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Simulation of routing protocols

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Abstract: A reliable, secure and scalable communication platform relies on correct combination of protocols. This project is all about routing protocols. Basically routing is useful for communication and disseminating information among the routers. Routing protocols are used for selecting best path for transferring data in a network. Here different types routing are presented and a comparative study has been done regarding the characteristic of each routing protocols. This to find out best protocols combination for any complex network for achieving fast and reliable communication. Routing protocols were created for routers. These protocols have been designed to allow the exchange of routing tables, or known networks, between routers. There are a lot of different routing protocols, each one designed for specific network sizes. The router learns about remote networks from neighbour routers or from an administrator. The router then builds a routing table. If the network is directly connected then the router already knows how to get to the network. If the networks are not attached, the router must learn how to get to the remote network with either static routing (administrator manually enters the routes in the router's table) or dynamic routing (happens automatically using routing protocols like EIGRP, OSPF etc.).

The routers then update each other about all the networks they know. If a change occurs e.g. a router goes down, the dynamic routing protocols automatically inform all routers about the change. If static routing is used, then the administrator has to update all changes into all routers and therefore no routing protocol is used. Statically programmed routers are unable to find routes, or send routing information to other routers. They send data over routes defined by the network Admin.

A Stub network is so called because it is a dead end in the network. There is only one route in and one route out and, because of this, they can be reached using static routing, thus saving valuable bandwidth.

A router is a system that sends data packets among computer networks. This makes an overlay online work, as a router is linked to two or a lot more data lines from various systems. When a data packet arrives in one of the lines, the router flows the address details in the packet to identify its greatest desired destination. Then, utilizing information and facts in its routing scheme, it guides the packet to the following network on its journey. Routers execute the targeted traffic directing functions on the World Wide Web. A data packet is generally submitted from one router to a different by means of the networks that comprise the internet function till it actually reaches its location node.

A routing protocol identifies how routers connect with each other, distributing details that make it possible for them to choose routes among any two nodes on a computer network.

KEYWORDS: **Introduction, Research Methodology,Simulation Scenarios, Result and Conclusion**

I. INTRODUCTION

The primary purpose of routing protocols is to deliver packets from source to destination. To quickly adapt changes which occur in network the routing protocol uses various algorithm, process and message. The characteristic of routing protocols are:

Correctness: The routing should be done properly and correctly so that the packets may reach their proper destination.

Simplicity: The routing should be done in a simple manner so that the overhead is as low as possible. With increasing complexity of the routing algorithms the overhead also increases.

Robustness: Once a major network becomes operative, it may be expected to run continuously for years without any failures. The algorithms designed for routing should be robust enough to handle hardware and software failures and should be able to cope with changes in the topology and traffic without requiring all jobs in all hosts to be aborted and the network rebooted every time some router goes down.

Stability: The routing algorithms should be stable under all possible circumstances.

Fairness: Every node connected to the network should get affair chance of transmitting their packets. This is generally done on a first come first serve basis.

Optimality: The routing algorithms should be optimal in terms of throughput and minimizing mean packet delays. Here there is a trade-off and one has to choose depending on his suitability.

II.RESEARCH METHODOLOGY

The various key points involved in the research work are discussed in this section. Various methods are compared with each other and the justification of chosen method is given in this section. Three methods are available for performance evaluation of protocols in a network which include mathematical or analytical analysis, direct measurement and computer simulation. After taking all the constraints and parameters under consideration mathematical and computer simulation are suitable for ourresearch.There are various advantages of mathematical analysis like cost, time and the ability of providing best predictive results. The direct measurement as a choice of method could be expensive but an alternative to simulation. In direct measurement the analysis is to be done on an operational network which can lead to disruptive situation and an operation network could be very expensive in terms of configuration complexity. The advantage of direct measurement is fairly accurate results. There are various simulators like NS-2, NS-3, Qual net, Telnet, Omnet++ ,OPNETetc. In order to do simulation work, the simulator was to be chosen suitably. The suitable choice after keeping many considerations was OPNET simulator introduced by the OPNET Technologies Inc. OPNET modeller is an object oriented and discrete event system (DES) based network simulator. The discrete event system is a widely used efficient simulation tool and well known for its efficient performance and reliability.

II. SIMULATION RESULTS

OPNET Modeller 14.5 has been used for the simulation analysis. This section describes the architecture of the network and how the four protocols are implemented on this network model. Four network scenarios have been designed as follows, which will be elaborately demonstrated in the upcoming sections. Scenario 1 is modelled as a, Base line scenario for OSPF protocol. Scenario 2 is modelled as a Baseline scenario for RIP protocol. Similarly scenarios 3 and 4 are modelled for IGRP and EIGRP protocols respectively. In the network model, we will be using five Cisco 7000 routers and two PCS (Work stations), Application Config, Profile Config and Link Failure component. In order to study the results from other scenarios (1,2,3 and 4), a baseline network model comprising of five Cisco 7000 routers connected with each other via ppp_ds3links and two Ethernet work stations. The two PCS in our network are the videoconferencing workstations

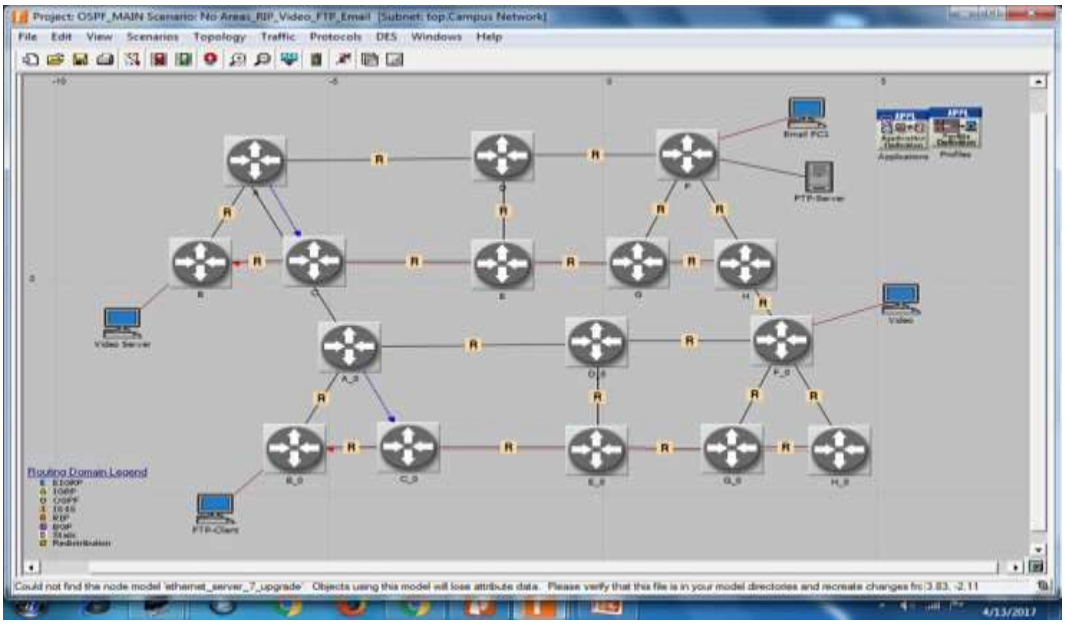

Figure 1: Simulation of RIP Network

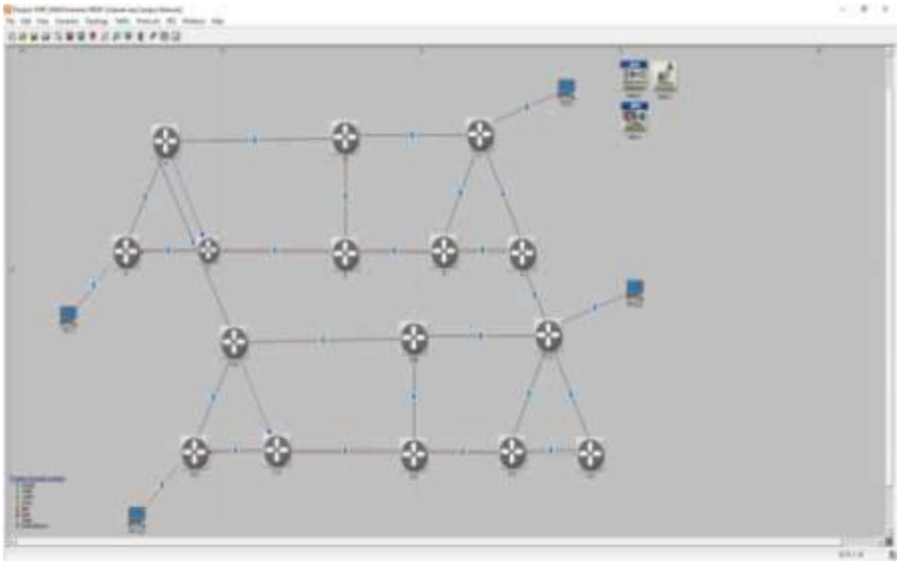

Figure 2: Simulation of IGRP Network

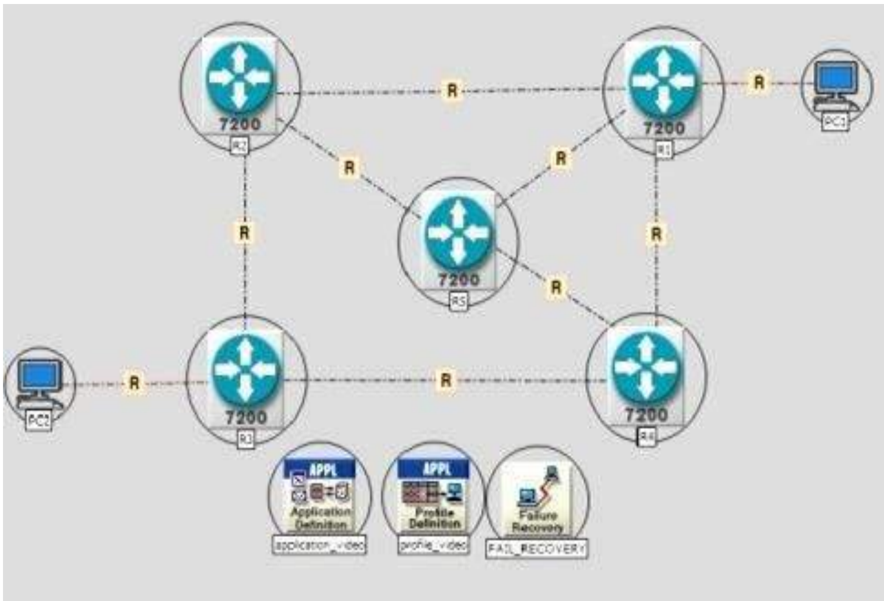

Figure 3: Simulation of RIP Network simple scenario.

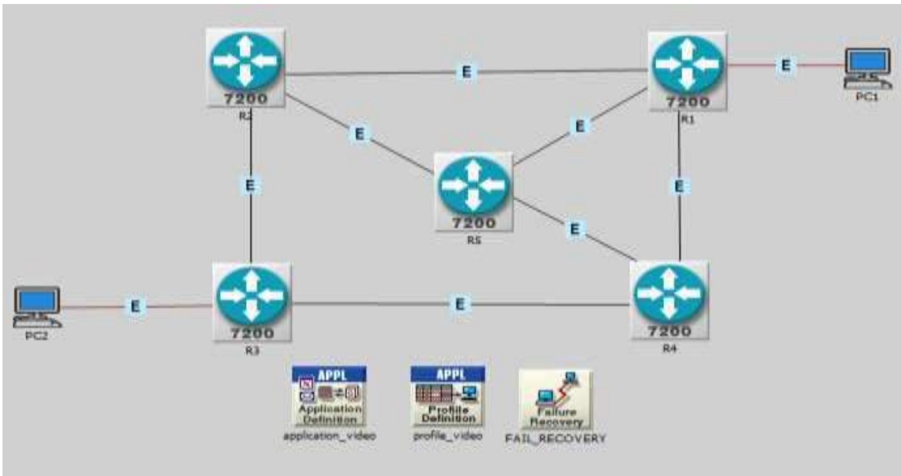

Figure 4: Simulation of EIGRP Network simple scenario.

III. RESULTS

We have analyzed the performance of protocols namely RIP, IGRP, OSPF and EIGRP respectively over a network with different situations and on simulating the network for15 minutes in case of situation 1 and for 6 minutes in case of situation 2, we have analyzed the performance in terms of convergence of RIP, IGRP, EIGRP and OSPF respectively.

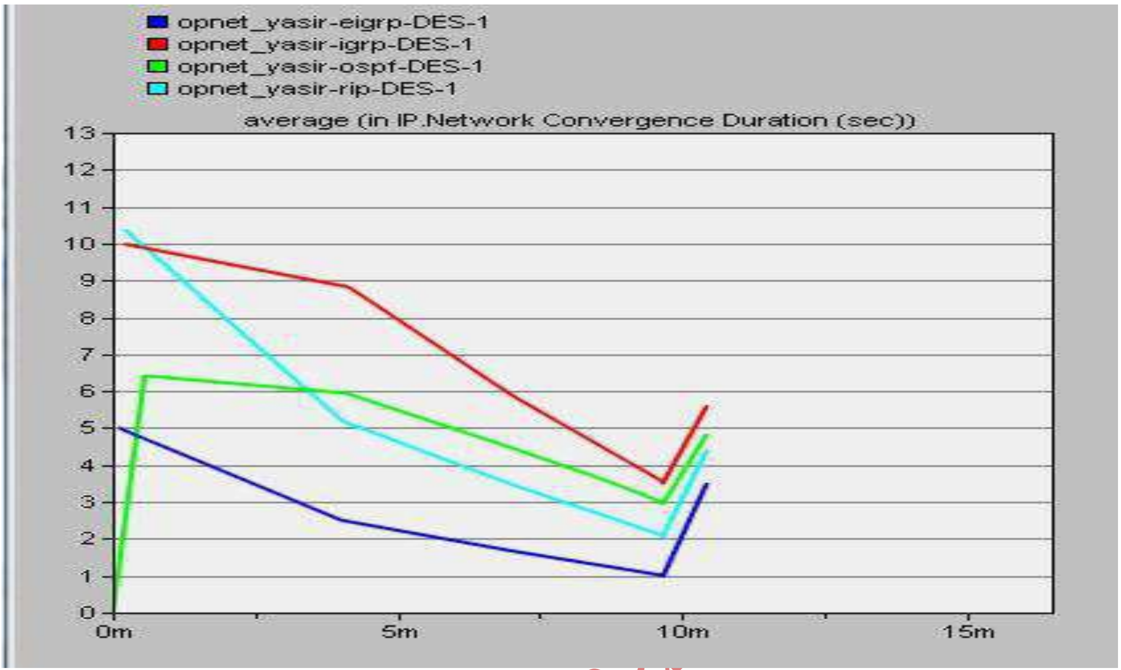

Figure 4: convergence after simulation

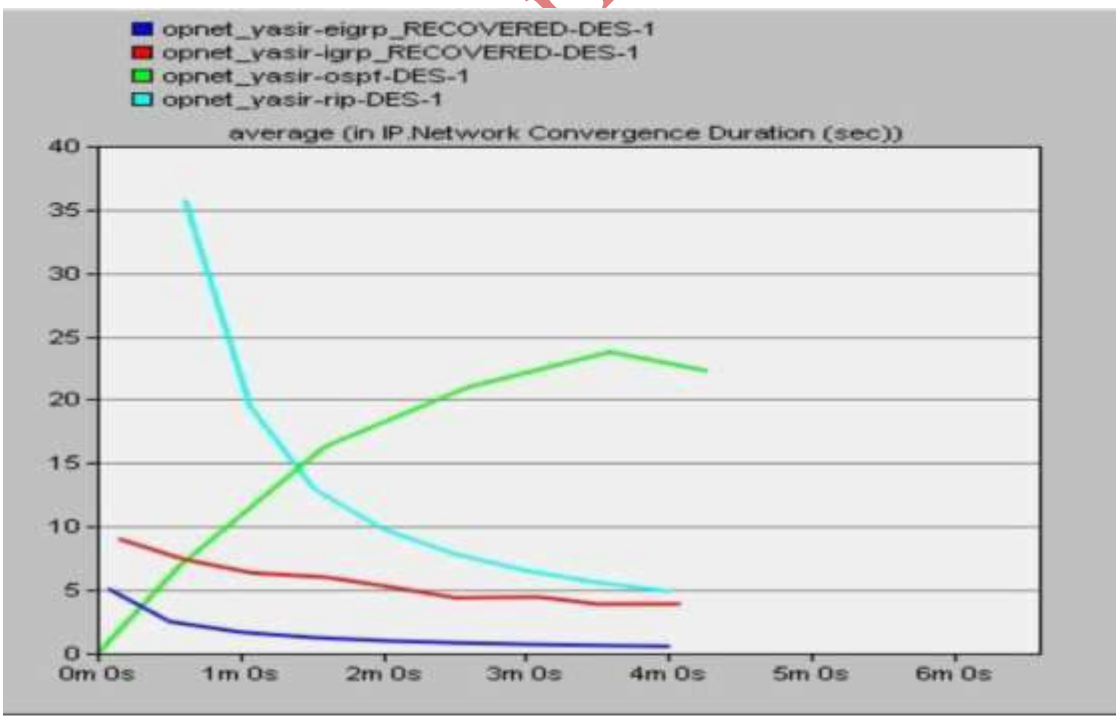

Figure 5: Simulation of IGRP Network convergence after simulation

Network traffic:Network traffic or data traffic is the amount of data moving across a network at a given point of time. Network data in computer networks is mostly encapsulated in network packets, which provide the load in the network. Here Network traffic for both OSPF and RIP network has been calculated.

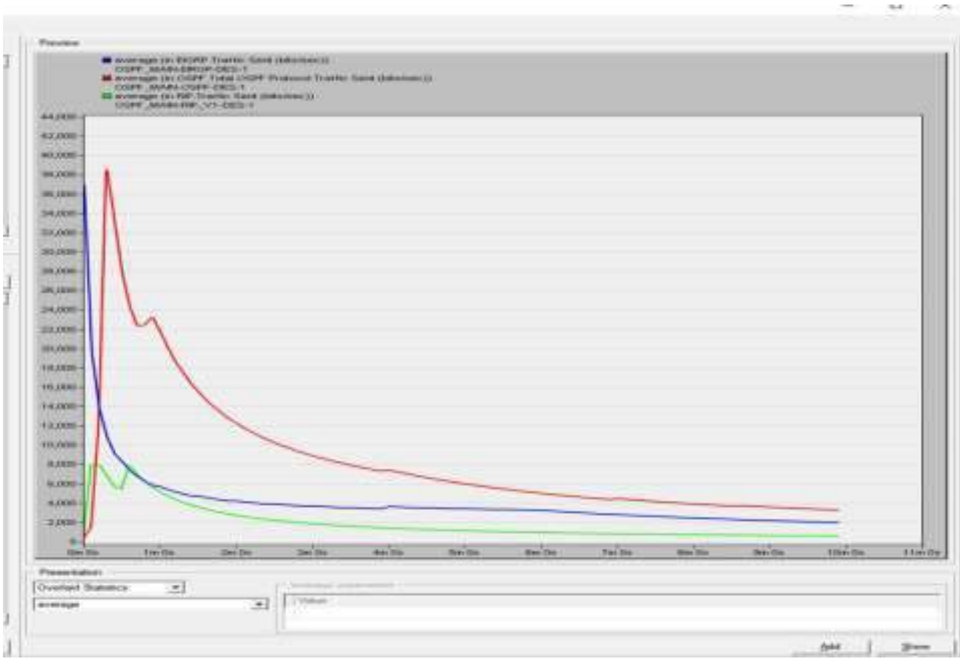

Figure 6: maximum traffic transferring rate after simulation of IGRP ,RIP and OSPF

Convergence:

Convergence time is a measure of how fast a group of routers reach the state of convergence. It is one of the main design goals and an important performance indicator for routing protocols to implement a mechanism that allows all routers running this protocol to quickly and reliably converge. Of course, the size of the network also plays an important role, a larger network will converge slower than a small one.

RIP is a routing protocol that converges so slowly that even a network of a few routers can take a couple of minutes to converge. In case of a new route being advertised, triggered updates can speed up RIP's convergence but to flush a route that previously existed takes longer due to the hold-down timers in use. OSPF is an example of a fast-converging routing protocol. A network of a few routers can converge in a matter of seconds.

Certain configuration and hardware conditions will prevent a network from ever converging. For instance, a "flapping" interface (an interface that frequently changes its state between "up" and "down") might cause conflicting information to propagate the

Network so that routers never agree on its current state. Under certain circumstances it might be desired to withhold routing information details from parts of the network via route aggregation, thereby speeding up convergence of the topological information shared by all routers.

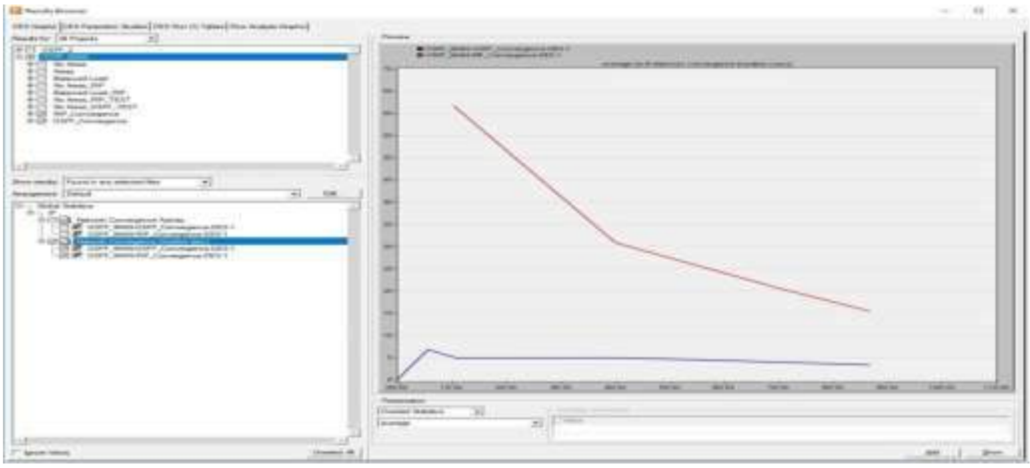

Figure 7: convergence time after simulation of RIP and OSPF

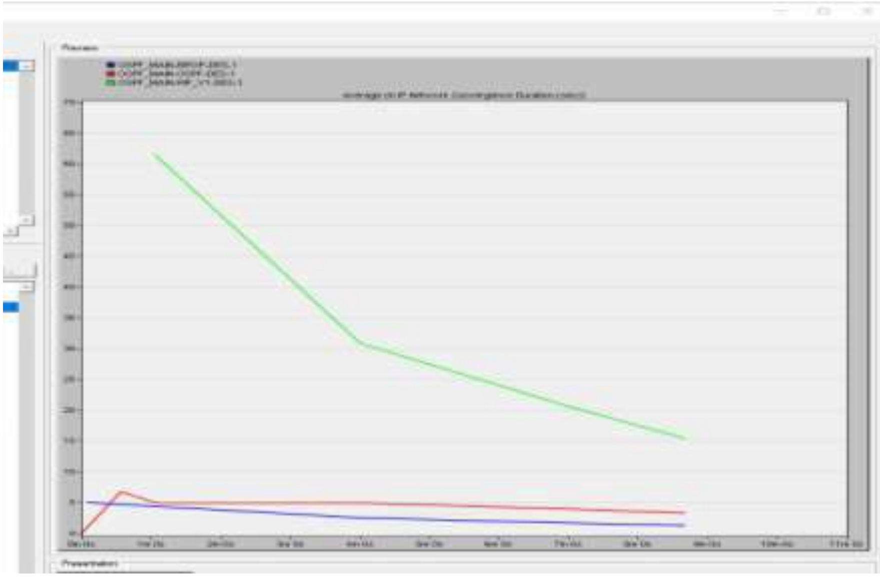

Figure 8: convergence time after simulation of RIP , OSPF and IGRP

In the above figure convergence time of OSPF and RIP has been calculated. Clearly we observe that RIP can take more time to come across a failure compare to OSPF and EIGRP

Hop count:

The hop count refers to the number of intermediate devices (like routers) through which data must pass between source and destination, rather than flowing directly over a single wire. Each router along the data path constitutes a hop, as the data is moved from one Layer 3 network to another. Hop count is therefore a basic measurement of distance in a network.

Hop count is a rough measure of distance between two hosts. A hop count of n means that n gateways separate the source host from the destination host. By itself, this metric is, however, not useful for determining the optimum network path, as it does not take into consideration the speed, load, reliability, or latency of any particular hop, but merely the total count. Nevertheless, some routing protocols such as RIP use hop count as their sole metric.

Each time a capable device receives these packets, that device modifies the packet, incrementing the hop count by one. In addition, the device compares the hop count against a time to live limit and discards the packet if its hop count is too high. This prevents packets from endlessly bouncing around the network in the event of routing errors. Routers are capable of managing hop counts, but other types of intermediate devices (e.g. hubs and bridges) are not.

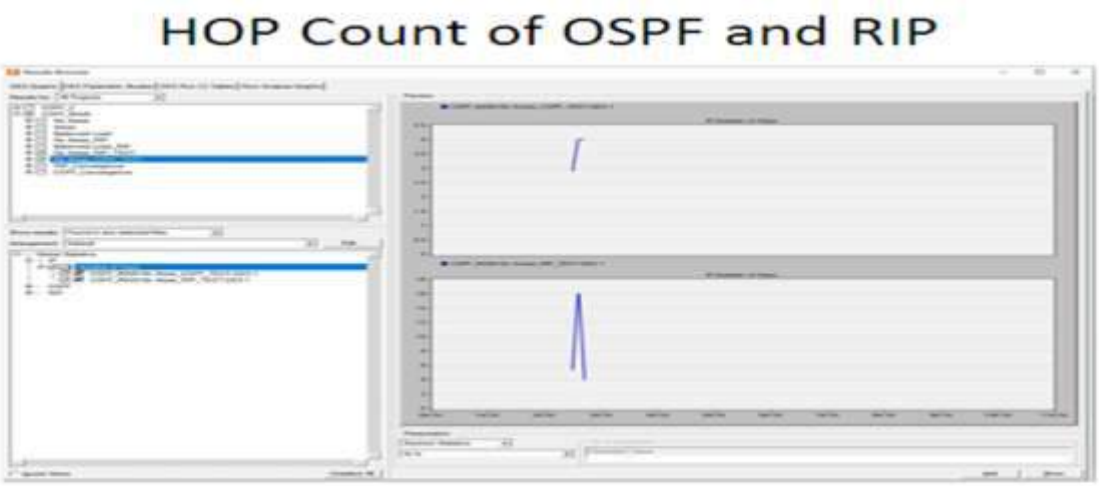

Figure 9: HOP count OSPF and RIP

Figure 10: HOP count of OSPF, RIP and EIGRP

In the above figure it has been observed that maximum number of hop count in RIP is 15.After that data packet cannot be reached to the next node but in OSPF the hop count is not limited to 15.so it is superior than RIP.

Load Balancing:

Network load balancing is the ability to balance traffic across two WAN links without using complex routing protocols like BGP.This capability balances network sessions like Web, email, etc. over multiple connections in order to spread out the amount of bandwidth used by each LAN user, thus increasing the total amount of bandwidth available. For example, a user has a single WAN connection to the Internet operating at 1.5Mbit/s. They wish to add a second broadband (cable, DSL, wireless, etc.) connection operating at 2.5Mbit/s. This would provide them with a total of 4Mbit/s of bandwidth when balancing sessions.

Session balancing does just that, it balances sessions across each WAN link. When Web browsers connect to the Internet, they commonly open multiple sessions, one for the text, another for an image, another for some other image, etc. Each of these sessions can be balanced across the available connections. An FTP application only uses a single session so it is not balanced; however if a secondary FTP connection is made, then it may be balanced so that on the whole, traffic is evenly distributed across the various connections and thus provides an overall increase in throughput.

Additionally, network load balancing is commonly used to provide network redundancy so that in the event of a WAN link outage, access to network resources is still available via the secondary link(s). Redundancy is a key requirement for business continuity plans and generally used in conjunction with critical applications like VPNs and VoIP.

Finally, most network load balancing systems also incorporate the ability to balance both outbound and inbound traffic. Inbound load balancing is generally performed via dynamic DNS which can either be built into the system, or provided by an external service or system. Having the dynamic DNS service within the system is generally thought to be better from a cost savings and overall control point of view.

When a router learns multiple routes to a specific network via multiple routing processes (or routing protocols, such as RIP, RIPv2, IGRP, EIGRP, and OSPF), it installs the route with the lowest administrative distance in the routing table. Refer to Route Selection in Cisco Routers for more information.

Sometimes the router must select a route from among many learned via the same routing process with the same administrative distance. In this case, the router chooses the path with the lowest cost (or metric) to the destination. Each routing process calculates its cost differently and the costs may need to be manipulated in order to achieve load-balancing.

If the router receives and installs multiple paths with the same administrative distance and cost to a destination, load-balancing can occur. The number of paths used is limited by the number of entries the routing protocol puts in the routing table. Four entries is the default in IOS for most IP routing protocols with the exception of Border Gateway Protocol (BGP), where one entry is the default. Six different paths configured is the maximum number. The IGRP and EIGRP routing processes also support unequal cost load-balancing. You can use the variance command with IGRP and EIGRP to accomplish unequal cost load-balancing. Issue the maximum-paths command in order to determine the number of routes that can be installed based on the value configured for the protocol. If you set the routing table to one entry, it disables load balancing. Refer to How Does Unequal Cost Path Load-Balancing (Variance) Work in IGRP and EIGRP? for more information about variance.
You can usually use the show ip route command to find equal cost routes. For example, below is the show ip route command output to a particular subnet that has multiple routes. Notice there are two routing descriptor blocks. Each block is one route. There is also an asterisk (*) next to one of the block entries. This corresponds to the active route that is used for new traffic. The term 'new traffic' corresponds to a single packet or an entire flow to a destination, depending on the type of switching configured.

IV. CONCLUSION AND FUTURE WORK

Based on the simulation results and recorded values, it can be concluded that EIGRP and OSPF are the best combination of protocols for a given network with about1000 hosts. However, combinations EIGRP and RIPv2would be better suited for a smaller network because of the absence of segmented areas. IS-IS has been known as the best protocol for ISP's and really large enterprises because of its scalability, fast convergence and added the advantage of not needing IP connectivity to be able to communicate with neighbors. The results also show that it communicates well with OSPF, due to their similarities. Therefore, the combination of the two protocols would be better than configuring only 1 of them for any given scenario with complex parameters. As a key component in enabling Internet routing worldwide, the BGP routing table is an important aspect that needs to be very carefully monitored. Although GLBP is not actually a new protocol, it is not very popular because of its operational cost and traffic allocations. Although HSRP has-been the most popular choice because of its ease of use, it does not efficiently utilize all available links. As a result, more resources are wasted. GLBP provides a solution to this wastage of resources by utilizing all available links, which ideally eliminates the need for HSRP. This means, a single load balancing router can handle and utilize multiple virtual redundant links.

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