Three Way Route Redistribution

Abinash Kumar
Dept. of Electronics and Commun.
RV College of Engineering,
Bangalore, India

Sahilkumar Chakraborty
Dept. of Electronics and Commun.
RV College of Engineering,
Bangalore, India

Sahana B (Assistant Prof)
Dept. of Electronics and Commun.
RV College of Engineering,
Bangalore, India.

***Abstract*- It is a very ordinary scenario to come across with multiple routing protocols within networks. In such cases route redistribution technique is used for maintaining the integrity of information when routing between different protocols. Redistribution is common phenomenon while upgrading ones' network or when merger between different organizations occur. Cisco packet tracer has been used to carry out simulations of redistribution between RIP EIGRP and OSPF protocols. The redistribution is carried out on border area routers.**

Keywords: RIPv2, EIGRP, OSPF, Route Redistribution

I. INTRODUCTION

Route Redistribution(RR) is the key to get different protocols in a network to communicate with each other. Multiple protocols can exist within an organization itself to enforce different types of policies. Primary function of redistribution is to propagate routing information from one protocol to another. It can also serve as an alternate path for packets in case the primary link fails. On a small scale network static routes can be used but in case there are many routes, this idea is not scalable since it would involve network administrators to configure static routes on multiple devices.

The router with multiple protocols runs a process for each routing protocol. Each routing process has its own routing information base[1]. To help with choosing of a definite path among multiple paths available, administrative distance is used. The route redistribution is not an optimal solution. Some of the problems related to RR are suboptimal routing and formation of loops[3]. It is possible that loops can occur due to RR. The protocols such as OSPF requires the complete view of network topology to from loop free paths. RR distorts the real topology thus routing paths may end up in loops. The case of suboptimal routing is explained in the section III. RR is inherent to modern day network design but is prone to configuration errors[2].

II. METRIC CALCULATION

Metrics are the variables of a routing protocols which help in deciding which path is suited for a particular destination. Different protocols have different metrics. Some of the metrics used are Bandwidth, delay, cost, Maximum Transmission Unit(MTU), Load, Hop Count and Reliability. The distance vector routing protocol such as RIP uses hop count as its metric. RIP is used in small sized networks. The Hop count is decrement after each visited node. When the count becomes zero the packet is dropped.

OSPF is used for large networks. It uses cost as its metric with 100 Mbps as reference[5]. The cost is the ratio of Reference bandwidth with the given bandwidth. It does not distinguish between the routing interfaces which bandwidth more than 100Mbps. Therefore, an interface with Bandwidth of 100 Mbps and 1 Gbps will have same cost that is 1. An interface with Bandwidth of 10 Mbps will have its cost as 10.

EIGRP is often considered as a hybrid protocol and is used for medium size networks. The metrics for EIGRP are Bandwidth, load, delay, reliability and MTU. EIGRP metric calculation: metric = ([K1 * bandwidth + (K2 * bandwidth) / (256 - load) + K3 * delay] * [K5 / (reliability + K4)]) * 256 [omnisec] Default values of K1 and K3 is 1 while K2, K4 and K5 defaults to 0, so the equation reduces to metric= Bandwidth + delay[4].

The paper is organized into four sections. After a brief introduction to RR in section I, the section II deals with RR analysis and simulation results. The section III explains the problem of suboptimal routing due to administrative distance with an example.

III. METHODOLOGY

Implementation using Cisco Packet tracer

Routing protocols are the basic reason why a packet can reach from one network to another. Without the routing protocol packets are unable to reach the destination in any other network. Route Redistribution feature is enabled on most of the cisco router therefore thus the simulation was carried out in Cisco Packet Tracer.

For the purpose of simulating a 3-way route redistribution, 4 network segments have been created s shown in figure 1. Two of them containing RIPv2 as routing protocol so that classless inter-domain routing is enabled. These are the network segments in the middle. One of the remaining 2, the left network has EIGRP as a routing protocol and the one on the right has OSPF.

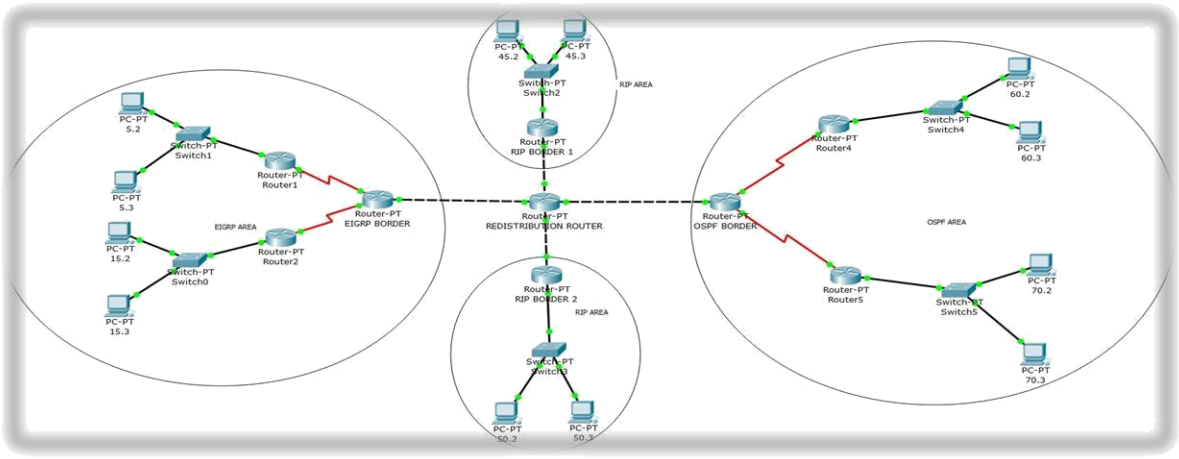

Figure1: Simulation Network

IV. IMPLEMENTATION

Network Configuration

There are basically 3 routing protocols in work even though 4 major network segments are present. Starting from the left the 1st segment has EIGRP with network address starting from 5.0.0.0 to 20.0.0.0. There are 4 networks in the inside the EIGRP area.

Table 1: EIGRP IP address configuration

Network	Endpoints	
5.0.0.0	Hosts : 5.2,5.3	Router 1
10.0.0.0	Router 1	EIGRP BORDER Router
15.0.0.0	Hosts : 15.2,15.3	Router 2
20.0.0.0	Router 2	EIGRP BORDER Router

Next in line are the 2 segments of RIP routing protocol in which network address consist of only 45.0.0.0 network and 50.0.0.0 network.

Table 2: RIP IP address configuration

Network	Endpoints	
45.0.0.0	Hosts : 45.2,45.3	RIP Border 1 Router
50.0.0.0	Hosts : 50.2,50.3	RIP Border 2 Router

On the rightmost part we have the OSPF network segment. The IP address start from 55.0.0.0 and range till 70.0.0.0. Similar to the EIGRP, this segment also has 4 networks inside its area.

Table 3: OSPF IP address configuration

Network	Endpoints	
55.0.0.0	Router 4	OSPF Border Router
60.0.0.0	Hosts : 60.2,60.3	Router 4
65.0.0.0	Router 5	OSPF Border Router
70.0.0.0	Hosts : 70.2,70.3	Router 5

Now the 4 major segments of network are connected to the router that will redistribute packets from one type of routing protocol to another. The IP table of this router's connection with 4 border routers are as given in the Table 4.

Table 4: REDISTRIBUTION Router IP address configuration

Network	Endpoints	
25.0.0.0	EIGRP Border Router	Redistribution Router
30.0.0.0	OSPF Border Router	Redistribution Router
35.0.0.0	RIP border Router 2	Redistribution Router
40.0.0.0	RIP border Router 1	Redistribution Router

Route Redistribution Strategy

Each router in its area is configured to the respective protocol so they can communicate with each other. The problem arises when a packet has to be send from one protocol are to another. For this to happen the administrator has to configure route redistribution on a router to inject packets from one routing protocol to another. In the current scenario this work done by the redistribution router.

```
router eigrp 1
 redistribute rip metric 10000 1 255 100 1000
 redistribute ospf 1 metric 1500 100 255 1 1500
 network 25.0.0.0
 network 35.0.0.0
 network 30.0.0.0
 network 40.0.0.0
 auto-summary
!
router ospf 1
 log-adjacency-changes
 redistribute rip metric 5000 subnets
 redistribute eigrp 1 metric 100 subnets
 network 30.0.0.0 0.255.255.255 area 0
 network 40.0.0.0 0.255.255.255 area 0
 network 25.0.0.0 0.255.255.255 area 0
 network 35.0.0.0 0.255.255.255 area 0
!
router rip
 version 2
 redistribute eigrp 1 metric 10
 redistribute ospf 1 metric 15
 network 25.0.0.0
 network 30.0.0.0
 network 35.0.0.0
 network 40.0.0.0
!
```

Figure 2: Running Configuration of Redistribution Router

Looking at the running configuration of the Redistribution router, it is noticeable that for injection of packets of one routing protocol to the rest two protocols, the administrator has to manually configure the redistribution commands in the route configuration of the other two protocols by using the redistribute commend along with proper values for the metrics.

Administrative Distance

Administrative distance is a numerical value used to select an optimal path when there are multiple paths available for same destination. It is a quantitative measure of how good a routing protocol is. Administrative distance of Static route, Internal EIGRP, OSPF and RIP are 1, 90,110,120 respectively. In case of redistribution when multiple protocols and paths are present, sometimes it can lead to suboptimal routing based on administrative distance. This statement is explained using an example below in Fig [3].

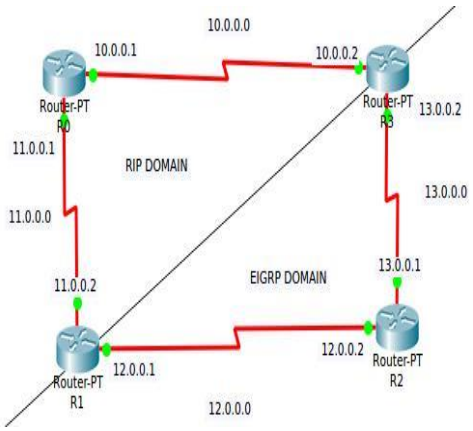

Figure 3: Routers R0 is in RIP domain and Router R2 is in EIGRP domain & routers R1 and R3 are border area routers.

Table 5: Routers with address of their interface.

Router	Interface	Address
R0	Se 2/0 Se 3/0	11.0.0.1 10.0.0.1
R1	Se 2/0 Se 3/0	11.0.0.2 12.0.0.1
R2	Se 2/0 Se 3/0	12.0.0.2 13.0.0.1
R3	Se 2/0 Se 3/0	13.0.0.2 10.0.0.2

The redistribution command has been applied on both border area routers. If a packet with source as R1 has to reach the destination of 10.0.0.1 the optimal path would be via network 11.0.0.0. But due to route redistribution packet undergoes suboptimal routing and travels via networks 12.0.0.0 and 13.0.0.0 as show in figure [4]. This can be confirmed using 'traceroute' command. The problem of suboptimal routing can be overcome by using access list.

```
R1>enable
R1#traceroute 10.0.0.1
Type escape sequence to abort.
Tracing the route to 10.0.0.1

  1   12.0.0.2      8 msec    1 msec    1 msec
  2   13.0.0.2      2 msec    2 msec    5 msec
  3   10.0.0.1      1 msec    1 msec    1 msec
R1#
```

Figure 4: Trace route command on R1 for destination 10.0.0.1

V. CONCLUSION

The route redistribution has confirmed to be working in all three section having 3 different routing protocols. A random pc selected from any routing protocol zone is able to ping any pc in the other zones with different routing protocol. Thus it confirms the injection of the one protocol packets into another with the necessary changes in the. The redistribution algorithm shows the way to communicate with different routing protocols. Route redistribution is certainly easily applicable and cost effective technique. Through using it, an administrator can also settle Tactical Internet Communication.

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