A Practical Analysis Report of RIP, EIGRP, and an OSPF Dynamic Routing Protocol using the Network Simulator Tool GNS-3

Abrar Naeem Shah and Sandeep Kang

Department of Computer Engineering, Chandigarh University, Chandigarh, India

Abstract

Routing is crucial in internet "communication" and is based on routing protocols. The routing protocol outlines the rules that routers use to share information between a source and a destination. In contrast, they do not move data from a source to the destination, but instead update the routing table containing data or, as we say, messages or information. Many routing protocols are available today, but they all serve the same goal-static and dynamic routing protocols. Dynamic routing is carried out automatically. Topology-based updates are made to routers, and routing tables are updated when topology changes. As a part of this research study, we will look at and analyze the protocols along with other associated research of RIP, EIGRP, and OSPF. In this study, we provide a practical analysis report by designing and implementing numerous LAN topology scenarios using the emulator (Graphical Network Simulator-3). Because of the proliferation of enormous commercial networks; their design uses a variety of routing protocols. so that a large network can remain connected; Network routers are required to implement route redistribution. This research develops the three phases on the same designed network topology and assesses the presentation of route redistribution across three routing technologies. RIP, EIGRP is the first phase, EIGRP, OSPF is the second, and RIP, OSPF is the third. This research also analyses the compatibility of the two separate versions of routing information protocol on the designed network topology in order to assess how two versions may interact with one other. This offers us the notion that there is a way out of it when the same problem emerges associated to EIGRP, OSPF, or BGP if protocols, as we know, Version-1 and Version-2 do not interact to one other. In this research, we also design the network lAN architecture and setup by utilising GNS-3 in order to evaluate how rip supports merely subnetted networks and eigrp supports major networks.

Keywords

Redistribution, Route-Summarization, Compatibility, Dynamic Routing Protocol.

1. Introduction

A two-way process in which information or messages is conveyed from one person or group to another is what communication means. Sharing information or transmission and exchange of data is what communication implies. This process continues, with at least one sender and receiver passing messages on. Sharing information was exceptionally hard a thousand years ago. Communication has progressed over the years. People communicate today in a far different way than they did in the past. Until alphabets, signs, symbols, letters, and the telephone came along, communication was limited to one-to-one. Today, the internet era has paved the way for numerous sources of communication. There are rules that govern the efficient, dependable, and secure transmission of information via protocols. Routed protocols allow data to be routed. In the case of Routed protocols, an addressing scheme and subnetting are necessary. An addressing scheme detects which network a host belongs to and identifies that host on that network. Routed

protocols acquire routing information for networks with the use of routing protocols. They are used to communicate between network routers and give routing information. By knowing the networks connected to other routers, each router can choose the most effective route to send the traffic.

Routing Protocols are static and dynamic. Static routing means manually telling the router that if we want to communicate to an unknown destination network, forward the packet to the nearest directly connected device known as next-hop. It is then the next hop's responsibility to forward the packet to the actual destination. Furthermore, dynamic routing is carried out automatically. Topology-based updates are made to routers, and routing tables are updated when topology changes.

Because of the centrality of routing protocols in internet connectivity, routing difficulties, and needs can be addressed throughout the design phase of a network. The corporate networks are made up of several routers that employ a range of routing protocols to send route information; Route redistribution has to be set up in routers. The purpose of this study is to evaluate and compare how well three distinct corporate network routing protocols perform route redistribution. The GNS-3 simulator is used to simulate the three stages in this research to examine the results of different configurations of various routing technologies that work within the precise designed network topology. The first scenario is represented by RIP-EIGRP, which is set up in the network architecture using the RIP and EIGRP routing protocols. A second scenario is the RIP-OSPF scenario, in which the routing protocols RIP and OSPF are used to configure the system. The third stage is represented by EIGRP and OSPF, which is set up using the OSPF and EIGRP routing protocol. Analyses the compatibility of the two separate versions of routing information protocol on the designed network topology in order to assess how two versions may interact with one another, and metric cost-types, delay are the goals of this paper. In order to compare and contrast how rip and eigrp support significant networks, create the network lAN architecture and configuration using GNS-3.

The remaining parts of the paper are laid out as:

a) Section 2: Covers a literature review,
b) Section 3: Describes the fundamental setup of planned network architecture utilising three protocols RIP-EIGRP-OSPF.
c) Section 4: Addresses the route-summarization.
d) Section 5: Showcases the phases of the planned network topology which has been developed using the GNS-3 simulator.
e) Section 6 exhibits the interoperability between RIP V1 and V2.
f) Section 7: A result analysis report is supplied.
g) Section 8: The conclusion and future efforts are addressed.

A literature review on dynamic routing protocol, performance analysis, route-summarization, route redistribution, and compatibility between RIP V1 and RIP V2 are covered in Section 2.Using the three protocols RIP, EIGRP, and OSPF, Section 3 explains the essential structure of the intended network architecture. The summary of the routes is discussed in Section 4.The three scenarios of the planned network architecture that were created using the GNS-3 simulator are shown in Section 5. Illustrates the compatibility between RIP V1 and V2 is demonstrated in Section 6.Section 7 includes a report on the analysis of the results. Section 8 discusses the conclusion and future works.

2. LITERATURE SURVEY

Verma *et al*. [1], in this paper, the routing protocol is used to convey the best connection and create the message in the network. Routing protocols enable the router to function. Dynamic protocols like RIP and OSPF are the most well-known routing protocols. By allocating traffic, SOSPF helps to reduce traffic congestion. Multicast Open Shortest Path First allows forwarding a multicast datagram from one network to another. Define the two protocols as well as the associated work in this paper. Each Link serves as an autonomous system for determining the quickest path to and from the destination tables.

Vikas *et al*. [2], to construct the network, use the Cisco Packet Tracer simulation tool to by changing specific network parameters; we may assess how well RIP, and OSPF perform in terms of convergence, traffic, and CPU usage.

K. K Wai *et al*. [3]**,** a proposed Local Area Network was studied and simulated using the RIP, EIGRP, and OSPF routing protocols based on matric, timer updates, administrative distance, authentication, hop count, and convergence. With the CISCO packet tracer simulator, the configuration of these routing protocols is done.

B.M Yakubu *et al*. [4], Through simulation, performed through OPNET as a simulating tool to determine which protocol matches the best for a client network, research is done on routing protocols: "RIP, EIGRP, and OSPF" in terms of; convergence, throughput, queueing delay, and utilization. The results were compared, and EIGRP was the most effective for client utilization regarding convergence, throughput, link utilization, and queueing delay.

Kalamani *et al*. [5], The OPNET simulator tool is used to compare and examine the performance of RIP, EIGRP, OSPF, and IGRP using metrics such as delay, throughput, packet delivery, Ethernet delay, and a load. As a result of the findings, we concluded that raising the transmission rate reduces the delay. In terms of throughput and load, EIGRP and OSPF perform considerably better than other routing protocols. We compared multiple protocols and recommended that large enterprises, educational institutions, and industrial sites implement EIGRP and OSPF routing protocols and key catalysts like 802.11a and 802.11g, which are capable of accelerating WLAN (Wireless Local Area Network) speeds to 54Mbps, to improve performance.

Don XU *et al*. [6], OPNET Modeler is being used to evaluate the effectiveness of the popular IP network protocols: RIP, EIGRP, and OSPF. We simulated a variety of scenarios to compare their performance. Simulation data shows that RIP is faster than voice packet delay, for video conferencing, OSPF is quicker than HTTP page response time and packet end-to-end latency, and EIGRP is faster than network convergence traffic and Ethernet delay.

A.G Biradar *et al*. [7], we compare an introductory study of: RIP, EIGRP, and OSPF protocols. To identify the optimum path for a packet, RIP utilizes a distance-vector algorithm, OSPF uses a link-state algorithm, and EIGRP uses diffusing update techniques. The purpose of this study is to find an efficient protocol for routing packets over GNS-3 by contrasting and evaluating the functionality of various routing protocols: RIP, OSPF, and EIGRP.

3. CONFIGURATION USING GNS-3 NETWORK SIMULATOR

3.1. Routing Information Protocol

The Routing Information Protocol (RIP), which uses port 520 and Administrative Distance Value 120, is UDP protocol. Three things are vital to comprehend for dynamic protocols: operation, path selection, and configuration. Three things are vital to comprehend for dynamic protocols: operation, path selection, and configuration.
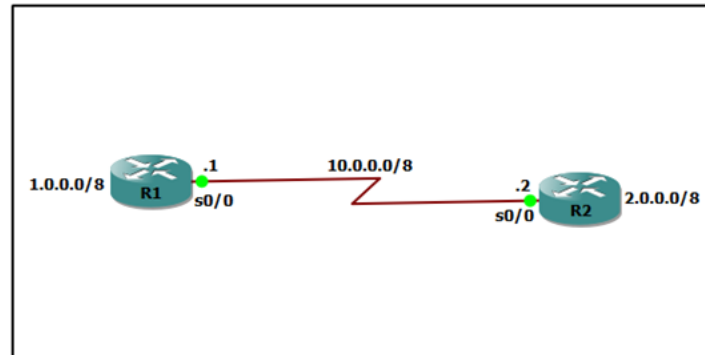

Figure 1. Router Connection Topology for RIP using GNS3

Table 1. Configuration of Router Connection Topology for RIP using GNS3

Router-R1	Router-R2
Config t	Config t
Int s0/0	Int s0/0
Ip add 10.0.0.1 255.0.0.0	Ip add 10.0.0.2 255.0.0.0
No sh	No sh
Int loo 1	Int loo 1
Ip add 1.0.0.1 255.0.0.0	Ip add 2.0.0.1 255.0.0.0
No sh	No sh
Router rip	Router rip
Ver 2	Ver 2
Net 10.0.0.0	Net 10.0.0.0
Net 1.0.0.0	Net 2.0.0.0
Exit	Exit
Sh ip route	Sh ip route

Table 2. Routing Table of Router R1 and R2
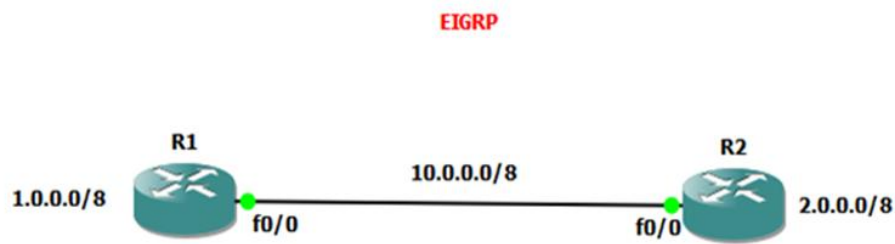
3.2. Enhanced Interior Gateway Protocol.

Figure 2. Router Connection Topology for EIGRP using GNS3

Table 3. Configuration of Router Connection Topology for EIGRP using GNS3 for R1

Table 4. Configuration of Router Connection Topology for EIGRP using GNS3 for R2

3.3. Open Shortest Path First

Figure 3. Router Connection Topology for OSPF using GNS3

Table 5. Configuration of Router Connection Topology for OSPF using GNS3

Router-R1	Router-R2
Config t	Config t
Int s0/0	Int s0/0
Ip add 10.0.0.1 255.0.0.0	Ip add 10.0.0.2 255.0.0.0
No sh	No sh
Int loo 1	Int loo 1
Ip add 1.0.0.1 255.0.0.0	Ip add 2.0.0.1 255.0.0.0
No sh	No sh
Router OSPF 1	Router ospf 2
Net 10.0.0.0 0.255.255.255 area 100	Net 10.0.0.0 0.255.255.255 area 100
Net 1.0.0.0 0.255.255.255 area 100	Net 2.0.0.0 0.255.255.255 area 100
Exit	Exit
Sh ip route	Sh ip route

Table 6. Configuration of Router Connection Topology for OSPF using GNS3 for R1

```
R1#sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            10.0.0.1        YES NVRAM  up                    up
FastEthernet1/0            unassigned      YES NVRAM  administratively down down
FastEthernet1/1            unassigned      YES NVRAM  administratively down down
Loopback1                  1.0.0.1         YES NVRAM  up                    up
R1#sh ip protocol
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.0.0.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    1.0.0.0 0.255.255.255 area 100
    10.0.0.0 0.255.255.255 area 100
 Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    2.0.0.2           110         00:02:29
  Distance: (default is 110)

R1#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    1.0.0.0/8 is directly connected, Loopback1
     2.0.0.0/32 is subnetted, 1 subnets
O       2.0.0.2 [110/2] via 10.0.0.2, 00:02:39, FastEthernet0/0
C    10.0.0.0/8 is directly connected, FastEthernet0/0
R1#p 2.0.0.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.0.0.2, timeout is 2 seconds:
!!!!!
```

Table 7. Configuration of Router Connection Topology for OSPF using GNS3 for R2

```
R2#sh ip int br
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            10.0.0.2        YES NVRAM  up                    up
FastEthernet1/0            unassigned      YES NVRAM  administratively down down
FastEthernet1/1            unassigned      YES NVRAM  administratively down down
Loopback1                  2.0.0.2         YES NVRAM  up                    up
R2#sh ip protocol
Routing Protocol is "ospf 2"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 2.0.0.2
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    2.0.0.0 0.255.255.255 area 100
    10.0.0.0 0.255.255.255 area 100
 Reference bandwidth unit is 100 mbps
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.0.0.1           110         00:04:13
  Distance: (default is 110)

R2#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/32 is subnetted, 1 subnets
O       1.0.0.1 [110/2] via 10.0.0.1, 00:04:22, FastEthernet0/0
C    2.0.0.0/8 is directly connected, Loopback1
C    10.0.0.0/8 is directly connected, FastEthernet0/0
R2#p 1.0.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.0.0.1, timeout is 2 seconds:
!!!!!
```

4. ROUTE SUMMARIZATION

First, let us take an example to know why route summarization came into existence.
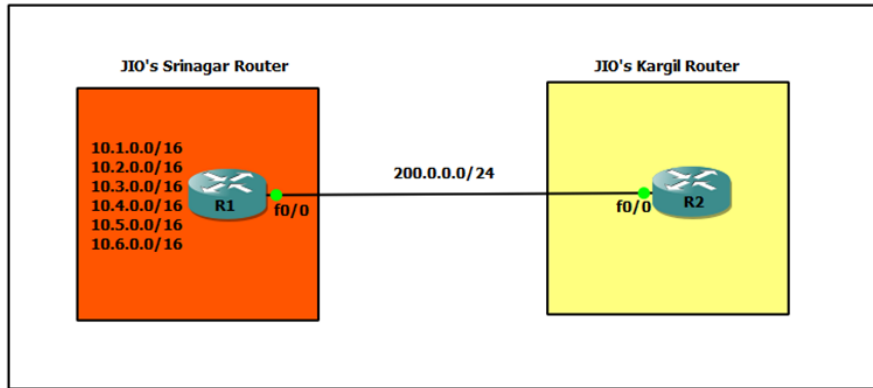

Figure 4. Route-Summarization Network Topology

Jio is an internet service provider (ISP). R1 is a Jio's Srinagar router that provides an internet to the private offices, homes, shops, government offices, etc., in Srinagar. All of these do default routes to the Srinagar router. R1 contains all of the routes (say millions of routes). Since the Srinagar router contains many routes, this router is a big means it contains huge memory and large/highest CPU process speed. R2 is a Jio's Kargil router. In Kargil, the population is less than in Srinagar, with fewer offices, shops, etc. So, the Kargil router is a small means it contains less memory and most minor CPU process speed.

Now, R2 wants the routes of R1. When R1 sends the routes to R2, In the R2 router, there is;

- Increase the routing table size
- Utilized most of the memory
- Effected process speed.

To overcome this problem, there is a concept called Route Summarization. Route-Summarization is a three-step process;

- In 1st step, we check all the networks from Left to Right, Top to Bottom.
- In 2nd step, whichever octant differs among them in 1st step, we open that octant here.
- Find Summary-IP (Add the value of ON (1) a bit in similar bits and Summary-Mask (Add the value of all the similar bits.

Table 8. Three-Step Route Summarization Process Example

Step 1: 10.1.0.0/16	Step-2: 128 64 32 16 8 4 2 1
10.2.0.0/16	0 0 0 0 0 0 0 1
10.3.0.0/16	0 0 0 0 0 0 1 0
10.4.0.0/16	0 0 0 0 0 0 1 1
10.5.0.0/16	0 0 0 0 0 1 0 0
10.6.0.0/16	0 0 0 0 0 1 0 1
	0 0 0 0 0 1 1 0
	0 0 0 0 0 1 1 1
Step-3:Find Summary IP= 10.0.0.0/13 Find Summary Mask= 255.248.0.0	

In both RIP and EIGRP, route summarization is defined the same way. It is a process by which we take the number of routes and try to summarize them into a single route. While summarizing the routes, we learned that the mask continuously decreases, known as Supper-netting. The main difference between RIP and EIGRP is that Rip has a limitation that it does not support the route-summarization of those networks whose mask will decrease than their actual class mask, that is

- For Class-A must not decrease then /8
- For Class-B must not decrease then /16, and
- For Class-C must not decrease, then/24

That means only subnetted networks, not major networks, are supported by RIP route-summarization. This Rip limitation is overcome by EIGRP, which permits route-summarization of major networks.
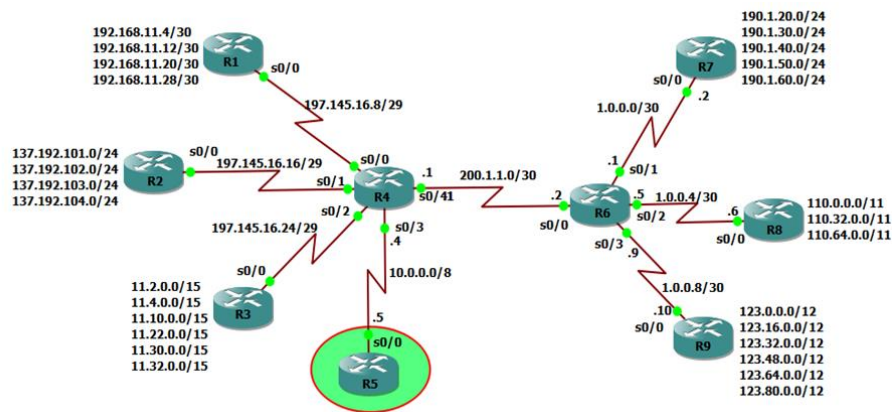

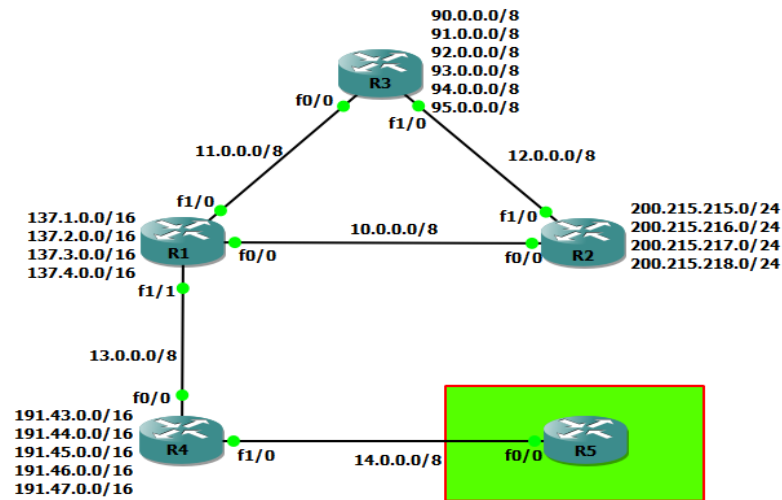Figure 5. Designed Network Topology of RIP for Route Summarization

Figure 6. Designed Network Topology of EIGRP for Route Summarization

5. REDISTRIBUTION

Compatibility is a technology that makes two protocols with most of the similarities to communicate. Redistribution is used when two protocols work on the same project but have no similarities. To make them compatible is what the redistribution is. So, it is the technology through which we communicate those protocols with no similarities. Sometimes in large scenarios, we have to use multiple protocols simultaneously. In that case, we have to use redistribution between protocols so that they can share their routing information. Without redistribution, routers with different routing protocols cannot share their routing tables. We can only configure redistribution on a router where both routing protocols are configured. Otherwise, we cannot configure redistribution. A distribution router is a router that translates the routes of one protocol into another so that they can communicate.

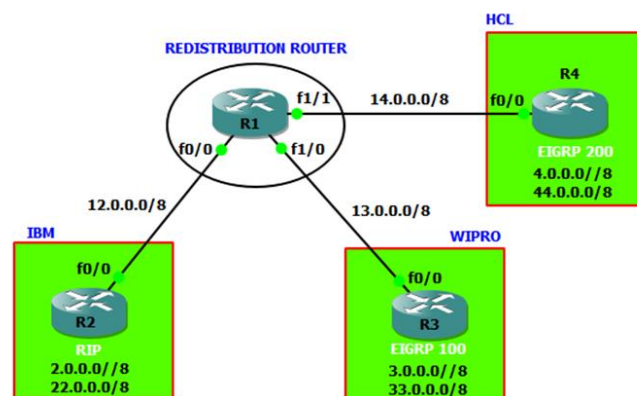### 5.1. Redistribution of RIP and EIGRP

Figure 7. Network Topology of RIP and EIGRP for Redistribution

Let's say three companies, IBM, WIPRO, and HCL, are working on the same project, but both companies are using different routing protocols. To make them communicate with each other, we

have configured RIP on the Router 2, i.e., IBM used the RIP protocol, and EIGRP on the Router 3, and Router 4, i.e., WIPRO and HCL are using the EIGRP protocol. Router 1 is a Redistribute Router as shown in Fig. 10 which helps to communicate different protocols with each other. On Router 3, we have used AS (Autonomous System) number 100 for EIGRP and on Router 4, we have used EIGRP 200. Now we have to configure redistribution on Router 1 so that both protocols can share their routing table with each other.

5.2. Redistribution of RIP and OSPF
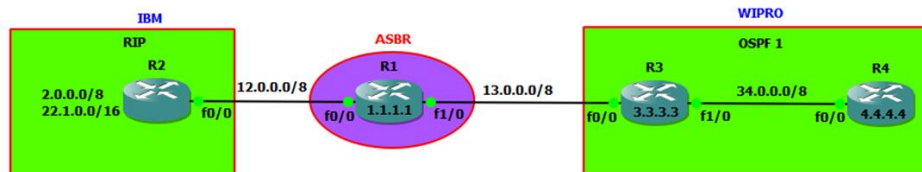
Figure 8. Network Topology of RIP and OSPF for Redistribution

Redistribution in OSPF allows OSPF to communicate with other protocols like RIP, EIGRP etc. Assume we have two companies IBM and WIPRO. We know OSPF gives name to router as per its job also. Here R1 is making OSPF to communicate with RIP. This router is named by OSPF as ASBR. But it is only Border Router not an Area Border Router because here area is same but protocols are different on its ends. This R1 is called Autonomous System Border Router. So, ASBR is the router which makes OSPF to communicate with any other protocol. A router can be DR, ABR, and ASBR at the same time.

5.3. Redistribution of OSPF and EIGRP

Figure 9. Designed Network Topology of OSPF and EIGRP for Redistribution

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Table 9. Redistribution Configuration for Designed Network Topologies of RIP, EIGRP and OSPF
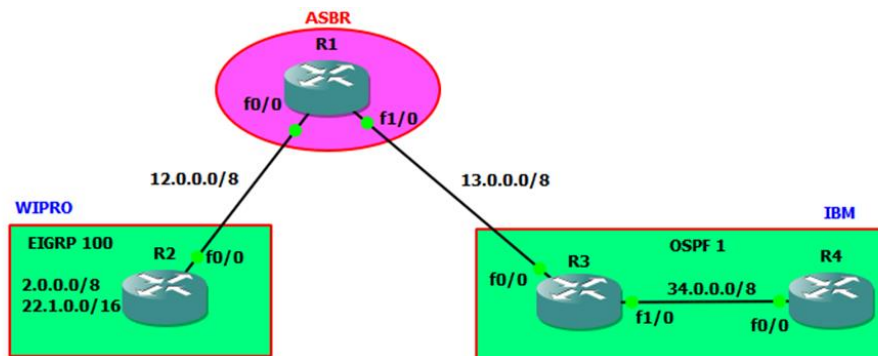
Redistribution of Rip and EIGRP	Redistribution of Rip and OSPF	Redistribution of OSPF and EIGRP
Redistribute EIGRP into RIP: R1(config)#router rip R1(config-router)#ver2 R1(config-router)#no au R1(config-router)#net 12.0.0.0 R1(config-router)#redistribute eigrp 100 metric 1 R1(config-router)#exit Redistribute RIP into EIGRP R1(config)#router eigrp 100 R1(config-router)#no au R1(config-router)#net 13.0.0.0 R1(config-router)#redistribute rip metric 1000000 1000 1 1 1 R1(config-router)#redistribute eigrp 200 R1(config-router)#exit Redistribute EIGRP 100 into EIGRP 200 and Vice Versa: Redistribute EIGRP 100 into EIGRP 200 and Vice Versa R1(config)#router eigrp 100 R1(config-router)#no au R1(config-router)#net 13.0.0.0 R1(config-router)#redistribute eigrp 200 R1(config-router)#exit R1(config)#router eigrp 200 R1(config-router)#no au R1(config-router)#net 14.0.0.0 R1(config-router)#redistribute eigrp 200 R1(config-router)#exit	Redistribute OSPF into RIP: R1(config)#router rip R1(config-router)#ver2 R1(config-router)#no au R1(config-router)#net 12.0.0.0 R1(config-router)#redistribute ospf 1 metric 1 R1(config-router)#exit Redistribute RIP into OSPF: R1(config)#router ospf 1 R1(config-router)#router-id 1.1.1.1 R1(config-router)#net 13.0.0.0 0.255.255.255 area 100 R1(config-router)#redistribute rip R1(config-router)#redistribute rip subnets R1(config-router)#exi	Redistribute OSPF into EIGRP: R1(config)#router eigrp 100 R1(config-router)#no au R1(config-router)#net 12.0.0.0 R1(config-router)#redistribute ospf 1 metric 1 R1(config-router)#exit Redistribute EIGRP into OSPF: R1(config)#router ospf 1 R1(config-router)#router-id 1.1.1.1 R1(config-router)#net 13.0.0.0 0.255.255.255 area 100 R1(config-router)#redistribute eigrp 1000000 1000 1 1 1 R1(config-router)#exit

6. COMPATIBILITY BETWEEN RIP VERSION-1 AND VERSION-2

Compatibility is one of the most crucial topics, not as Rip is considered but for other protocols. The Rip gives us the idea that there is a way out of it when the same thing happens related to EIGRP, OSPF, or BGP. As we know, Version-1 and Version-2 do not talk to each other.

Let us take an example. Assume there is a 40Cr IT project and this IT project is a government project. The government gave this project to the two experienced companies (old companies), e.g., IBM (say 15 years of experience) and Wipro (say 12 years of experience). The government said these two companies complete this IT project in 6 months. When IBM configured the project, they used RIP Version-1, and in the same way, WIPRO used RIP Version-2.

- In Rip, 255.255.255.255, it means sending to all and receiving from all without any condition.
- Also, 224.0.0.9 means sending to all but receiving only if sent from address 224.0.0.9

- Rip Version-1 accepts the routing table of version-2 because version-1 accepts both version-1 and version-2, but the problem lies in the Rip version-2 because it sends version-2 but can accept /receive only version-"2".

So, the problem is with Version-2. To overcome this problem, compatibility between version-1 and version-2 comes into existence. Now we see how it works. At R1, Rip Version-1 is applied, and in R2, Rip Version -2 is applied. Now we can interact with each other by giving the solution at R2 for R2 and others by giving the solution at R1 for R2. When we globally use Rip Version-2, say Version-2 is applied to all the interfaces on that router. Similarly, when we use Rip Version-1, say Version-1 is applied to all the router interfaces. So, the solution is that we can change the version on a particular interface. So, in the given topology, either we can change version-1 on R1 on interface f1/0 to version-2 or version-2 on R2 on interface f1/0 to Version-1.

R1:
Int f1/0
IP RIP send ver2
However, the better solution is changing a version-1 on R1 on interface f1/0 to version-2 because version-2 sends with the mask.
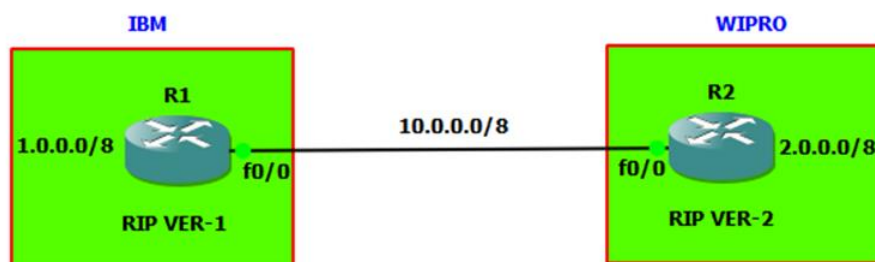R2:
Int f1/0
IP RIP receive ver1

Figure 10. Designed Network Topology of Compatibility between RIP Version-1 and Version-2

7. RESULT AND ANALYSIS

As a result of implementing RIP, EIGRP, and OSPF on the same network topology scenario, we obtained the routing table, analyzing the metric value, the administrative distance value, and the length of time for each network in the routing table, along with their exit interface IP address. We also learned that RIP is exclusively utilized in small networks, whereas EIGRP is used in medium networks and OSPF is used in large networks. We also looked at how route summarization addresses issues such as increasing the size of the routing table, utilizing the majority of memory and affecting process speed. Routing tables also advertise both the protocols with their connected networks and metrics following the redistribution of protocols in various scenarios. Following the redistribution, two different protocols can share their routing tables and communicate. In Figure 5, and 6 we execute route summarization wherever possible such that Router 5 has all of the routes of all other routers in its routing table, despite its limited memory and CPU speed. In Figure 7, R2 wishes to communicate with R3 and R4. However, because these routers use different protocols, they cannot communicate with one another. R2 need each other's route in their routing table to communicate with R3, R4, and vice versa. We employ redistribution on router R1 to ensure that R2, R3, and R4 receive each other's routes in their routing tables.

Table 10. Routing Table of R5 before and After Route-Summarization in RIP

BEFORE	AFTER

```
   1.0.0.0/30 is subnetted, 3 subnets
R     1.0.0.0 [120/2] via 10.0.0.4, 00:00:02, Serial0/0
R     1.0.0.4 [120/2] via 10.0.0.4, 00:00:02, Serial0/0
R     1.0.0.8 [120/2] via 10.0.0.4, 00:00:02, Serial0/0
   137.192.0.0/24 is subnetted, 4 subnets
R     137.192.104.0 [120/2] via 10.0.0.4, 00:00:02, Serial0/0
R     137.192.101.0 [120/2] via 10.0.0.4, 00:00:02, Serial0/0
R     137.192.103.0 [120/2] via 10.0.0.4, 00:00:02, Serial0/0
R     137.192.102.0 [120/2] via 10.0.0.4, 00:00:04, Serial0/0
   200.1.1.0/30 is subnetted, 1 subnets
R     200.1.1.0 [120/1] via 10.0.0.4, 00:00:04, Serial0/0
   190.1.0.0/24 is subnetted, 5 subnets
R     190.1.60.0 [120/3] via 10.0.0.4, 00:00:04, Serial0/0
R     190.1.50.0 [120/3] via 10.0.0.4, 00:00:05, Serial0/0
R     190.1.40.0 [120/3] via 10.0.0.4, 00:00:05, Serial0/0
R     190.1.30.0 [120/3] via 10.0.0.4, 00:00:05, Serial0/0
R     190.1.20.0 [120/3] via 10.0.0.4, 00:00:05, Serial0/0
   192.168.11.0/30 is subnetted, 4 subnets
R     192.168.11.4 [120/2] via 10.0.0.4, 00:00:05, Serial0/0
R     192.168.11.12 [120/2] via 10.0.0.4, 00:00:05, Serial0/0
R     192.168.11.20 [120/2] via 10.0.0.4, 00:00:05, Serial0/0
R     192.168.11.28 [120/2] via 10.0.0.4, 00:00:05, Serial0/0
   197.145.16.0/29 is subnetted, 3 subnets
R     197.145.16.8 [120/1] via 10.0.0.4, 00:00:05, Serial0/0
R     197.145.16.16 [120/1] via 10.0.0.4, 00:00:05, Serial0/0
R     197.145.16.24 [120/1] via 10.0.0.4, 00:00:05, Serial0/0
   110.0.0.0/11 is subnetted, 3 subnets
R     110.64.0.0 [120/3] via 10.0.0.4, 00:00:05, Serial0/0
R     110.32.0.0 [120/3] via 10.0.0.4, 00:00:05, Serial0/0
R     110.0.0.0 [120/3] via 10.0.0.4, 00:00:08, Serial0/0
C   10.0.0.0/8 is directly connected, Serial0/0
   11.0.0.0/15 is subnetted, 6 subnets
R     11.10.0.0 [120/2] via 10.0.0.4, 00:00:08, Serial0/0
R     11.2.0.0 [120/2] via 10.0.0.4, 00:00:08, Serial0/0
R     11.4.0.0 [120/2] via 10.0.0.4, 00:00:08, Serial0/0
R     11.30.0.0 [120/2] via 10.0.0.4, 00:00:08, Serial0/0
R     11.22.0.0 [120/2] via 10.0.0.4, 00:00:09, Serial0/0
R     11.32.0.0 [120/2] via 10.0.0.4, 00:00:09, Serial0/0
   123.0.0.0/12 is subnetted, 6 subnets
R     123.80.0.0 [120/3] via 10.0.0.4, 00:00:09, Serial0/0
R     123.64.0.0 [120/3] via 10.0.0.4, 00:00:09, Serial0/0
R     123.48.0.0 [120/3] via 10.0.0.4, 00:00:09, Serial0/0
```

```
R5#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     1.0.0.0/28 is subnetted, 1 subnets
R      1.0.0.0 [120/2] via 10.0.0.4, 00:00:05, Serial0/0
   137.192.0.0/20 is subnetted, 1 subnets
R     137.192.96.0 [120/2] via 10.0.0.4, 00:00:05, Serial0/0
   200.1.1.0/30 is subnetted, 1 subnets
R     200.1.1.0 [120/1] via 10.0.0.4, 00:00:05, Serial0/0
   190.1.0.0/18 is subnetted, 1 subnets
R     190.1.0.0 [120/3] via 10.0.0.4, 00:00:05, Serial0/0
   192.168.11.0/27 is subnetted, 1 subnets
R     192.168.11.0 [120/2] via 10.0.0.4, 00:00:07, Serial0/0
   197.145.16.0/27 is subnetted, 1 subnets
R     197.145.16.0 [120/1] via 10.0.0.4, 00:00:07, Serial0/0
   110.0.0.0/9 is subnetted, 1 subnets
R     110.0.0.0 [120/3] via 10.0.0.4, 00:00:08, Serial0/0
C   10.0.0.0/8 is directly connected, Serial0/0
   11.0.0.0/10 is subnetted, 1 subnets
R     11.0.0.0 [120/2] via 10.0.0.4, 00:00:08, Serial0/0
   123.0.0.0/9 is subnetted, 1 subnets
R     123.0.0.0 [120/3] via 10.0.0.4, 00:00:08, Serial0/0
R5#
```

Table 11. Routing Table of R2 using Redistribution of RIP and EIGRP

```
R2#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    2.0.0.0/8 is directly connected, Loopback1
R    33.0.0.0/8 [120/1] via 12.0.0.1, 00:00:19, FastEthernet0/0
R    3.0.0.0/8 [120/1] via 12.0.0.1, 00:00:19, FastEthernet0/0
R    4.0.0.0/8 [120/1] via 12.0.0.1, 00:00:19, FastEthernet0/0
C    22.0.0.0/8 is directly connected, Loopback2
C    12.0.0.0/8 is directly connected, FastEthernet0/0
R    13.0.0.0/8 [120/1] via 12.0.0.1, 00:00:20, FastEthernet0/0
R    44.0.0.0/8 [120/1] via 12.0.0.1, 00:00:20, FastEthernet0/0
R    14.0.0.0/8 [120/1] via 12.0.0.1, 00:00:20, FastEthernet0/0
R2#p 14.0.0.4

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 14.0.0.4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/66/88 ms
R2#
```

Table 12. Routing Table of R3 and R4 using Redistribution of RIP and EIGRP

```
R3#sh ip route                                          R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP    Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route      ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route      o - ODR, P - periodic downloaded static route

Gateway of last resort is not set                       Gateway of last resort is not set

D EX 2.0.0.0/8 [170/284160] via 13.0.0.1, 00:01:16, FastEthernet0/0    D EX 2.0.0.0/8 [170/284160] via 14.0.0.1, 00:00:17, FastEthernet0/0
C    33.0.0.0/8 is directly connected, Loopback2         D EX 33.0.0.0/8 [170/158720] via 14.0.0.1, 00:03:13, FastEthernet0/0
C    3.0.0.0/8 is directly connected, Loopback1          D EX 3.0.0.0/8 [170/158720] via 14.0.0.1, 00:03:13, FastEthernet0/0
D EX 4.0.0.0/8 [170/158720] via 13.0.0.1, 00:01:16, FastEthernet0/0    C    4.0.0.0/8 is directly connected, Loopback1
D EX 22.0.0.0/8 [170/284160] via 13.0.0.1, 00:01:16, FastEthernet0/0    D EX 22.0.0.0/8 [170/284160] via 14.0.0.1, 00:00:17, FastEthernet0/0
D EX 12.0.0.0/8 [170/284160] via 13.0.0.1, 00:01:16, FastEthernet0/0    D EX 12.0.0.0/8 [170/284160] via 14.0.0.1, 00:00:17, FastEthernet0/0
C    13.0.0.0/8 is directly connected, FastEthernet0/0   D EX 13.0.0.0/8 [170/30720] via 14.0.0.1, 00:03:13, FastEthernet0/0
D EX 44.0.0.0/8 [170/158720] via 13.0.0.1, 00:01:16, FastEthernet0/0    C    44.0.0.0/8 is directly connected, Loopback2
D EX 14.0.0.0/8 [170/30720] via 13.0.0.1, 00:01:16, FastEthernet0/0    C    14.0.0.0/8 is directly connected, FastEthernet0/0
R3#                                                     R4#
```

When we write redistribute rip, we get the following results: Because it is a valid command, the RIP router will be authorized to join OSPF. LSA-5 also refers to routers that originate from various protocols, and these routes are designated as OE2. Only major networks, not sub-netted networks, will be transferred. If we do not specify a cost, it will be set to 20 by default. It is referred to as Root Cost/Speed Cost. In the OSPF domain, RIP must adopt cost, and metrics must be discarded. We use the command redistribute rip subnets to redistribute subnetted networks as well. For example, if our manager specifies that the cost is set to 30, we can do it using redistribute RIP subnets metric 30. There are two types of metrics: metric-type 1, where the cost changes and metric-type 2, where the cost is always 20. Redistribute rip subnets metric 30 metric-type 1. Using this command, the cost of the routes will change, as shown below in the routing table on R3 and R4.

Table 13. Routing Table of R3 and R4 Metric-Type 1

```
R3#sh ip route                                          R4#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP    Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area      D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2      N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2      i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route      ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route      o - ODR, P - periodic downloaded static route

Gateway of last resort is not set                       Gateway of last resort is not set

C    34.0.0.0/8 is directly connected, FastEthernet1/0   C    34.0.0.0/8 is directly connected, FastEthernet0/0
O E1 2.0.0.0/8 [110/31] via 13.0.0.1, 00:00:29, FastEthernet0/0    O E1 2.0.0.0/8 [110/32] via 34.0.0.3, 00:00:13, FastEthernet0/0
     22.0.0.0/16 is subnetted, 1 subnets                     22.0.0.0/16 is subnetted, 1 subnets
O E1    22.1.0.0 [110/31] via 13.0.0.1, 00:00:29, FastEthernet0/0    O E1    22.1.0.0 [110/32] via 34.0.0.3, 00:00:12, FastEthernet0/0
O E1 12.0.0.0/8 [110/31] via 13.0.0.1, 00:00:29, FastEthernet0/0    O E1 12.0.0.0/8 [110/32] via 34.0.0.3, 00:00:12, FastEthernet0/0
C    13.0.0.0/8 is directly connected, FastEthernet0/0   O    13.0.0.0/8 [110/2] via 34.0.0.3, 00:06:21, FastEthernet0/0
R3#                                                     R4#
```

Table 14. Routing Table of R3 and R4 Metric-Type 1

Table 15. Routing Table of R3 and R4 Metric-Type 2

7.1. Comparison Analysis of Dynamic Routing Protocols

Table 16. Comparison Analysis of ''RIP, EIGRP, and OSPF'' on the basis of work done

Dynamic Routing Protocol	RIP	EIGRP	OSPF
Full Form	Routing Information Protocol	Enhanced Interior Gateway Protocol	Open shortest Path First
Algorithm	Bellmen-Ford	Dual	Dijkstra
Type of Protocol Used	Distance Vector	Dual	Link State
Interior/Exterior	Interior Gateway Protocol	Interior Gateway	Interior Gateway
Matric	Hop Count	Bandwidth and Delay	Cost
Hop Limit	Upto 15	255, Default is 100	No Limit
Administrative Distance	120	Int. 190 Ext. 170	AD is 110
Class-Full/Class-Less	Version-1 is Class-Full and Version-2 Class-Less	Class-Less	Class-Less
Port Number	UDP-520	IP-88	IP-89
Routing Table Denoted By	R	D	O
Summarization	Auto	Auto	Manual
Supports VLSM	In Version-2 only	Yes	Yes
Update Types	Full	Only Changes	Only Changes
Convergence	slow	Very Fast	Fast
Network	Small	Medium	Large

8. CONCLUSION AND FUTURE SCOPE

An enterprise-level topology is built using the Dynamic Routing Protocol: RIP, OSPF, and EIGRP, and GNS3 is used to evaluate their performance.. Compared to EIGRP and OSPF, the RIP method is simpler to configure and execute on routers. Compared to RIP, EIGRP and OSPF have a shorter delay time, and EIGRP has the shortest convergence time. It may be established that EIGRP is the optimum routing protocol for an enterprise network. Many practical and theoretical topics have been explored in this comparison of RIP, EIGRP, and OSPF. RIP has deficient performance, OSPF has good performance, and the analysis findings indicate that EIGRP performs rather well when compared to RIP and OSPF. We also practically perform and analyze how different protocols are communicated using different designed topology scenarios with the help of redistribution. In addition, we practically analyze and test the compatibility of two versions in RIP and also analyze how route summarization is performed in RIP And EIGP with the help of Network Simulator Tool (GNS-3).

We will need to conduct security research on RIP, OSPF, and EIGRP in the future.GNS should also be used to compare OSPF and EIGRP in the IPv6 context. Understanding the parameters of the protocol and how they affected the simulation results was the main obstacle of this study. The collection, interpretation, and relationship between the routing tables and the network architecture posed another challenge. The OPNET simulation tool will be used to evaluate the route redistribution over three distinct dynamic routing protocols in the subsequent endeavour.

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