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Review Paper on Comparison of RIP, OSPF and EIGRP Protocols Using Simulation

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ABSTRACT:-Routing plays important role in internet communication and it is based on routing protocols, now a day's many routing protocols exist, among these routing protocols most famous are RIP (Routing information protocol) and OSPF (Open shortest path first). In this research work we analyze the performance of these protocols in term of their convergence, traffic, CPU utilization by changing special parameters within network. Cisco Packet Tracer simulation tool is used to design the network; analysis of the results is examined using standard tools.

Keywords: *OSPF, RIPv2, EIGRP Performance Analysis.*

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1. INTRODUCTION

Communication is a method of sharing information to each other. Thousand years back, sharing information was very complicated. In early life of mankind man and women used body language and speech for talk to each other, but inventions made it easy for the people to communicate with each other very easily. In a petite time, mankind developed a rules and languages to communicate with each other. Combination of these rules and languages are called protocols. Now a day's telephone, internet, is use to communicate with each other. Inventions became very essential that life without them is stiff. Today the communication between computers has increased and it is poignant the heights of sky. Users sitting in one place of word can communicate to other place of the word by using a variety of communication channels. Most important aspect of communication is routing and routing is done by routing protocols. In this research we study two different routing protocols OSPF and RIP in detail; we collect compare and analyze the performance of RIP and OSPF in term of their convergence, time, CPU utilization, and network traffic.

2. ROUTED PROTOCOLS

When data are send from one location which is normally one network to other location routed term is used Routed protocols are network layer protocols it uses to move traffic among networks. Example of routed protocols are IP, IPX, AppleTalk, Telnet, RPC, SNMP, SMTP, Novell, IPX, OPI networking protocol, Decent, AppleTalk, Banyan Vines, Xerox Network System (XNS). These protocols are used to communicate between different networks.

3. DYNAMIC ROUTING

Dynamic routing means destination is decided at the run time. In dynamic routing, routing information is share with other routers. Dynamic routing protocols learn route automatically by neighbor routers. Because in autonomous system (AS) neighbor routers send route information to each other. Router choose best path, hop number and delay, in dynamic routing link cost depend on bandwidth. Updated values send to other routers. It is very easy for network administrator for maintaining and configuring routes in dynamic routing. Dynamic routing protocols have some disadvantages like routing loops, short time. Dynamic routing protocols have the capability to maintain the network operation in case of a failure or when the network configuration topology change.

3.1 ROUTING INFORMATION PROTOCOL(RIP)

RIP routing information protocol is known as dynamic routing protocol. There are two versions of RIP version 1 and version 2, but no days we are only using version 2 because version 1 does not support VLSM and version 1 also do not send the complete routing information. RIP has four timers- the Update timer, Invalid timer, Hold timer and the Flush timer. It sends the Hello message at every 30 seconds to its neighbor routers. RIP uses multicast address 224.0.0.9 for sending its routing information to other routers. By default, its AD value is 120. It also supports auto summarization so if we are configuring VLSM so we have to set "no auto-summary" command in the router. The metric of RIP is "Hop count" i.e. it selects best path on the basis of hop count. It provides limited hop counts from 0 to 15. We only use RIP within the small networks.

3.3 OPEN SHORTEST PATH FIRST (OSPF)

Among routing protocols OSPF is very famous IGRP (interior gateway routing protocol) category. OSPF is based on link state routing. It uses Dijkstra algorithm to determine the route to reach each destination. It is a non-proprietary routing protocol. OSPF also support VLSM (variable length subnet mask) or CIDR (class inter domain routing). It works on the basis of area and the range of areas are between 0 to 65535, area 0 is known

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as Backbone area and all other areas are known as Standard areas. OSPF uses two multicast address 224.0.0.5 and 224.0.0.6 for sending and receiving updates. By default, is sends HELLO message at every 10 seconds and its dead interval is 40 seconds. OSPF uses protocol number 89 and by default its AD value is 110. It has no hop count limit. OSPF also uses the process ID and if two ospf areas have to communicate with each other than the process ID must be same, the range of process ID is between 1 to 65535. By default, it supports 4 paths having equal cost and supports only manual summarization. In OSPF configuration first we have to provide the process ID and then we have to provide the wild card mask along with network and area number. OSPF has two states one is Down-it says about something wrong is configured and other is Init- it is given after receiving hello message form neighbor router.

3.2 Enhanced Interior Gateway Routing Protocol (EIGRP)

EIGRP is Hybrid protocol which have both distance vector & has link-state protocol characteristics. EIGRP supports Variable-Length Subnet Masking (VLSM). EIGRP sends partial route updates only when there is a metric changes or the network changes. EIGRP does not send full routing-updates in periodic-fashion as like distance vector protocol do. EIGRP support for authentication, only routers with same authentication can communicate with each other. EIGRP Uses DUAL algorithm for loop-prevention and provide the fast convergence, which is easy to configure. Enhance interior Gateway routing by default, supports equal-cost load balancing. EIGRP also support unequal cost load-balancing using the command variance. With variance command EIGRP includes routes that are equal to or less then n times the minimum metric-route to a destination. EIGRP uses the administrative distance of 90 for internal routes and 170 for external routes, and where as '5' for EIGRP-summary routes. EIGRP is potential routing-protocol for the core of a network and it can be used in large networks. When designing a network with Enhance interior Gateway routing protocol, remember that it supports VLSMs, CIDR, and network summarization Also EIGRP is not limited to 16 hops as RIP and not broadcasts its routing table. You can use EIGRP for large networks. When we use EIGRP for network. EIGRP can Integrates seamlessly with IGRP like auto redistribution of Routes with IGRP and vice versa. EIGRP consumes less bandwidth as there is no extra broadcasts, periodic updates. As EIGRP advertises its routing updates to its neighbors like distance vector do, but EIGRP uses hello packets and forms neighbor-relationships as link-state do. EIGRP sends partial updates when a metric or the topology changes on the network. It does not send full routing-table updates in periodic fashion as do distance-vector protocols. EIGRP supports IP, Internetwork Packet-Exchange(IPX), and Apple-Talk routed protocols. Enhance interior Gateway routing protocol discovers / maintains information about its neighbors. It multi-casts hello packets to address 224.0.0.10 on every 5 seconds. Using this router builds a table with EIGRP neighbor information. The hold-down time to maintain a neighbor is three times the hello time: 15 seconds. If the router does not receive a hello in 15 seconds, it removes the network from the routing table. EIGRP sends multicasts hellos on every 60 seconds in WAN interfaces using X.25, Frame Relay and ATM. The neighbor hold-down time is 180 seconds for these types of neighbors. EIGRP uses Reliable Transport protocol to manage EIGRP packets, which ensures the delivery of EIGRP-route updates and also uses sequence numbers to ensure ordered delivery. EIGRP implements DUAL to selects a best path and a backup best-path to reach a destination. The best path is called successor, and the backup path is called feasible successor. EIGRP uses 5 types of packets i.e. hello, Acknowledgment, Update, Query and Reply.

4. CONVERGENCE

Convergence is broad term which has several meanings but according to the network convergence, means that in an internet work all routers have same topological information about their network. When routers start convergence they collect topological information for other routers through implemented routing protocol. One important thing is that this information is not contradicted on the real time information available in network. We Find out real state of network by using this information. Converged network is defined as "It is a network in which all routers know that what type of topology is running and according to the topology they share packets to each other."

4.1 Convergence Time

Time that is required for the routers to learn routes of entire inter network is called convergence time. Convergence time is very important thing because this time tells researchers when some network goes in failure condition that how much time it takes to come in normal condition.

4.2 Convergence Process

At the start of routing when routing enables topological information of inter network interaction between routers. This process is very important for sending, receiving information this type of information is required depends upon routing protocols like, RIP, OSPF, EIGRP.

5. SIMULATION

Simulation is a software package in which we predict the behavior of network, and we have no need of actual network. In simulation we set different parameters related to our network. Simulation of routing protocols is one of them. Simulation is not as real network but it is a standard for research purpose It provides environment like physical which is not possible in real. In real we cannot create 200 routers, 100 switches, 200 LAN nodes etc. but in simulation it is possible. Main advantage of simulation is that it gives you your results in Mathematical, and graphical form by using these graphs summarizes the research

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results. Another advantage of simulation is that any type of routing protocol like OSPF, EIGRP, RIPv2.

Simulate in any network the researcher wants. Simulation has three types, live simulations, Virtual simulations, Constructive simulations. Simulation is tool which provides a facility to draw a network which is copy of actual network and set different parameters for it and there is no need of real network

5.1 CISCO Packet Tracer SIMULATION

Packet Tracer is a cross-platform visual simulation tool designed by Cisco Systems that allows users to create network topologies and imitate modern computer networks. The software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface. Packet Tracer makes use of a drag and drop user interface, allowing users to add and remove simulated network devices as they see fit. The software is mainly focused towards Certified Cisco Network Associate Academy students as an educational tool for helping them learn fundamental CCNA concepts. Previously students enrolled in a CCNA Academy program could freely download and use the tool free of charge for educational use. Since August 2017 with version 7.1 is free to everyone.

5.2 SIMULATION METHODOLOGY

To understand Simulation, we had created network topology as shown in fig. 5.1

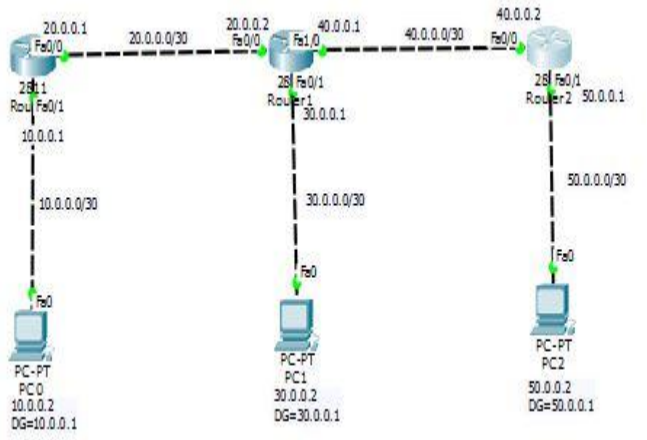

Fig.-(5.1) Overall view of network topology

In this research work we have been created six scenarios. These scenarios consist of one OSPF scenario and one RIP scenario and one EIGRP scenario, one scenario of redistribution between EIGRP and OSPF, One scenario of redistribution between OSPF and RIP. And one scenario of redistribution between RIP and EIGRP. Each router in scenario configures with OSPF and RIP protocols. Detail of network and configuration devices is as under. We have various series routers by Cisco. Ping parameters Application configuration, Profile configuration, Link failure utilities. allowing users to add and remove simulated network devices as they see fit. The software is mainly focused towards Certified Cisco Network Associate Academy students as an educational tool for helping them learn fundamental CCNA concepts. Previously students enrolled in a CCNA Academy program could freely download and use the tool free of charge for educational use Since August 2017 with version 7.1 is free to everyone. Software allows users to simulate the configuration of Cisco routers and switches using a simulated command line interface.

6. ROUTING PROTOCOLS

6.1 RIP

Figure (5.1) shows the detail structure of topology. Network topology design of RIPv2. In this topology the route from PC0 to PC2 go through router1 and router2 because in RIP protocol the packet goes through minimum hop count and in this topology the minimum hop-count from PC0 to PC2 goes through router0, router1 and router2.

RIPv2 is a very slow protocol compared to OSPF and EIGRP so in this topology it can take few seconds to send router information and connect. Here we are using version 2 of RIP along with VLSM, we have to give "no auto-summary command" if we are using VLSM in RIPv2 because RIP supports auto summarization.

How to configure RIPv2

```
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 10.0.0.0
Router(config-router)#network 20.0.0.0
Router(config-router)#exit
```

And if we are using VLSM than we have to configure "no auto-summary" also.

6.2 EIGRP

When we configure figure (5.1) EIGRP with this topology then we have seen here that the Packet from PC0 to PC2 go through the same route, EIGRP path selection is done on the basis of Bandwidth, Delay, Reliability, and Load. The EIGRP protocol is a very fast protocol then RIP and OSPF. It sends Hello message on every five seconds. In this scenario also we are VLSM. In EIGRP configuration we have to give the wild card mask and "no auto-summary" command if we are using VLSM.

How to configure EIGRP:

```
Router(config)#router EIGRP 10
Router(config-router)#network 10.0.0.0
Router(config-router)#network 20.0.0.0
Router(config-router)#exit
```

6.3 OSPF

When we configure OSPF protocol in this scenario, we have configured here the process id of OSPF is 10 and the area no is 0. We have used here VLSM also. Here we do not have to give the "no auto-summary" in ospf like RIPv2 and EIGRP. OSPF sends hello message to its neighbors at every 10 seconds and the hold-timer is 40 seconds which is faster than RIP but slower than EIGRP.

How to configure OSPF:

```
Router(config)#router OSPF 10
```

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Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20.0.0.0 0.255.255.255 area 0
Router(config-router)#exit

7. REDISTRIBUTION

Sometimes in the big scenarios we have to use many protocols at same time so in that case we have to use the Redistribution between protocols so that they can share their routing information with each other. Without Redistribution it's not possible that routers with different routing protocols can share their routing table with each other. We can only configure Redistribution on that router where both routing protocols are configured otherwise we cannot configure Redistribution.

There are two types of redistribution:

Internal Redistribution The redistribution with in the same protocols such as EIGRP with different AS numbers, we have to redistribute between both AS numbers so they can share their routing information with each other.

External Redistribution The redistribution between two different routing protocols such as redistribution between RIP and EIGRP or redistribution between RIP and OSPF or redistribution between OSPF and EIGRP.

Here we have considered three scenarios including Redistribution between RIP and OSPF, Redistribution between EIGRP and RIP and Redistribution between OSPF and EIGRP.

7.1 REDISTRIBUTION OF RIP AND OSPF

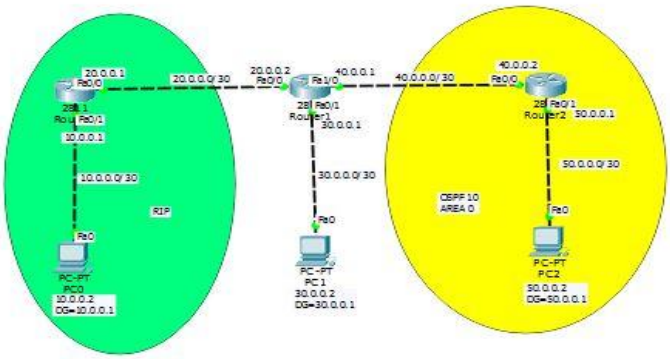

Fig.-(7.1) Network Topology of redistribution of RIP & OSPF

In this topology we have configured the RIP protocols on the Router0 i.e. on the green side, and the OSPF on the Router2 i.e. on the yellow side and Both RIPv2 and OSPF on the Router1 i.e. on the middle router.

Here we have to apply the redistribution on the middle router because both the protocols RIP and OSPF are configured on the middle router.

Configure Redistribution on this Topology:

First we have configured the RIPv2 on router0 and OSPF on router2 and OSPF and RIPv2 both on router1. Here we have also used VLSM in this topology.

Now we have to redistribute RIPv2 and OSPF so that they can share their routing information with each other.

Redistribute OSPF into RIP:

Router1(config)#router rip
Router1(config-router)#redistribute ospf 10 metric 2
Router1(config-router)#exit

Redistribute RIP into OSPF:

Router1(config)#router ospf 10
Router1(config-router)#redistribute rip metric 1 subnets
Router1(config-router)#exit

These are the commands which are used for configuration between OSPF and RIP.

7.2 Redistribution of RIP AND EIGRP

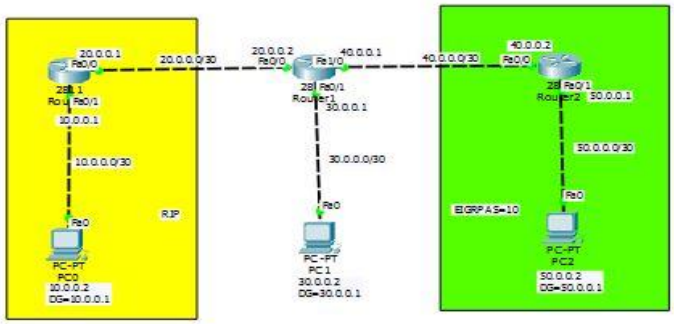

Fig.-(7.2) Network Topology of redistribution of RIP & EIGRP

In this topology we have configured RIP on the Router0 i.e. on the yellow side and EIGRP on the Router2 i.e. on the green side, and both RIP and EIGRP on the Router1, here we have used AS number 10 for EIGRP.

Now we have to configure redistribution on the Router1 so that the both protocols can share their routing table with each other.

Redistribute EIGRP into RIP:

Router1(config)#router rip
Router1(config-router)#redistribute eigrp 10 metric 1
Router1(config-router)#exit

Redistribute RIP **into EIGRP:**

Router1(config)#router eigrp 10
Router1(config-router)#redistribute rip metric 100000 100 255 1 1500
Router1(config-router)#exit

so these are the commands that are used for Redistribution process.

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7.3 REDISTRIBUTION BETWEEN EIGRP AND OSPF

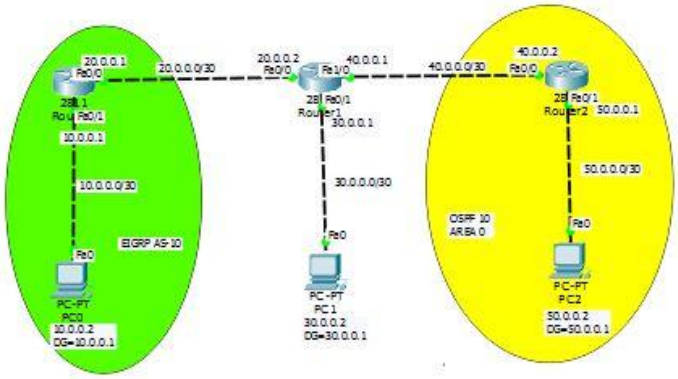

Fig.-(7.3) network Topology of redistribution of EIGRP & OSPF

Here we have configured EIGRP on the Router0 and OSPF on the Router2 and both RIP and EIGRP on the Router1 because Redistribution is done on the Router1 so we have to enable both the protocols on Router1. Hare we have used EIGRP AS number is 10 and the OSPF process-id is 10 and area number is 0.

Redistribute EIGRP into OSPF:
Router1(config)#router ospf 10
Router1(config-router)#redistribute eigrp 10 metric 2 subnets
Router1(config-router)#exit

Redistribute OSPF into EIGRP:
Router1(config)#router eigrp 10
Router1(config-router)#redistribute ospf 10 metric 100000 100 255 1 1500
Router1(config-router)#exit
So now this is the redistribution process, we are using this process because a company on more than one companies can communicate with each other with different protocols also, without redistribution it's not possible that two different protocols can share their routing table with each other so they cannot communicate with each other.

8. RESULTS AND ANALYSIS:

After implementation of RIP, EIGRP and OSPF on the same routers in the same scenario we have obtained the routing table and analyzing that routing tables are representing the protocols names along with its metric and AD value and the length time for any network is available in the routing table and their exit interface IP-address. We have also analyzed that RIP is only used with in the small networks and EIGRP is used for medium sized networks and OSPF is used for large networks.
And after the Redistribution of protocols in the same scenario the routing tables are advertising both the protocols with their connected networks and metrics. After redistribution two different protocols can share their routing table with each other and can communicate with each other. The redistribution Technique is used in the large network where two different protocols are enabled.

TABLE 8.1-COMPARISON OF RIP, EIGRP AND OSPF

BASICS FOR COMPARE	RIP	EIGRP	OSPF
KNOWN-AS	ROUTING INFORMATION PROTOCOL	ENHANCED INTERIOR GATEWAY ROUTING PROTOCOL	OPEN SHORTEST PATH FIRST
PROTOCOL TYPE	Distance vector Routing Protocol	Link State Routing Protocol	Hybrid Protocol
HOP COUNT LIMIT	15	By-default=100 but it can support up to 255	No Hop Count Limit
MULTICAST ADDRESS	224.0.0.9	224.0.0.10	224.0.0.5 224.0.0.8
ON ROUTING TABLE	Denoted by R in Routing Table	Denoted by D in Routing table	Denoted by O in Routing Table
ALGORITHM	Works on Bellman-ford Algorithm	Works on DUAL (Diffusing Update Algorithm)	Works on Dijkstra Algorithm
AD VALUE	By-default it is 120	By-default it is 90	By-default it is 110
SUMMARIZE	Auto	Auto	Manual
TYPES OF TABLE	It creates two tables in the router- ROUTING TABLE, TOPOLOGY TABLE	It creates three tables in the router- ROUTING TABLE, TOPOLOGY TABLE, NEIGHBOR TABLE	It creates three tables in the router- ROUTING TABLE, DATABASE TABLE, NEIGHBOR TABLE
METRIC	metric is "Hop-count"	matric is "Bandwidth and Delay"	metric is "Bandwidth"
USE	Small networks	Medium networks	Large Networks
VLSM SUPPORT	Yes	Yes	Yes
CONVERGE	Slow	Very Fast	Fast

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In the table comparison concludes various theoretical parameters such as Metric, Hop-Count, AD value, Limit of Hop-Counts, Tables in router, Multicast Address, Protocol type etc.

9. Conclusion and Future work

In this comparison between RIP, EIGRP and OSPF, we have considered many practical and theoretical aspects. After analyzing these protocols, it is concluded that RIP has very poor performance and OSPF has a moderate performance and EIGRP has a good performance as compared to RIP and OSPF.

In the networking era the technology is changing day by day and we can easily say that the future of networking is Network Automation that is done with the programming of Python and good Network knowledge. Network automation means performing the configuration, testing, analysis, troubleshoot, easily. Automation helps us to do a job more easily as compared to manual working on CLI (command Line Interface). Some of the popular networking tools are NS-2, NS-3 and OPNET.

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