Performance Analysis of Protocols RIP & EIGRP

Jeevan Prasad Adhikari

Abstract- The Routing Information Protocol (RIP) is one of the Internet's first widely used routing protocol. It is still useful in local and medium area networks. RIP is classified as a distance-vector routing protocol, which employs the hop count as a routing metric, The maximum number of hops allowed for RIP is 15[3]. A hop count of 16 is considered an infinite distance viewing such distance as unreachable and undesirable route in it routing process. This hop count limits the size of network that RIP operate. EIGRP is a Cisco-proprietary routing protocol that is based on IGRP. EIGRP supports CIDR and VLSM, allowing network designers to maximize address space. EIGRP is often described as a hybrid routing protocol that offers the best of distance vector and link-state algorithms. EIGRP is an advanced routing protocol that relies on features commonly associated with link-state protocols. This paper consist of comparisons of RIP and EIGRP, it includes the various trouble resolving techniques and traffic handling techniques during communication in simple as well in bulky networks[5].

Key Words :- Routing Protocols RIP, IGRP, EIGRP.

I. INTRODUCTION

RIP is one of the most enduring of all routing protocols[2]. It's a very simple protocol, based on distance-vector (or Bellman-Ford, as it's also known) routing algorithms that predate ARPANet (the Advanced Research Projects Agency Network). To be exact, these algorithms were originally described academically by R. E. Bellman, L. R. Ford, Jr., and D. R. Fulkerston between 1957 and 1962. During the 1960s, these algorithms were widely deployed by various companies and marketed under different names.

RIP version 2, or RIPv2 as it is more commonly known, was first proposed as an update to RIP in RFC1388 in January 1993.

Enhanced Interior Gateway Routing Protocol (EIGRP) or Enhanced IGRP is a Cisco proprietary routing protocol utilizing the Diffusing Update Algorithm (DUAL). It is a hybrid protocol as it incorporates features of a Distance Vector routing protocol and features of a Link State routing protocol. EIGRP is an ideal choice for large, multiprotocol networks built primarily on Cisco routers. In the context of routing protocol performance, each of them has different architecture, adaptability, route processing delays and convergence capabilities[7].

II. FUNDAMENTALS

RIP is a classful protocol, which means that it doesn't carry subnet mask information in its routing update. It is incapable of supporting variable length subnet masking (VLSM) and discontiguous networks.

RIP enables devices to exchange information about networks that they are directly connected to, as well as any other networks that they have learned from other RIP devices[5].

Since RIP calculates the best route to a destination based solely on how many hops it is to the destination network, RIP tends to be inefficient in network using more than one LAN protocol, such as Fast Ethernet and serial or Token Ring. This is because RIP prefers paths with the shortest hop count. The path with the shortest hop count might be over the slowest link in the network[4].

RIP cannot handle more than 15 hops. Anything more than 15 hops away is considered unreachable by RIP. This fact is used by RIP to prevent routing loops.

Packet Type

III. ROUTING INFORMATION PROTOCOL

The RIP message format is shown below. Each message contains command entry and a version number and can contain entries for up to 25 routes. Each route entry includes an address family identifier, the IP address reachable by the route, and the hop count for the route[3].

command	version	*Zeroes*
Address Family ID		*Zeroes*
IP Address		
Zeroes		
Zeroes		
Metric		

Fig1.1 The RIP message format

Command will always be set to either one, signifying a Request message, or two, signifying a Response message. There are other commands, but they are all either obsolete or reserved for private use.

Version will be set to one for RIPv1.

Address Family Identifier is set to two for IP. The only exception to this is a request for a router's full route table.

IP Address is the address of the destination of the route. This entry might be a major network address, a subnet, or a host route.

Metric is a hop count between 1 and 16.

RIP TIMERS

TIMER	DEFAULT	CONTROLS
Update	30 sec.	Interval between route update advertisements
Hold-Down	90 sec.	Period a route is withdrawn from the table to prevent a routing loop.

Timeout	180 sec.	Interval a route should stay 'live' in the routing table. This counter is reset every time the router hears an update for this route.
Flush	120 sec.	How long to wait to delete a route after it has timed out.

EIGRP

The IP header of an EIGRP packet specifies protocol number 88, and the maximum length of the packet will be the IP maximum transmission unit(MTU) of the interface on which it is transmitted-usually 1500 octets.

EIGRP Reliable Transport Protocol

Five types of EIGRP packets exist, further categorized as reliable packets and unreliable packets. The reliable EIGRP packets are as follows[5]:

Update— Update packets contain EIGRP routing updates sent to an EIGRP neighbor.

Query— Queries are sent to neighbors when a route is not available and the router needs to ask the status of the route for fast convergence.

Reply— Reply packets to the queries contain the status of the route being queried for.

The unreliable EIGRP packets are as follows:

Hello— Hello packets are used to establish EIGRP neighbor relationships across a link.

Acknowledgment— Acknowledgment packets ensure reliable delivery of EIGRP packets.

EIGRP Tables

1. <u>Route Table</u> – where the best route (successor) to each destination is kept
2. <u>Topology Table</u> – where all the feasible routes are kept (feasible successor), but also contains successor routes. *Up to six valid routes for any destination will be stored.*
3. <u>Neighbor Table</u> – where EIGRP neighbors and info about them are kept

Advertised Distance vs. Feasible Distance

1. **Advertised Distance** is the distance from a *neighbor* (next hope router) to the destination network. It is also referred to as the "AD".
2. **Feasible Distance** is the AD + the metric to reach the neighbor advertising the AD. It is also referred to as the "FD". The FD is also considered the EIGRP "metric".

EIGRP Metric

The metric is calculated using the following equation (of which the "K" values are ON (1) or OFF (0)): **[K1 * bandwidth + ((K2 * bandwidth) / (256 - load)) + K3 * delay] * [K5 / (reliability + K4)]**

Remember that K values must match on all routers in the EIGRP ASN[5]. The only values that are taken in to account are bandwidth and delay. Additionally, *load* and *reliability* can be used.

The default K values are:

1. K1 = 1
2. K2 = 0
3. K3 = 1
4. K4 = 0
5. K5 = 0

The default metric takes only bandwidth and delay in to consideration. Additionally, MTU never plays a part of the equation.

Bandwidth is the link with the least amount of bandwidth. Assuming it is 64Kb you would use it to divide 10,000,000 and then multiply by 256. So 10,000,000 / 64 * 256.

The "delay" value is cumulative. Delay is associated to each interface in milliseconds, and as a particular route crosses router after router (hops) the delay becomes cumulative. We can use the **show interface** command to see the delay value associated to an interface. Sum up all of the delays, and convert in to 10′s of milliseconds, then divide by 256.

figure 1.2 shows the EIGRP packet header. Notice that following the autonomous systems number are the Type/Length/Value (TLV) triplets. Some common TLVs are the EIGRP parameter TLV, the IP internal route TLV, and the IP external route TLV[3].
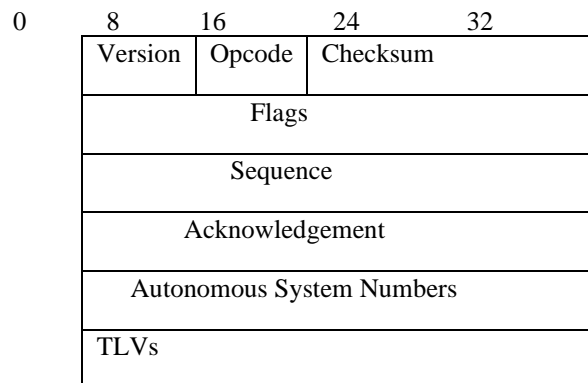
0	8	16	24	32
Version	Opcode	Checksum		
Flags				
Sequence				
Acknowledgement				
Autonomous System Numbers				
TLVs				

Figure 1.2. EIGRP Packet Header

The EIGRP packet parameters are described as follows:

- **Version**— Specifies different versions of EIGRP. Version 2 of EIGRP was imple-mented beginning with Cisco IOS Software Releases 10.3(11), 11.0(8), and 11.1(3). EIGRP Version 2 is the most recent version that contains many enhancements to improve the stability and scalability of EIGRP[5].
- **Opcode**— Specifies the types of EIGRP packet contained. Opcode 1 is the update packet, opcode 3 is the Query, opcode 4 is the reply, and opcode 5 is the EIGRP hello packet.
- **Checksum**— Used as the regular IP checksum, calculated based on the entire EIGRP packet, excluding the IP header.
- **Flags**— Involves only two flags now. The flag indicates either an init for new neighbor relationship or the conditional receive for EIGRP RTP.
- **Sequence**— Specifies the sequence number used by the EIGRP RTP.
- **Acknowledgment**— Used to acknowledge the receipt of an EIGRP reliable packet.
- **Autonomous System Number**— Specifies the number for the identification of EIGRP network range.

IV.CONFIGURATION:

Configuration between 2 Routers, Ethernet, Pc connection to each side, ip addresses are given[3].
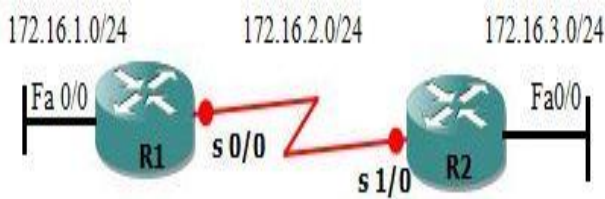

Fig .1.3

ROUTER 1
router>**en**
router#**config t**
router(config)#**hostname R1**
R1(config)#**enable secret cisco**
R1(config)#**line vty 0 4**
R1(config-line)#**password cisco**
R1(config-line)#**login**
R1(config-line)#**exit**
R1(config)#**^Z**
R1#
R1#**copy running-config startup-config**
Or
R1# **copy run start**
Or
R1#**wr me** (short for **write memory**)
Step 4: Adding IP Addresses
R1#**config t**
R1(config)#**int fa0/0**
R1(config-if)#**ip address 172.16.1.1 255.255.255.0**
R1(config-if)#**no shutdown**
R1(config-if)#**int s0/0**
R1(config-if)#**ip address 172.16.2.1 255.255.255.0**
R1(config-if)#**clock rate 64000**
R1(config-if)#**no shutdown**
R1(config-if)#**end**
R1#
R1#**config t**
R1(config)#**router RIP**
R1(config-router)#**network 172.16.1.0**
R1(config-router)#**network 172.16.2.0**
R1(config-router)#**end**
R1#
R1#**show ip protocols**
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 4 seconds
Invalid after 180 seconds, hold down 180, flushed after 240
Outgoing update filter list for all interfaces is not set
Incoming update filter list for all interfaces is not set
Redistributing: rip
Default version control: send version 1, receive any version
Interface   Send Recv Triggered RIP Key-chain
FastEthernet0/0   1   2 1
Serial0/0   1   2 1
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
172.16.0.0
Passive Interface(s):
Routing Information Sources:
Gateway   Distance   Last Update
172.16.2.2   120   00:00:24

Distance: (default is 120)
R1#
R1#**show ip int brief**

Interface IP-Address OK? Method Status Protocol

FastEthernet0/0   172.16.1.1   YES manual up
up
 Serial0/0   172.16.2.1   YES manual up
up
R1#
R1#
R1#config t
R1(config)#**no ip routing**
R1(config)#**ip routing**
R1(config)#**router eigrp 10**
R1(config-router)#**network 172.16.2.0**
R1(config-router)#**network 172.16.1.0**
R1(config-router)#**no auto-summary**
R1(config-router)#**^Z**
R1#

R1#**show ip route**

Codes: C - connected, S - static, I - IGRP, 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, E - EGP
    i - IS-IS, 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
    172.16.0.0/24 is subnetted, 3 subnets
C   172.16.1.0 is directly connected, FastEthernet0/0
C   172.16.2.0 is directly connected, Serial0/0
D   172.16.3.0 [90/20514560] via 172.16.2.2, 00:06:07, Serial0/0
R1#**show ip eigrp topology**

IP-EIGRP Topology Table for AS 10
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
    r - Reply status
P 172.16.1.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/0
P 172.16.2.0/24, 1 successors, FD is 20512000
    via Connected, Serial0/0
P 172.16.3.0/24, 1 successors, FD is 20514560
    via 172.16.2.2 (20514560/28160), Serial0/0
R1#**show ip eigrp neighbors**
IP-EIGRP neighbors for process 10
H Address   Interface   Hold Uptime   SRTT RTO
Q Seq

(sec) (ms)   Cnt Num
0 172.16.2.2   Se0/0   13 00:07:04 40   1000 0 3

R1#

ROUTER 2
router>**en**
router#**configt**
router(config)#**hostname R2**
R2(config)#**enable secret cisco**
R2(config)#**line vty 0 4**
R2(config-line)#**password cisco**
R2(config-line)#**login**
R2(config-line)#**exit**
R2(config)#**^Z**
R2#
R2#**copy running-config startup-config**
Or
R2# **copy run start**
Or
R2#**wr me** (short for **write memory**)
Step 4: Adding IP Addresses
R2#**config t**
R2(config)#**int fa0/0**
R2(config-if)#**ip address 172.16.3.1 255.255.255.0**
R2(config-if)#**no shutdown**
R2(config-if)#**int s0/0**
R2(config-if)#**ip address 172.16.2.2 255.255.255.0**
R1(config-if)#**no shutdown**
R1(config-if)#**end**
R1#
RouterA#**config t**
R2(config)#**router RIP**
R2(config-router)#**network 172.16.2.0**
R1(config-router)#**network 172.16.3.0**
R1(config-router)#**end**
R1#
R2(config)#**no ip routing**
R2(config)#**ip routing**
R2(config)#**router eigrp 10**
R2(config-router)#**network 172.16.2.0**
R2(config-router)#**network 172.16.3.0**
R2(config-router)#**no auto-summary**
R2(config-router)#**^Z**
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#**sh ip route**
Codes: C - connected, S - static, I - IGRP, 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, E -
EGP
i - IS-IS, 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
   172.16.0.0/24 is subnetted, 3 subnets
D   172.16.1.0 [90/20514560] via 172.16.2.1, 00:20:08,
Serial0/0
C   172.16.2.0 is directly connected, Serial0/0

C   172.16.3.0 is directly connected, FastEthernet0/0

R2#**show ip eigrp topology**

IP-EIGRP Topology Table for AS 10
Codes: P - Passive, A - Active, U - Update, Q - Query, R -
Reply,
    r - Reply status
P 172.16.3.0/24, 1 successors, FD is 28160
       via Connected, FastEthernet0/0
P 172.16.2.0/24, 1 successors, FD is 20512000
       via Connected, Serial0/0
P 172.16.1.0/24, 1 successors, FD is 20514560
       via 172.16.2.1 (20514560/28160), Serial0/0

R2#**show ip eigrp neighbors**

IP-EIGRP neighbors for process 10
H Address   Interface   Hold Uptime   SRTT RTO
Q Seq
(sec)   (ms)   Cnt Num
0 172.16.2.1   Se0/0   10 00:20:44 40   1000 0 3
PC>ping 172.16.3.2

Pinging 172.16.3.2 with 32 bytes of data:
Reply from 172.16.3.2: bytes=32 time=156ms TTL=126
Reply from 172.16.3.2: bytes=32 time=93ms TTL=126
Reply from 172.16.3.2: bytes=32 time=78ms TTL=126
Reply from 172.16.3.2: bytes=32 time=94ms TTL=126

Ping statistics for 172.16.3.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 78ms, Maximum = 156ms, Average = 105ms
PC>

PC>ping 172.16.1.1

Pinging 172.16.1.1 with 32 bytes of data:
Reply from 172.16.1.1: bytes=32 time=94ms TTL=254
Reply from 172.16.1.1: bytes=32 time=62ms TTL=254
Reply from 172.16.1.1: bytes=32 time=63ms TTL=254
Reply from 172.16.1.1: bytes=32 time=62ms TTL=254
Ping statistics for 172.16.1.1:

   Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
   Minimum = 62ms, Maximum = 94ms, Average = 70ms
PC>

V. COMPARISON

Basic differences between RIPv1 and EIGRP is mentioned
below[3].

RIPv1	EIGRP
• Distance-vector protocol. • Uses UDP port 520. • Classful protocol • Metric is router hop count. • Maximum hop count is 15; unreachable routes have a metric of 16. • Periodic route updates broadcast (255.255.255.255) every 30 seconds. • 25 routes per RIP message. • Implements split horizon with poison reverse. • Implements triggered updates. • No support for authentication. • Administrative distance for RIP is 120. • Used in small, flat networks or at the edge of larger networks.	• Hybrid routing protocol • Uses IP protocol 88. • Classless protocol • Default composite metric of bandwidth and delay. • You can factor load and reliability into the metric. • Sends route updates to multicast address 224.0.0.10. • Sends partial route updates only when there are changes. • Support for authentication. • Uses DUAL for loop prevention. • By default, equal-cost load balancing. Unequal-cost load balancing with the variance command. • Administrative distance is 90 for EIGRP internal routes, 170 for EIGRP external routes, and 5 for EIGRP summary routes. • Potential routing protocol for the core of a network; used in large networks.

VI.CONCLUSION

Routing protocols have evolved and have been adapted to the needs of increasingly complex networks. Therefore, when a protocol is chosen, many factors must take into account[4]. Some of them are the type of network it is wanted to be implemented, which future applications will be running in the network, its potential growth, etc.

In order to avoid some limitations of RIPv1, for example classful addressing, a network administrator can use RIPv2, which allows VLSM and CIDR. Moreover, RIPv2 supports authentication. This characteristic ensures that routers only accept routing information from routers that have been authenticated[5].

EIGRP keeps a topology table of the network and uses the DUAL algorithm to select a loop-free path. EIGRP uses the notions of successor and feasible successor and the query process to achieve fast convergence. EIGRP also carries the subnet mask information when sending out routing update. This enables EIGRP to support discontiguous networks and VLSM, which makes EIGRP a scalable routing protocol capable of fitting today's network requirements[6].

REFERENCES

1. Komala CR, Srinivas Shetty, Padmashree S., Elevarasi E., "Wireless Ad hoc Mobile Networks", National Conference on Computing Communication and Technology, 2010,pp. 168-174.
2. Dan P., Lixia Z., and Dan M., "A Framework for Resilient Internet Routing Protocols," Computer Journal of IEEE Network, vol. 4, no. 1, 2004, pp. 1-36.
3. Jeff. Doyle, Jennifer Carroll "Routing TCP / IP", Pearson Education, Second edition, 2006.
4. Talal Mohamed Jaffar, "Simulation-Based Routing Protocols Analysis (Thesis)" Ph.D Thesis, Dept. Elect. Eng., Georgia Institute of Technology, 2007.
5. Amir Ranjbar, "Troubleshooting and Maintaining Cisco IP Networks (TSHOOT)",Cisco Press,Indian Polis,USA, first edition, 2010.
6. Thorenoor, S.G., "Dynamic Routing Protocol Implementation Decision between EIGRP, OSPF and RIP Based on Technical Background Using OPNET Modeler", April 23-25, 2010. Computer and Network Technology (ICCNT), 2010 Second International Conference. Vol. 1, pp. 191-195.
7. Jeff. Doyle, Jennifer Carroll "Routing TCP / IP", Pearson Education, Volume I, Second edition, 2006.