Performance Comparison of Routing Protocols

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Abstract - *This paper focuses the study of different routing protocols used in computer networks. A routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes in a computer network. The choice of route is done by routing algorithms. Each router possesses prior knowledge of networks that has been directly related. A routing protocol shares this information first among immediate neighbors, and then throughout the network. By this way, routers gain knowledge of topology of network. There are many routing protocols used for routing purposes like RIP, EIGRP and OSPF. In order to reach results and compare them, Optimized Network Engineering Tool (OPNET MODELER) was used.*

Key Words: **Routing Protocols, RIP, EIGRP, OSPF, OPNET**

1. INTRODUCTION

In IP networks, the main responsibility of a routing protocol is to carry packets forwarded from one node to different. In a network, routing can be defined as transmitting information from a source to a destination by one-hopping or multi hopping. Routing protocols should provide at least two facilities: selecting routes for different pairs of source/destination nodes and, successfully transmitting data to a given destination. Routing protocols are used to describe how routers communicate to each other, learn available routes, build routing tables, make routing decisions and share information with neighbors. Routers are used to connect various networks and to provide packet forwarding for other types of networks. The main goal of routing protocols is to discover the best path from a source to a destination.

Routing is a fundamental process for choosing the shortest path from various paths in order to forward a packet from source to destination nodes at the smallest cost. The routing protocols can be categorized into the interior and exterior gateway protocols. Border Gateway Protocol (BGP) is an exterior gateway protocol. BGP is accepted to share routing information between autonomous systems (AS) on the internetwork that is a distance vector routing protocol. An interior gateway protocol is used to share routing information between gateways within an AS. It is divided into distance vector and link-state routing protocols. A distance-vector algorithm forms a vector that includes costs to all different nodes and advertises a vector to its neighbors whereas each node in a link-state algorithm advertises the state of the link to its neighbors and the cost of by link. A distance vector routing protocol is a hop count metric and the next-hop presents a direction. It is based on the Bellman-Ford algorithm to calculate the optimal path. [1] [2]

2. Metrics and Routing

The route cost can be estimated based on metric parameters of the path. To determine the best path among all the available routes, routing protocols select the route with the smallest metric value (or cost).Every routing protocol has its own metric calculation.[3]There are many scenarios where routing protocols find more than one route to the same destination. To select the most suitable between the accessible paths, routing protocols should be able to estimate and select between these paths. Therefore, for this goal, many metrics are used. A metric is a value appropriated by the routing protocols to attach a cost to arrive at the destination or remote network. When there are multiple paths to the same destination, metrics are used to determine the best path.. [4]

Routing Information Protocol:

The routing information protocol (RIP) is one of the basic and simplest forms of distance vector routing protocol being implemented today. This protocol is available in two versions: RIPv1 (RFC 1058)[5] and RIPv2 (RFC 1723)[6]. However, we will be discussing the newest version (RIPv2) since the older version is not a classless routing protocol and does not support variable length subnet masks (VLSM) for the network entries available in the routing tables. RIPv2 emerges with all the features available in RIPv1 and contains some extra features such as update authentication, multicasting and etcetera along with backward compatibility.

Routing Information Protocol (RIP) is a distance vector routing protocol that measures its metrics by counting the number of hops between source and destination nodes. RIP selects the minimum number of hops for reaching a destination. RIP allows a maximum hop count of 15 hops in a path, in the case of the hop count exceeding 15 hops for reaching a destination network, it is considered unreachable network. RIP updates its full routing table with its closest neighbors every 30 seconds, and the administrative distance in RIP is 120 [2].

1) RIPv2

RIPv2 is an improvement to the first RIP protocol produced in 1994.RIPv2 is additionally, a distance vector routing protocol but has some improvements to perform it further efficiently than RIPv1.AlthoughRIPv2 is more productive than RIPv1, it is not fitting for larger, more heterogeneous networks.

RIPv2 does the identical routing metric as RIPv1, hop count. Hop count is the number of routers among a source and destination.RIPv2 also has the equivalent hop count frontier as RIPv1.If a route has higher than 15 hops, the route will be ignored as unreasonable.

a) **Routing Updates**

Updates with RIPv2 are sent through multicasts and not broadcasts like the original RIP protocol. The multicasts are sent utilizing a multicast address of 224.0.0.9. This helps limit RIP routing table advertisements from being processed by every system on the network. Only systems that listen to the multicast address of 224.0.0.9 will process the updates.

RIPv2 can similarly be configured to create classless routing. When configured for classless routing, RIPv2 will carry submit masks when it transfers routing updates. This grants for the use of subnetting and discontiguous networks.

RIPv2 accepts for authentication to be needed for updates. While authentication is permitted, each router is configured with the RIP update password. The password transferred with the RIP update must meet the password configured on the target router. If the passwords seem not to match, then the receiving router will not process the update.[7]

ENHANCED INTERIOR GATEWAY ROUTING PROTOCOL:

Enhanced Interior Gateway Routing Protocols (EIGRP) is a CISCO proprietary protocol and it is an enhancement of the Interior Gateway Routing Protocol (IGRP).EIGRP was issued in 1992 as a more It is a popularly applied interior gateway routing protocol that uses the Diffusion Update Algorithm (DUAL) for computing routes .EIGRP is additionally known as a hybrid protocol because it has the characteristics of a link-state protocol for creating neighbor relationships and a distance vector routing protocol for advertising routes..[8]

Interior Gateway Routing Protocol (IGRP) is based on a distance vector routing protocol, and IGRP handles maximum hop count up to 255 hops, where 100 is a default hop count in IGRP.IGRP sends a full routing table every 90 seconds, and the official distance of IGRP is 100, and IGRP uses bandwidth, delay, reliability, load, and maximum transmission unit (MTU) in its metric, where bandwidth and delay are the default enhanced Interior Gateway Routing Protocol(IGRP) [9].

Enhanced Interior Gateway Routing Protocol (EIGRP) is an enhancement of IGRP that uses a distribution update algorithm instead of hop count compared with IGRP to select the optimal path among source and destination nodes. The standard distance used by EIGRP is 170 for external routes outside the local AS and 90 for routes originating within the local AS.EIGRP is a follower to the IGRP consequently they are fit in their performance, where the applied metric in one protocol can be interpreted into the metrics of the other protocol .EIGRP sends updates only when changes executed, and the only changes part are transferred, not the entire routing table. This will begin rapid convergence and reduce the load of the routing protocol [10].

OPEN SHORTEST PATH FIRST

Open Shortest Path First (OSPF) is a link state routing protocol which was initially developed in 1987 by the Internet Engineering Task Force (IETF) working group of OSPF [3]. In RFC 1131, OSPF v1 specification was published in 1989. The second version of OSPF was released in 1998 and published in RFC 2328 [3].

OSPF allows sets of networks to be grouped together. Such grouping is called an area. The topology of an area is hidden from the rest of the Autonomous System. This information hiding enables a significant reduction in routing traffic. Also, routing within an area is determined only by its (the area's) own topology, lending the area protections from bad routing data. An area is a generalization of an IP sub-netted network.

A link-state routing protocol is based on Dijkstra's algorithm to determine the optimal path between source and destination nodes. Open Shortest Path First (OSPF) and Intermediate System to Intermediate System (IS-IS) are a link-state routing protocol. OSPF is systematized by the Internet Engineering Task Force (IETF) as an interior gateway protocol. The OSPF is designed to support large networks efficiently. OSPF protocol is used to find the optimal for the information to reach an appropriate destination. OSPF uses cost as its metric, which is computed based on the bandwidth of the link. OSPF has no hop-count limit and its administrative distance is 110, it supports the classless protocol. OSPF advertises the status of directly connected links using Link-State Advertisements (LSAs). OSPF sends updates (LSAs) only to the part that has changed and only when a change has taken place. LSAs are additionally renewed every 30 minutes. [11]

3. PERFORMANCE METRICS

There are several metrics to analyze routing protocols over Riverbed Modeler. Delay, throughput, and convergence duration as performance metrics can supply us a wide aspect of how a given routing protocol over different networks topology behaves and we can recover from that whether the protocol is proper for the topology or not, with this we will also determine there are different metrics to examine routing protocols over Riverbed Modeler. Delay, throughput, and convergence duration as performance metrics can give us a wide view of how a given routing protocol over different network topology behaves and we can retrieve from that whether the protocol is suitable for the topology or not, with this we will also discover 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[12].

Throughput: is the average of successfully delivered packets (messages) per unit of time (seconds) through a communication channel. In computer networks, throughput is measured in bits per second and some situations in data packets per second[13][14].

Convergence: duration is the time in which a group of routers reaches 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 a quick convergence time. It is measured by the rate per second[15][16].

4. SIMULATION STUDY AND ANALYSIS

This section will also discuss the results obtained from simulating the scenario in this paper, so we analyze and compare the simulation results for the proposed scenarios, and then decide on the scenarios in terms of the appropriate applications for each scenario.

Further, in this part, topologies have been used to configure various protocols and simulation parameters. The following stage presents the obtained simulation results and compares the performance of the three routing protocols in order to compare RIP, OSPF, and EIGRP. As shown in figure1.

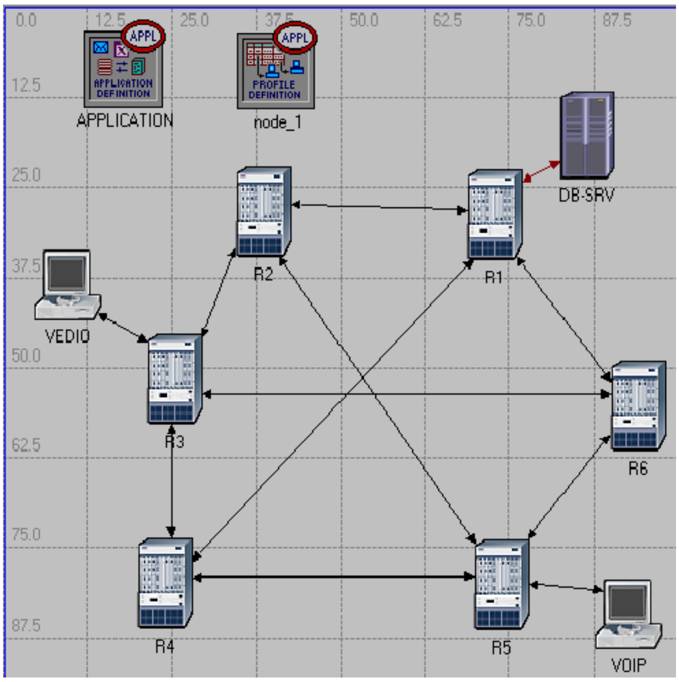

Figure 1. Simple Mesh Topology.

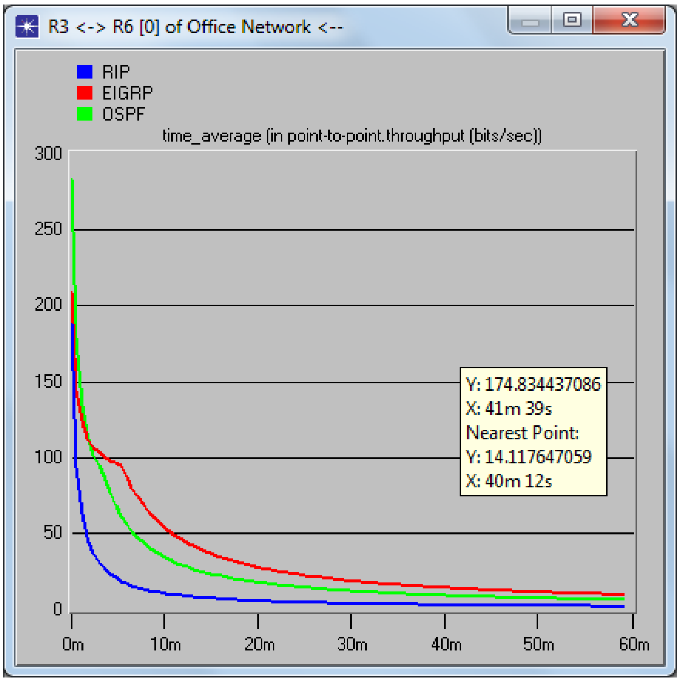

Figure 2. Point to point throughput bits/sec.

From the above observation and the study of the comparisons, it has been noticed that EIGRP has faster throughput than RIP while OSPF has the fastest throughput among them in all the stages.

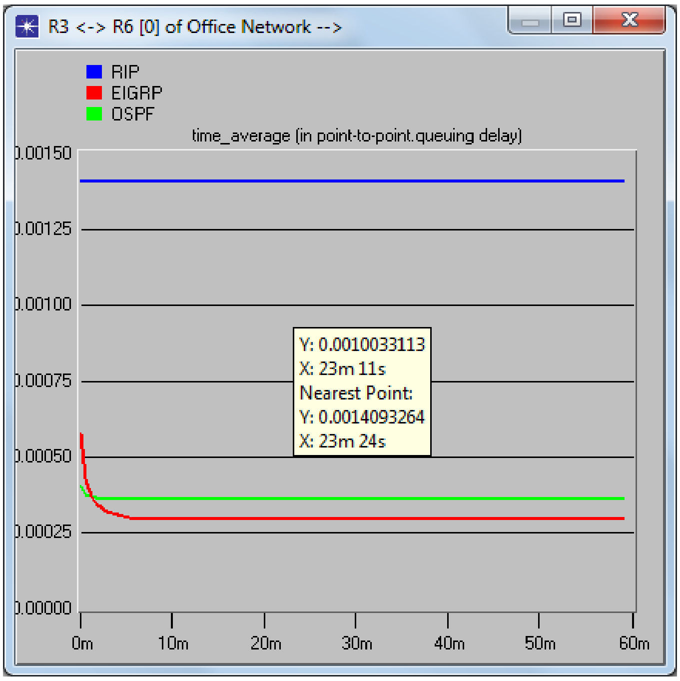

Figure 3. Queuing delay.

From the study of the above diagram, RIP is the highest in queuing delay while in the beginning EIGRP had higher queuing delay than OSPF however; it gradually declined and became the least in terms of queuing delay.

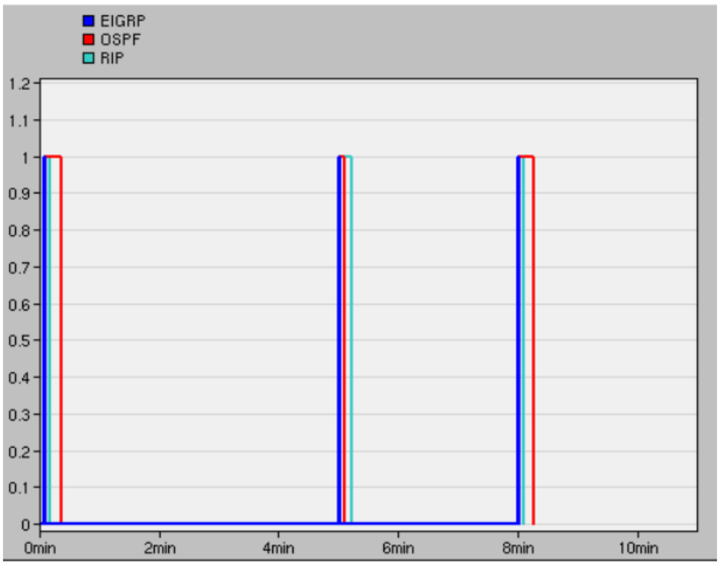

Figure 4. Convergence Activity.

From the comparison of the convergence activity, EIGRP has the fastest convergence in all the stages while OSPF has a faster convergence time than RIP.

5. References

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