International Journal For Technological Research In Engineering
Volume 3, Issue 10, June-2016 *ISSN (Online): 2347 - 4718*

A COMPARATIVE STUDY OF IGP AND EGP ROUTING PROTOCOLS, PERFORMANCE EVALUATION ALONG LOAD BALANCING AND REDUNDANCY ACROSS DIFFERENT AS

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Abstract: The term routing refers to taking a packet from one device and sending it through the network to another device on a different network. Routers don' t really care about hosts‑they only care about networks and the best path to each one of them. The logical network address of the destination host is key to get packets through a routed network. It' s the hardware address of the host that' s used to deliver the packet from a router and ensure it arrives at the correct destination host. In this paper, we have performed a comparative analysis of Interior Gateway Routing Protocols (IGRP) and an Exterior Gateway Routing Protocol (EGP) performance evaluation. This is to find out the best protocol combination for any complex scenario to achieve fast and reliable communication. Hot Standby Routing Protocol (HSRP) and Gateway Load Balancing Protocol (GLBP) are also simulated to analyse the load balancing and redundancy parameter for Border Gateway Protocol (BGP).
Index Terms: BGP, IGRP, EGP, HSRP, GLBP, GNS3, Wire Shark and Routing Protocols.

I. INTRODUCTION

In today's era, communication technologies growing rapidly to accommodate the increasing demand of high speed applications and networks. Therefore, technological inventors are expected to design and develop efficient solutions and applications to support the end user high speed network requirements. The Network is a combination of multiple connected hosts over cables or via wireless media to exchange information or data. The open systems interconnection (OSI) refrence model was created , to determine the compatibility of various connected devices for communication. The routing protocols are implemented in network layer of the model. To kinds of routing protocols are used for internal and external network communication , namely, Interior gateway protocols (IGP) and Exterior gateway protocols (EGP). IGPs are used for routing within an AS and EGPs are used for routing between different AS. Among the IGPs, Open Shortest Path First (OSPF) and Enhanced Interior Gateway Routing Protocol (EIGRP) are considered prominent protocols for real-time applications within a single AS. Intermediate System to Intermediate System (IS-IS) is mostly used in large scalable networks, and, therefore, is more popular in use within Internet Service Provider's (ISP) networks. Border Gateway Protocol (BGP) is the Exterior Gateway Routing Protocol, which allows different Autonomous Systems (AS) to intercommunicate. An Autonomous System is a group of networks under the same administrative control. In this research paper, we have used three scenarios running on the different combination of multiple routing protocols. The simulation is implemented on the "GNS3" network simulation software and Wireshark is used to observe the data transmission traffic and capture the packets. The results provide a guideline for the selection of the best combination of protocols for any given scenario under specific parameters. Hot Standby Routing Protocol (HSRP) and Gateway Load Balancing Protocol (GLBP) are also simulated to analyse the load balancing and redundancy for Border Gateway Protocol (BGP).

II. RELATED WORKS

Over the past two decades, a lot of research has been published on the comparative performances of IGPs. BGP is advisable when multi-homing to multiple ISP's or whentrying to communicate with an alternate AS [5]. [6] Concluded that OSPF has the best detection mechanism but is practically more suitable for limited networks because of the higher possibility for packets to drop from different areas while EIGRP is better suited for scalable networks. [3] Suggests that EIGRP is more suitable for topologies with few routers while IS-IS is ideal for complex topologies because of its higher scalability feature. [7] Studied their implementation with varying sizes of topologies and suggested that EIGRP is better suited for networks with the critical delivery that cannot tolerate errors while OSPF is more suitable for networks with bandwidth constraints.

A. Routing Protocols Overview

The Interior Gateway Routing Protocols have two broad classifications, Distance-Vector and Link State. The Distance-Vector Protocols use the Bellman-Ford algorithm, which calculates the shortest path from a single node by considering the negative edge weights. Data is forwarded using the best paths selected from the routing tables. They are further classified into RIP (version 1 - version 2) and EIGRP. Link-State Routing Protocols calculates the best path from source to destination using the Dijkstra algorithm, then present this information to all neighbouring routers. They are further classified into OSPF and IS-IS [1]. They also have the added advantage of being able to segment a network into multiple administrative clusters, known as areas. BGP is the Exterior Gateway Protocol, and unlike the others; is a path-vector protocol

1.*Routing Information Protocol (RIP) (version 1-2)*

Routing Information Protocol (RIP) is a true distance-vector routing protocol. RIP sends the complete routing table out of all active interfaces every 30 seconds. It relies on hop count to determine the best way to a remote network, but it has a maximum allowable hop count of 15 by default, so a destination of 16 would be considered unreachable. RIP works okay in Very small networks, but it's super inefficient on large networks with slow WAN links or on networks with a large number of routers installed and completely useless on networks that have links with variable bandwidths.

2.Enhanced IGRP (EIGRP)

EIGRP is a classless, enhanced distance-vector protocol that gives us a real edge over another Cisco proprietary protocol, Interior Gateway Routing Protocol (IGRP). That's basically why it's called Enhanced IGRP. Like IGRP, EIGRP uses the concept of an autonomous system to describe the set of contiguous routers that run the same routing protocol and share routing information. But unlike IGRP, EIGRP includes the subnet mask in its route updates. And as you now know, the advertisement of subnet information allows us to use VLSM and summarization when designing our networks!

3.Open Shortest Path First

Open Shortest Path First is an open standard routing protocol that's been implemented by a wide variety of network vendors, including Cisco. And it's that open standard characteristic that's the key to OSPF's flexibility and popularity. Most people opt for OSPF, which works by using the Dijkstra algorithm to initially construct a shortest path tree and follows that by populating the routing table with the resulting best paths. EIGRP's convergence time may be blindingly fast, but OSPF isn't that far behind, and its quick convergence is another reason it's a favorite. Another two great advantages OSPF offers are that it supports multiple, equal-cost routes to the same destination, and like EIGRP, it also supports both IP and IPv6 routed protocols.

4) Intermediate System to Intermediate System (IS-IS)

IS-IS is mostly used by ISPs because it's a great protocol for large internetworks due to its simplicity, stability, and better support for MPLS. This protocol is similar to OSPF, for it also uses areas to break down the routing domain into smaller. It also establishes adjacencies using the Hello protocol and exchanges link state information using LSPs [7 - 1]. Within an AS, IS-IS routing only takes place at level 1 and level 2.

5) Border Gateway Protocol (BGP)

BGP is a path vector protocol, built to work between multiple AS. It maintains path information that gets updated dynamically with incremental updates, unlike the IGPs which periodically flood the whole network with the known topology information. BGP maintains a separate routing table based on the shortest AS path and other attributes, as opposed to IGP metrics like distance, or cost [14]. BGP uses multiple neighbours, known as peers. These are further classified into - iBGP peers, which route within the same AS, and eBGP peers, which route between separate AS. In iBGP, there is no restriction that states that neighbours have to be directly connected. However, an iBGP peer will not advertise the prefix learned from one to another iBGP peer to avoid routing loops within the same AS.

TABLE 1. SUMMARISED COMPARISION OF THE ROUTING PROTOCOLS

	RIPv2	EIGRP	OSPF	IS-IS	BGP
Int/Ex	Int	Int	Int	Int	Ex
Type	DV	Hyb	LinkS	LinkS	PV
Def Metric	Hop C	BW/ Delay	Cost	Cost	Mul attri
Adm D	120	90 int 170 ext	110	115	200 intn 20 ext
Hop CL	15	224 (100 def)	None	None	EBGP: 1 IBGP: None
Conv	Slow	Very fast	Fast	Fast	Average
Upd	Full T	O Chg	O Chg	O Chg	O Chg

B. Problems of BGP and their solutions

1)HSRP is a Cisco proprietary protocol used to establish a fault-tolerant default gateway. The protocol provides a gateway failover for the network connected to the router. This protocol can be used for redundancy and load-sharing.

2) Gateway Load-Balancing Protocol (GLBP)

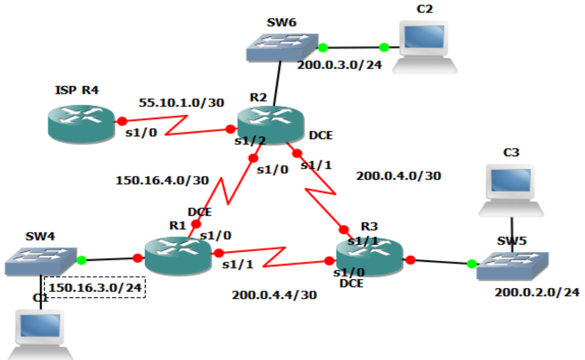
GLBP allows load-balancing of traffic from a network segment without the different host IP configurations required to achieve the same results with HSRP. Load balancing does not actually depend on the traffic load incoming and outgoing but is based on the number of hosts connecting to the gateway router.

III. EXPERIMENT SETUP

In this research, we have created three network models to test the suggestion by [8], and analysed the load balancing and redundancy performance of BGP.

A. Scenario 1(RIP v2 and EIGRP)

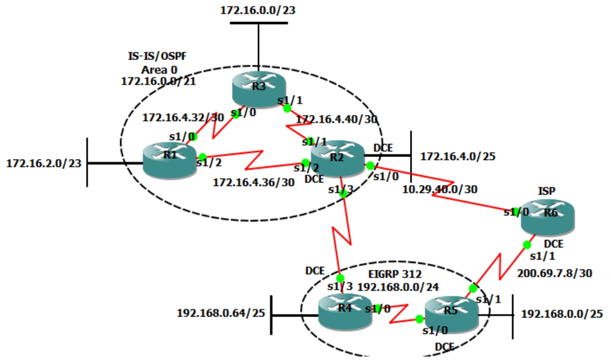
The first scenario (Fig. 2) was created to accommodate a simple topology, with 4 routers - 1 simulated an ISP and 3 switches connected to 3 routers and a host from each network connected to each router to test the connectivity and monitor traffic from each end of the topology.



B. Scenario 2(EIGRP and OSPF)

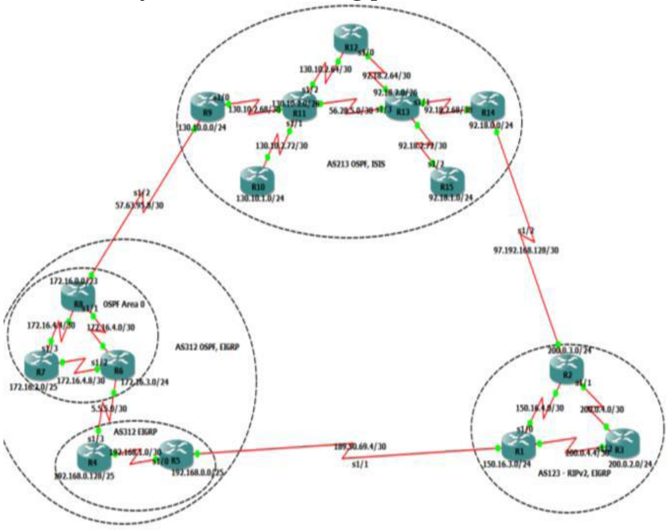
The second scenario (Fig. 3) is similar to the first. 2 more outers are introduced in another cluster, each connected to the same ISP. The first cluster serves as a backbone area for

OSPF, which is implemented independently and evaluated, with EIGRP configured on the other cluster. The ISP is connected via the default route to both clusters.



C. Scenario 4 (BGP)

There was one major variation done to each scenario before interconnecting them (Fig. 5). Since each scenario is connected to another with two different links, there is no direct need of a service provider link. To evaluate the better option, HSRP and GLBP were implemented at different times, before generating traffic using “Chargen”, a feature built-in to TCP. It is disabled by default for security purposes, as it can be used to launch DoS attacks by spoofing an IP address [13]. The server sends a continuous stream of TCP packets once the connection is made, up to 5mb of data per minute, which is just enough to evaluate the effectiveness of redundancy and load-balancing protocols.



IV. RESULTS AND DISCUSSIONS

A. Scenario 1- RIP vs EIGRP

The scenario was first run on RIPv2, then EIGRP. The timestamps of each frame and the total number of frames were recorded. After the analysis, the serial links between R4 and R5, R5 and R6 were configured with RIPv2 and EIGRP respectively. The link between R1 and R2 was removed to check the effectiveness of the redundant link between R4 and R6. To allow the protocols to communicate with each other, the redistribution command was used. Each simulation was recorded for a period of 300 seconds. For further testing, after the result analysis, multiple hosts were added to each connected network to study the convergence time under a higher traffic load.

TABLE 2
SUMMARY OF SCENARIO 1 RESULTS

RIP	
Total No of frames	92
Total captured bytes	(156+116)*11 = 2992
EIGRP	
Total No of frames	218
Total captured bytes	(109*64) = 6976 bytes where 109 = number of EIGRP frames
After Redistribution Total No of frames	1110
Total captured bytes	(44+56)*100 = 10000 bytes where 100 = number of frames

B. Scenario 2 – EIGRP vs OSPF

This scenario used a different approach because of the segmentation into separate areas and the protocols running simultaneously. Both areas connect to the same ISP and are also set to redistribute and intercommunicate. Results of connectivity within both areas were separately monitored before the intercommunication link was configured.

TABLE 3
SUMMARY OF SCENARIO 2 RESULTS

EIGRP	
Total No of frames	216
Total captured bytes	216*64 = 13824
Total observation time	315S
OSPF	
Total No of frames	142
Total captured bytes	84*142 = 11928
Total observation time	320s
After Redistribution Total No of frames	225
Total captured bytes	148*64 = 9472
Total observation time	320s

C. Scenario 3 – HSRP and GLBP Evaluation

HSRP was configured on an alternate topology with the same parameters to analyse the comparative studies. GLBP was configured as the final step of the simulation, to distribute the traffic loads accordingly while giving priority to the most complex scenarios with a higher number of hosts. We produced as much traffic as possible and all links were individually monitored for 10 minutes. We can observe from table 5 that the complexity of the AS links did not matter because the generated traffic remained approximately the same. These routing protocols do not offer load balancing. Therefore, protocols like HSRP and GLBP is needed for redundancy and load balancing.

TABLE 4
SUMMARY OF SCENARIO 3 RESULTS

OSPF	
Total No of frames	142
Total captured bytes	72*84 = 6048
Total observation time	317s
IS – IS	
Total No of frames	75
Total captured bytes	75*74 = 5550
Total observation time	318s
After Redistribution	
Total No of frames	74
Total captured bytes	74*85 = 6290
Total observation time	318s

V. CONCLUSION

Based on the simulation results and recorded values, it can be concluded that EIGRP and OSPF are the best combination of protocols for a given network with about 1000 hosts. However, a combinations EIGRP and RIPv2 would be better suited for a smaller network because of the absence of segmented areas. IS-IS has been known as the best protocol for ISP's and really large enterprises because of its scalability, fast convergence and added the advantage of not needing IP connectivity to be able to communicate with neighbours. The results also show that it communicates well with OSPF, due to their similarities. Therefore, the combination of the two protocols would be better than configuring only 1 of them for any given scenario with complex parameters.

ACKNOWLEDGMENT
I would like to thank Mr. Sunil Kumar for his valuable technical input to this project.

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