and became the least in terms of queuing delay. We can also see that in terms of convergence rate, EIGRP has the fastest convergence in all phase. While OSPF has a faster convergence time than RIP. And this literature doesn't deal with any simulations related to any link failure cases or work on different topologies. And protocols like RIPv1, RIPv2, EIGRP, OSPF were analysed using network simulated in cisco packet tracer [7] and concluded that EIGRP is better than all other protocols in terms of convergence time and from the point of view of throughput and delay, OSPF dominates RIP.

Athira M et al. [3] compared the performance of these routing protocols for real time connections with help of an enterprise network topology. This outcome indicated that, in OSPF and EIGRP the delay is lesser than in RIP. And in terms of throughput, OSPF is better than RIP. In other study [4] three protocols are compared for Ring, Mesh and Big Mesh topologies. They have concluded that, in terms of convergence time the EIGRP performed well than other protocols in different topologies and uses bandwidth efficiently. In another study at [8] states the EIGRP uses DUAL which avoids routing loop. So, convergence time is less in star and mesh topologies and also concludes that the mesh topology is the best topology in terms of convergence time. In the case of link failure, the EIGRP performs well in terms of convergence time as it adds new links when a link fails. The performance of OSPF is lesser than EIGRP. In the ref. [9] the performance of RIP and OSPF protocols are compared in two different network simulators which are ENSP and GNS3. And the analysis indicates, the connection time of OSPF routing protocol (83 ms) is faster than RIP (177 ms). And GNS3 network simulator had 329 ms average time, while the ENSP has 94 ms.

3. SIMULATION ENVIRONMENT AND CONFIGURATION PARAMETERS

Netsim is network simulation software for network design verification, network development, and research. It's C-based software with a package of intelligent libraries that allows you to emulate not only simulations, but also merging real and virtual worlds. We can also change routing parameters in RIP like update timer, timeout timer and garbage collection time and in OSPF, link state refresh time and maximum age. It also allows us to use options like event trace, packet trace and an animation window. We have compared the performance with and without link down situation. For creating a link down situation, we have reduced the bandwidth (upload speed) of link.

3.1. RING TOPOLOGY

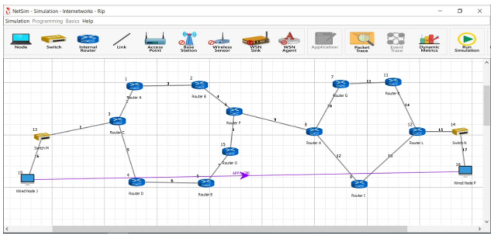

Figure 3.1.1 Ring Topology Internetwork

We have made a network on ring topology. This network (figure 3.1.1) has two rings made with 12 routers (A to L). The purple line indicates the source to destination transmission. Using RIP, it followed the path with minimum hop count of 7. The selected path is (Source→ Switch →C → A→ B→F → H → I → L → Switch → Destination). The throughput is 0.581664 (Mbps) and the delay is 13188.437912 (microsec). The selected path using OSPF protocol is (Source → Switch →C→A→B→F→H→G→K→ L → Switch → Destination). The throughput is 0.579912 megabits per second and the latency is 1420.232749 microseconds. To analyse it further we changed the link properties of link ID 10 (1Mbps) and 12 (50Mbps). Now the path changed to (Source→ Switch →C → A→ B→F → H → I → L → Switch → Destination), which is similar as the route of RIP. But there is not much difference in throughput. So, we added one more source node. Upload speed of link 12 was reduced from 50 to 1Mbps and kept link 10 high. For RIP, the applications throughput and delays are shown in the Fig 3.1.2 and for OSPF in Fig 3.1.3.

Application_Metrics_Table

Application_metrics — Detailed View

Application Id	Throughput Plot	Application Name	Throughput (Mbps)	Delay(microsec)
1	Application_throughput_plot	APP1_CBR	0.487640	1635197.378323
2	Application_throughput_plot	APP2_CBR	0.486472	1647010.035654

Figure 3.1.2 Throughput using RIP

Application_Metrics_Table

Application_metrics — Detailed View

Application Id	Throughput Plot	Application Name	Throughput (Mbps)	Delay(microsec)
1	Application_throughput_plot	APP1_CBR	0.578160	1420.233454
2	Application_throughput_plot	APP2_CBR	0.582248	1542.311815

Figure 3.1.3 Throughput using OSPF

3.2. STAR TOPOLOGY

The star topology is created using 5 routers (A to E) as in the Fig 3.2.1.

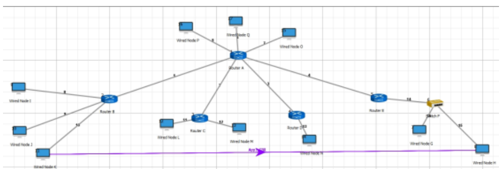

Figure 3.2.1 Star topology Internetwork

Using RIP, the selected route is (Source → B →A →E → Switch →Destination). The throughput and delay are shown in the Fig 3.2.2 and using OSPF in Fig 3.2.3.

Application_Metrics_Table

Application_metrics Detailed View

Application Id	Throughput Plot	Application Name	Throughput (Mbps)	Delay(microsec)
1	Application throughput plot	APP1_CBR	0.579328	651.060645

Figure 3.2.2 Throughput using RIP

Application_Metrics_Table

Application_metrics Detailed View

Application Id	Throughput Plot	Application Name	Throughput (Mbps)	Delay(microsec)
1	Application throughput plot	APP1_CBR	0.579328	651.060645

Figure 3.2.3 Throughput using OSPF

3.3. MESH TOPOLOGY

This network is built using 5 routers (A to E) as shown in the Fig 3.3.1.

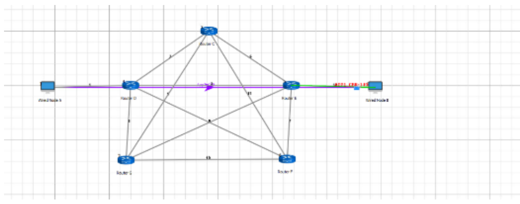

Figure 3.3.1 Mesh topology

In RIP the selected route with least hop count of 3 is (Source → D →E → Destination). The throughput and delay are shown in the fig 3.3.1. Using OSPF, the route followed is (Source → D →C → E → Destination) and results are in the Fig 3.3.3.

Application_Metrics_Table

Application_metrics Detailed View

Application Id	Throughput Plot	Application Name	Throughput (Mbps)	Delay(microsec)
1	Application throughput plot	APP1_CBR	0.578160	6215.307636

Figure 3.3.2 Throughput using RIP

Application_Metrics_Table

Application_metrics Detailed View

Application Id	Throughput Plot	Application Name	Throughput (Mbps)	Delay(microsec)
1	Application throughput plot	APP1_CBR	0.579328	502.280645

Figure 3.3.3 Throughput using OSPF

4. RESULTS & INFERENCES

For the ring topology internetwork, the application throughput and delay in RIP are 0.48 Mbps and 1641103.7069 microseconds on average respectively. Using OSPF, the application throughput and delay are 0.58 Mbps and 1481.2726 microseconds on average respectively. The average application throughput via OSP is better than in RIP and the average end-to-end delay is also lesser in OSPF. For the star topology internetwork, if there is any link failure, it has no other route to communicate. So, the application throughput and delay will be same in both the cases. For the mesh topology internetwork, the application throughput and delay using RIP are 0.578 Mbps and 6215.3076 microseconds respectively, and using OSPF, 0.579 Mbps and 502.280 microseconds. The average end-to-end delay is comparatively lesser using OSPF than RIP.

5. CONCLUSION

The RIP performs well in all the three network topologies if there is no failure in link. But in case of a link with lesser bandwidth, the RIP still follows the route with lesser bandwidth which increases delay whereas the OSPF follows the alternate route with higher bandwidth (upload or download speed). This makes OSPF better in every link failure case in both ring and mesh topology. But in star topology, both the protocols perform similar as there is no alternate path. Overall, OSPF performs well in all topologies.

6. REFERENCES

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