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Comparison of Routing Algorithms using Riverbed Modeler

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Abstract: One of the vital practice in the internet is routing of data packets. A routing protocol specifies the method of communication among routers used in the inter connection of networks. A routing table in the memory of a router keeps track of routes to particular network destination. There are varios routing protocols which have application on the internet like Routing Information Protocol (RIPv2), Open Shortest Path First (OSPF), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Intermediate System To Intermediate System (IS-IS), etc. Every single protocol has its unique way of packet routing. This paper presents a simple relative study of RIP, OSPF, EIGRP and IS-IS dynamic routing protocols. The Routing Information Protocol (RIP) comes under the distance vector algorithm while Enhanced Interior Gateway Routing Protocol (EIGRP) is an advanced distance-vector routing protocol, the Open Shortest Path First Protocol (OSPF) is a link state routing algorithm. Intermediate System to Intermediate System (IS-IS) regulates the superlative route for information through a packet-switched network. The crucial objective of this research work is to illustrate the comparitive performance analysis of dynamic routing protocols and redistribution among the protocols. Cisco routers were used in our simulated network topology.

Keywords: Routing Protocols, Topology, Convergence, Comparison.

I. INTRODUCTION

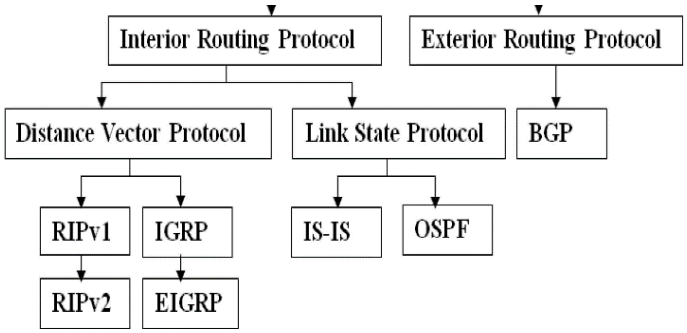
In the last decade, thanks to the increasing innovation of telecommunications technology, we have seen the surge in number of internet users in developing countries. It is possible to exchange the routing information between routers through the routing protocols. Routing protocols based on certain algorithms permits routers to inform about remote networks dynamically and add this information to their routing tables automatically.

To identify the optimum path to each network, routing protocols are used and added to the routing table. The fundamental advantage of using dynamic routing protocol is that whenever there is topology change routers exchange routing information, which permits routers to learn certainly not only about alien networks but also to find substitute paths if there is a link failure to a running network.

In comparison with static routing, less administrative overhead is required in dynamic routing protocols. Routing protocols let routers to share data about remote networks dynamically and add this information to their routing tables spontaneously. Besides, to meet the demands of changing network requirements dynamic routing protocols have evolved over several years. Individual router comprises particulars of its neighboring networks only. A routing protocol shares this information first among immediate neighbors, and then throughout the network.

This way, routers gain knowledge of the topology of the network. Several organizations have shifted towards more recent routing protocols, for example Enhanced Interior Gateway Routing Protocol (EIGRP) and Intermediate systems

To Intermediate systems (IS-IS).Figure-I shows how dynamic routing protocols are classified.



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II. PERFORMANCE ANALYSIS

Riverbed Modeler is used as simulation tool for Performance Analysis

A. Metrics

The best path is decided by the Routing protocols. These routing protocols make use of metrics for decision. Several factors plays vital role in dynamic routing protocols to decide the ideal or shortest pathway to exact target. For example RIP uses hop count (number of hops) to determine the best possible route, OSPF make use of bandwidth as metric, and EIGRP uses a mixture of delay and bandwidth as metric.

(1) RIPv2 – Hop Count

RIPv2 uses hop count as a metric value. The hop count Corresponds to the number of routers a packet must cross to reach the destination node. The RIPv2 chose the route with the lowest hop count.

(2) OSPF – cost

Open Shortest Path First (OSPF) uses "Cost" as a metric and practices a Reference Bandwidth of 100 Mbps for cost calculation. The formula to estimate the metric is Reference Bandwidth divided by Interface Bandwidth.

(3) EIGRP – Delay and Bandwidth

EIGRP uses various values in its composite metric to calculate the best path in a network. Delay, Bandwidth, Load and Reliability. Best path is selected with the smallest composite metric value calculated from these multiple parameters. In general, delay and bandwidth as default parameters.

(4) IS-IS – Narrow and Wide

There are two basic metric types Narrow and Wide and another one state is the transitional state. The transitional mode is used when migrating from narrow to wide.

B. Convergence

Convergence is achieved when all the routers of a network have the same topological data. When all the routers throughout the network have consistent data in their respective routing table. The network achieves converge when all routers have comprehensive and precise data about the network under consideration. Convergence is a vital concept for a set of routers that engage in dynamic routing. Every Interior Gateway Routing Protocol depend on convergence for optimum operation. Convergence time is the time necessary by the routers to update the routing table, calculate the best path and share the data throughout the network. BGP, an exterior gateway routing protocol never usually convergence in a network as big as the Internet. The network's routing protocol must converge for reliable operation.

C. Throughput

The units of information a system can process in a given amount of time is throughout. Traffic throughput of a network is delimited by the routing protocol in consideration, and the router hardware, a crucial theme for many network administrators. Throughput is useful to systems from several parts of CPU and network systems to organizations. Associated procedures of system efficiency include the time for some certain workload to be completed, acknowledgment of response time, the amount of time between a single interactive user request.

TABLE I

Feature	RIP	OSPF	EIGRP	IS-IS
Type	Distance Vector	Link state	Hybrid	Link state
Algorithm	Bellman-ford	Dijkstra	DUAL	Dijkstra
Class full/class less	V1 : class full V2 : class less	Class less	Class less	Class less
Metric	Hop count	Cost	Bandwidth/Delay	Narrow and Wide
Timers update (Hello/Dead)	30 sec	Triggered when network change occurs, send periodic update LSA refreshes every 30 minutes	Triggered (LAN 5/15, WAN 60/180)	
Administrative distance	120	110	Internal 90 External 170	115
Authentication	V1 : No	MD5 Authentication	MD5 Authentication	MD5 Authentication

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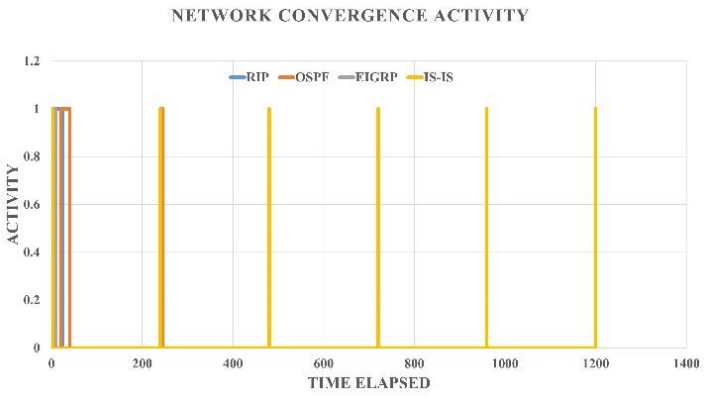
	V2 : Yes			
Hop limit	15	235	None	
Convergence	Slow	Fast	Very fast	Fast
Type of updates	Full table	Only changes	Only changes	
Support VLSM	V1 : No V2 : Yes	Yes	Yes	Yes
Network size	Small	Large	Large	Large
Split Horizon sensitive	No	Yes	Yes	Yes
Area Types	-	Backbone, stubby, Not so-stubby, totally stubbing	-	-
Latency	More	Less	Less	Less

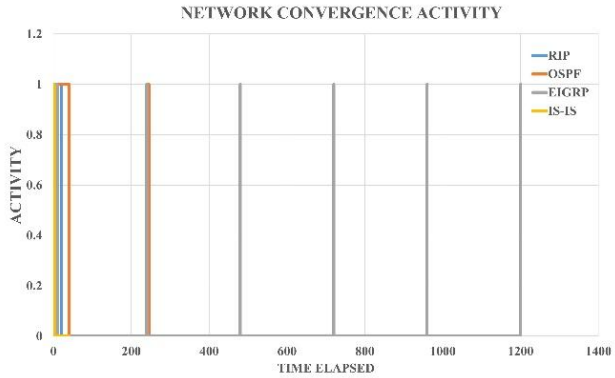
Primary differences of RIP, OSPF, EIGRP, IS-IS protocols response time, the amount of time between a single interactive user request and receipt of the response.

III. RESULTS AND ANALYSIS

A. Network Convergence Activity



The first pseak represent initialization. The next peak after initialization is failure and after that is recover peak and so on. The convergence time depends on the width of peak. If the peak is wider, the protocols converges slowly. In this mesh topology, IS-IS is the fastest protocol among all four. EIGRP is slight faster than RIP. It is clear from the graph that OSPF is slowest.



Convergence activity in a 50 nodes tree network for different routing protocols. IS-IS is the fastest among all four. OSPF has a longer initialization time compare to RIP, EIGRP and IS-IS. Both OSPF and RIP has longer initialization time as compared to EIGRP and IS-IS. EIGRP has longer initialization time than IS-IS.

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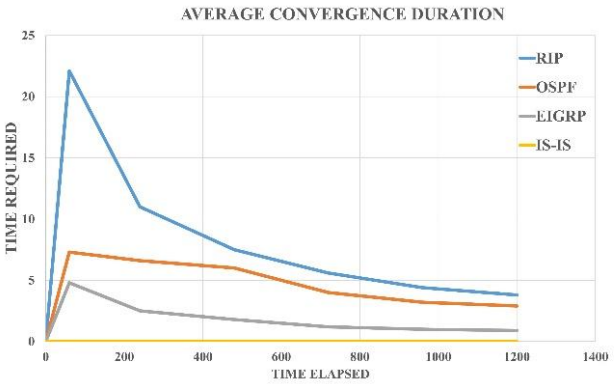
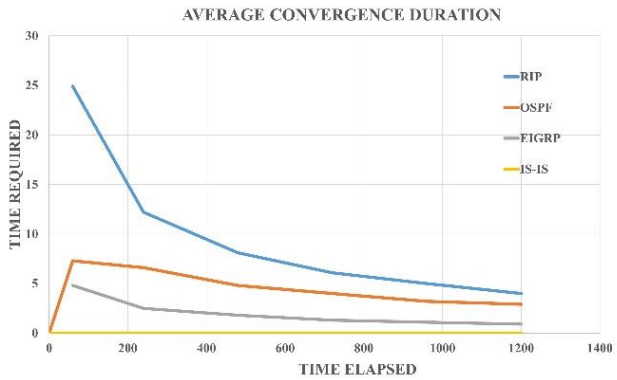
B. Network Convergence Duration



Convergence duration for 50-node tree network for different protocols. IS-IS is still the fastest. Time required for EIGRP convergence is more than IS-IS. OSPF take a slight longer time than EIGRP and it is clear from the graph that RIP is the slowest and take a considerably lot more time than OSPF.



As concluded from the graph, IS-IS is still faster is every aspect i.e. faster initialization time and faster convergence duration. OSPF is the second fastest in convergence but has some delay in initialization. EIGRP has zero initialization time but converges after OSPF. RIP is the slowest in convergence and it also has some delay in initialization.

C. Traffic Sent

The figure above shows the router traffic sent in bits/sec in four protocols using mesh topology. The first peak in this figure represents initial traffic, the next peak is link failure and the peak after that is link recovery. The figure clearly signifies that OSPF has the highest initial traffic since OSPF will map whole network, which requires routers to distribute a large amount of information. Also, we observe that IS-IS has the highest bandwidth efficiency, and second one is EIGRP. RIP update its routing table every 30 seconds hence RIP shows a little difference than OSPF and EIGRP.

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IV. CONCLUSION

We studied the performance of four major types of routing protocols: RIP, OSPF, EIGRP and IS-IS using Riverbed Modeler. Tree and Mesh topologies had been built and the simulation of each routing protocols in all three topologies had been performed. At first implemented the three routing protocols into a small tree network and evaluated the convergence activity, convergence duration and traffic sent (bytes/sec) to compare the difference in their performance and after that, we implemented the three protocols into large mesh and large tree topologies and evaluated the same three parameters. IS-IS is the fastest among all four. OSPF has a longer initialization time compare to RIP, EIGRP and IS-IS. Both OSPF and RIP has longer initialization time as compared to EIGRP and IS-IS. EIGRP has longer initialization time than IS-IS.

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