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Comparison and Analysis of Routing Protocols Using Riverbed Modeler

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ABSTRACT

In recent years several routing protocols have been proposed to be used on different types of networks. Some comparative studies were carried out to analyze and compare the performance of several routing protocols over Local Area Network (LAN). In this work, RIP, EIGRP, OSPF routing protocols were analyzed, compared and simulated over Riverbed Modeler. The performance of different protocols are compared using Riverbed Modeler tool in which metrics like delay, throughput, and convergence time are measured. The behavior of the protocols over different network topologies and different data rates were analyzed.

Keywords: Routing, Protocols, Riverbed, RIP, LAN Networks, OSPF, EIGRP.

INTRODUCTION

Computers interconnect with each other through multi-hop link in Local Area Networks(LAN). Routing has great significance in the circumstances of transmitting the data from source to destination. Research colleagues have done several researches of routing protocols over different types of networks, one of such research is carried out to analyze and compare the function of most common routing protocols such as RIP, EIGRP and OSPF. The aim of the paper is to make a deep analysis of the common routing protocols using Riverbed Modeler by implementing over different network types with different data rates. As a consequence of this work we can determine routing protocols in terms of the suitableness of common protocols over different network types. This way we can recommend the type of routing protocol should be used in a defined network type. Routing technique is critical part of every network types. Today most of enterprises prefer usage of LAN over their internal infrastructures for security reasons. Generally Routing is classified into

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parts as static and dynamic routing. [1], [2]. Static routing is performed manually while in dynamic routing is done by algorithms. In this paper, LAN is designed and various routing protocols were implemented over LAN in order to test and compare the performance of above routing protocols. According to the behavior of the protocol over different network types it can be implemented to the suitable network type.

LITERATURE SURVEY

Different studies over routing protocols have been carried out and some of those shows below; Nurul I. and Wilford G. Have offered some ways of how to increase the performance e.g by incrementing the buffer size. Wireless Local Area Network (LAN) is evaluated with using high priority traffic in [2]. The work of Krishna Gorantala in [3], tries to improves data transmissions over large network without any connection damage. A. Ahmad et.al. [4] Have carried out a realistic study over two routing protocols (AODV and DSR) on a university campus, they have used a quantative metrics like throughput, delay and receiving traffic over a given scenarios to analyze the performance of the routing protocols. Some other routing protocols were proposed in these works. [5] [6] [7] [8] [9] [10] [11] [12] but a few comparative study were carried out. The focus of our work is to make comparison between routing protocols over LAN network using Riverbed modeler, metrics like delay, router convergence duration, and throughput were measured for different data rates and topologies.

ROUTING PROTOCOLS

Every network has a goal of sharing information between its nodes which resides on the network. It's is simple to send/receive data to a node inside a network, but it gets a little complicated when it comes to sharing an information to an outside network. When a network wants to communicate with another network routing protocol is necessary. Routing is fundamental for systems to communicate with outside networks. The duty of every router is to forward the coming packets to their suitable destinations. To achieve this, routers need routing protocols, that's why routing protocols are crucial for every network. In order to do routing every router should synchronize its routing table with its associative neighbors and also throughout the network, after that a network topology is formed. Various routing protocols are described below.

Routing Information Protocol

RIP is a distance vector protocol which uses single distance metric as 'Hop Count' for minimum hop. RIP prevents wrong routing of information using a limit of 15 hubs (intermediate nodes). Despite the weakness and limited size of RIP, it offers a great advantages such us using UDP and port number of 520 [12]. Distance vectors were exchanged every 30 seconds which is called Advertisement and each advertisements route to up to 25 destination in networks. The protocol routed in 4.3 BSD Unix distribution.

Enhanced Interior Gateway Protocol

EIGRP is one of hybrid routing protocols it composed of the properties of distance vector and link-state routing protocols. The relationships forms by EIGRP known as adjancies. With routes in the identical autonomous system-as, by interchanging hello packets. Routes share their routing information just after the formation of adjacencies. The multicast address of 224.0.0.10 is used by EIGRP to propagate its hello packets. For protocol packets delivery reliability purpose EIGRP uses Reliable transport protocol. Unlike other routing protocols EIGRP uses multiple metrics to determine optimal route to destination. Bandwidth (K1), Load (K2), delay of the line (K3), reliability (K4) and Maximum Transmission Unit-MTU (K5), But as default EIGRP uses just bandwidth and delay as metrics. EIGRP is one of classless routing protocols which supports VLSM. [13] .

Open Shortest Path First Protocol

OSPF is based on Dijkstra's algorithm and it has the function of calculating the minimum path tree of the routes. One of the main pros of the protocol is to detect errors by itself and finally broadcast domain is provided by multicast addressing in OSPF [12]. By default every router has a built in information of Link-state protocol, with the advantage of this OSPF makes up its topology. Forming the topology it helps OSPF to determine routing decisions. Like EIGRP, OSPF supports VLSM.

Intermediate System to Intermediate System

IS-IS, is usually a preferred routing protocol in large-scale networks. IS-IS is working with reference to the OSI reference model which makes it different. With IS-IS the data is transported with the Connectionless Network Service (CLNS) standard. Hierarchical / scaling can be achieved by separating wide domains into sub-domains (areas or sub-domains). However, each router can only belong to one area. There is another important detail in transmission between ISs. IS-IS packages are encapsulated in Layer 2 without being subjected to OSI Layer 3 encapsulation [14].

PERFORMANCE METRICS

There are different metrics to analyze routing protocols over Riverbed Modeler. Delay, throughput, and convergence duration as performance metrics can give us deep view of how a given routing protocol over different network topology behaves and we can retrieve form that whether the protocol is suitable for the topology or not, with this we will also determine There are different metrics to analyze routing protocols over Riverbed Modeler. Delay, throughput, and convergence duration as performance metrics can give us deep view of how a given routing protocol over different network topology behaves and we can retrieve form that whether the protocol is suitable for the topology or not, with this we will also determine the performance of the protocols, over a given data rates to see how it adopts with different data rates (increasing) as (1, 2, 4, 8) Mbps. Performance metrics are detailed below:

End-to-End delay or E-to-E delay is the average of successfully completed packets from one source to destination over a network.

Throughput is the average of successfully delivered packets (messages) per unit of time (seconds) through communication channel. In computer networks, throughput is measured in bits per second and some situations in data packets per second.

Convergence duration is the time which a group of routers reach the state of convergence by creating routing tables after the convergence each router gets a map of the topology it resides from there each router decides which packet should be sent in which route. Optimally the routing protocols must have fast convergence time. It is calculated with the rate of second.

Table 1. Network Parameters

Component	*Model*
Nodes	*Ethernet workstation*
Routers	*Cisco 7200*
Link	*100Base_T, DDS3,DDS1*
Protocol	*EIGRP,RIP,OSPF*
Switch	*Ethernet_16_switch*
Data rate	*1,2,4,8 Mbps*
Packet rate	*1 Packet/s*

SIMULATION SETUP AND EVALUATION

In this paper, the different network topologies (Star and Mesh) has been modeled by using Riverbed modeler and the performances of various routing protocols in different data rates (1,2,4,8) Mbps has been analyzed. Attributes of the network design, network topologies, LAN parameters with different protocols and traffic configuration parameters are used in the scenarios. Results of the simulation shown in below section and also traffic and LAN parameters are shown in Table 1. The performance as delay, throughput and convergence duration for various protocols were chosen and analysis is performed.

ANALYSIS AND RESULTS

The goal of this paper is to compare routing protocols and evaluate the performance of the protocols using the Riverbed modeler in different situations and in different topologies. we created two separate topologies (star and mesh) on the Riverbed Modeler, and we created 12 scenarios in each topology. We evaluated the RIP, OSPF and EIGRP routing protocols to evaluate as follows; each protocol evaluated 8 different scenarios with 4 different data rates on each topology for delay time, throughput, convergence time, and protocol traffic, and as a result, we obtained the following graphs and summarized comparison of protocols is given in Table 2.

Table 2. General comparison of the routing protocols

	EIGRP	RIP	OSPF	IS-IS
Algorithm	DUAL	Bellman-Ford	Dijkstra	Dijkstra
Type	Hybrid	Distance Vector	Link- state	Link-state
Interior/Exterior	Interior	Interior	Interior	Interior
Classful	Yes	Yes	No	No
Metric	Bandwidth/Delay	Hop Count	Cost	Cost
Convergence Time	Very Low	High	Low	Low
Updates	Any changes	Full table	Any Changes	Any changes
Protocol And Port	IP, 88	UDP, 520	IP, 89	Ethernet/PPP, No Port

Figures 1 and 2 illustrates that RIP, and OSPF have more End-to-End delay than EIGRP. Also it's notable that from 1 to 4 Mbps the performance looks same which means at low bandwidth RIP and OSPF generates less delays than high bandwidth.

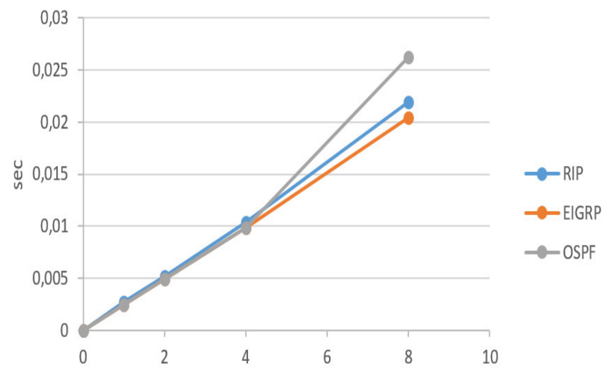

Figure 1. End to End Delay (Star Topology)

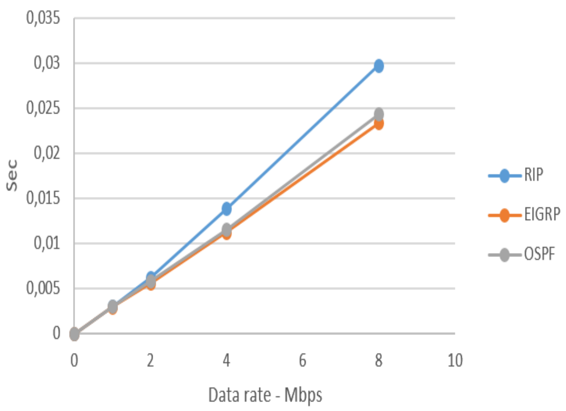

Figure 2. End to End Delay (Mesh Topology)

Throughput is the total amount of sent/received bits- per second, RIP demonstrates major decrease of throughputs when it comes topology type. As it shows on the graph RIP transferred more than 1200 bits at Star Topology but just less than 100 bits for Mesh topology. As we know RIP sends update messages every 30 seconds as default.

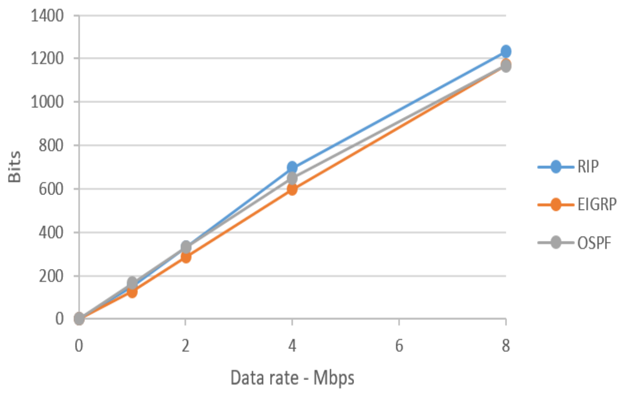

Figure 3. Throughput (Star Topology)

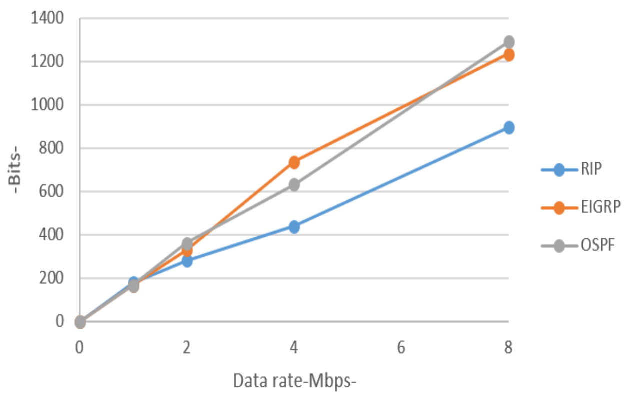

Figure 4. Throughput (Mesh Topology)

Convergence duration is the time that a cluster of routers achieve the situation of convergence. The routing protocols should have low convergence rate. Figure 6 and 7 shows the convergence duration of the routing protocols over topologies (star and mesh). The figures gives us a clear view of how EIGRP converges faster than other protocols over both topologies with less than a second. Thus we can say that EIGRP has a fast convergence rate.

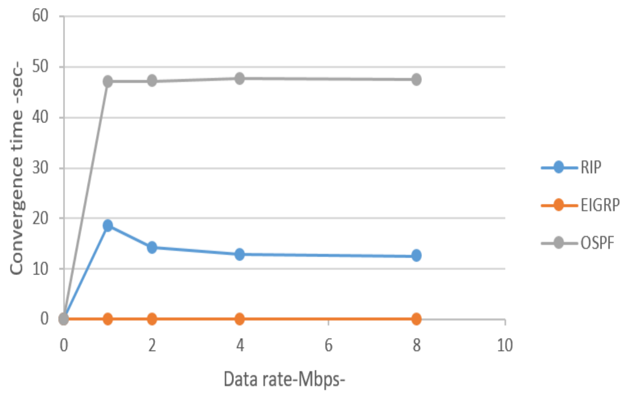

Figure 5. Convergence duration (Mesh Topology)

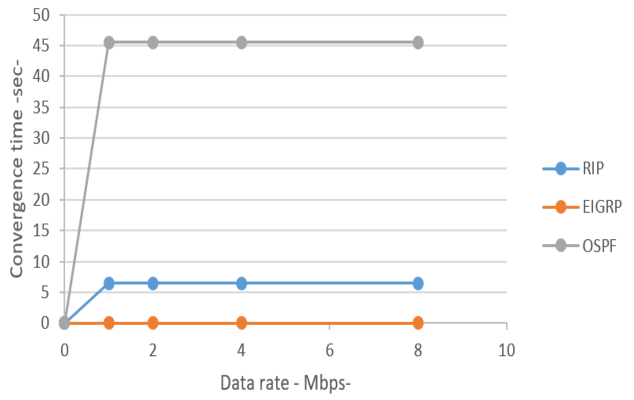

Figure 6. Convergence duration (Star Topology)

CONCLUSION

In this paper, common routing protocols were analyzed and compared each other according to end-to end delay, throughput and convergence duration using Riverbed Modeler, in advance to that the behavior of EIGRP, RIP and OSPF routing protocols were studied over different network topologies (Star, Mesh) and data rates (1,2,4,8 Mbps).According to our findings we can say that CISCO's proprietary protocol EIGRP showed best performance over both topologies but it has a drawback when the routing traffic which EIGRP generated more routing traffic according to RIP and OSPF that results extra delay to the network. Also RIP demonstrated poor performance to the experiment according to its long convergence duration which causes long delays as it shown to the end-to end delay graph. OSPF protocol gave good performance at 1 to 2 Mbps data rates but it has more delays at 4 to 8 Mbps data rates which shows that OSPF can be more successful at low bandwidth networks other than high bandwidth networks. We can recommend to the high bandwidth networks to use EIGRP because of its less delay and quick convergence duration with high throughput.

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