Beyond Inherent Routing Metrics: A simulated comparison of Routing Information Protocol and Enhanced Interior Gateway Routing Protocol.

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ABSTRACT

This paper empirically compared the two routing protocols Routing Information Protocol (RIP) and Enhanced Interior Gateway Routing Protocol (EIGRP). A simulated environment was developed with a network setup to test and compare overall throughput of data transmission output in the contextual implementation of either routing protocols. The results of the experiment showed that RIP provides faster transmission and response times as compared to EIGRP implementation under the simulated environment in the event of all conditions are equal. This paper used a simulated environment to compare the routing protocols' performance in an attempt to go assess the specific protocols beyond their inherent features.

Keywords: Routing Protocols, Protocol performance, RIP, EIGRP, Comparing Routing Protocols

Aims Research Journal Reference Format:
Danquah P., Lartey J.D. & Kani J.A. (2018): Beyond Inherent Routing Metrics: A simulated comparison of Routing Information Protocol and Enhanced Interior Gateway Routing Protocol. Advances in Multidisciplinary & Scientific Research Journal. Vol. 4. No.2, Pp 35-46

1. INTRODUCTION.

Computer networks that have routers may have routing done statically or dynamically in its implementation. Dynamic routing protocols may be implemented to reduce administrative work and also make room for scalability or easy growth of the network. Routing dynamically requires the implementation and configuration of routing protocols, a routing protocol is a language or set of rules by which routers share information about the reachability and status of networks. The criteria for exchanging routing information typically includes procedure to select the best path based on the destination's reachability information in a route table. The procedure leverages on routing metrics that is determined through specific routing algorithms of the specific routing protocol in use. The routing metrics is used to determine a ranking of paths to a remote destination from the most preferred to least preferred. The metrics range from hop counts, costs, routing convergence, scalability and other factors. Routing protocols may share information via varying approaches depending on its design, information may be shared first among its immediate neighbors, and then subsequently throughout the network. Routers ultimately obtain knowledge of the topology of the network.

1.1 Objective

This paper sets out to compare routing protocols based on results obtained from tests carried beyond the inherent metrics of the routing protocols. Specifically, network round trip times and time to live are used to compare the protocols on the basis of message round trip and time to live for packets transmitted.

2. LITERATURE REVIEW

Types of Routing Protocols: "Routing protocols are classified into distance vector and link state. Distance vector routing protocol is based on Bellman – Ford algorithm and Ford – Fulkerson algorithm to calculate paths" (Wang, Chang & Cheng, 2009). A distance vector routing protocol uses a distance calculation and a vector direction of next hop router as reported by neighboring routers to choose the best path. It requires that a router informs its neighbors of topology changes periodically. "Link state routing protocols build a complete topology of the entire network are and then calculating the best path from this topology of all the interconnected networks" (Seeger & Khanna, 1986). Generally, link state routing protocols require more processing power and memory due to its tendercy to have a complete picture of the network. Classful and Classless Routing Protocols: Classful routing protocols are routing protocols that do not transmit subnet mask information within the routing updates, they also operate in such a way that that every interface and host on the network must essentially use the same subnet mask in addressing.

The classful routing protocols therefore have the tendency to be wasteful with more address spaces and also sending out periodic routing updates to all active interfaces of each router thereby causing congestion on the slower Wide Area Network links (Fuller & Li, 2006). Classless routing protocols on the other hand include subnet mask information when transmitting routing updates to neighboring routers' routing tables. As classless routing protocols' updates are exchanged, it allows using the networks with the different length of subnet masks thus supporting Classless Inter-Domain Routing (CIDR) and Variable Length Subnet Mask (VLSM).Classless routing protocols exchange the entire routing table with the neighbor routers only at the very first time and routing updates are sent only when changes occur in the network topology (Doyle & Carroll , 2005). This significantly reduces bandwidth consumption.

2.1 Static and Dynamic Routing

Routing may be done statically or dynamically, Static routing is the process of manually making routing entries into a router's routing table, in static routing, all the changes in the layout of the logical network must be manually done by the system administrator. Dynamic routing on the other leverages on the routing protocols to automatically gathers routing paths from other connected routers to determine the best path even if or when there is a real time logical network layout change.

"Dynamic routing protocols are also further categorized into Interior Gateway Protocols (IGP) distance vector, IGP link-state and Exterior Gateway Protocols (EGP)" (Lammle, 2007). Typical examples are Routing Information Protocol, Open Shortest Path First and Border Gateway Protocol respectively.

2.2 The Routing Protocols in Context

Routing Information Protocol (RIP): This routing protocols is a distance-vector routing protocol which employs the concept of hop count as its routing metric. RIP makes use of limits on number of hops allowed to prevent possible routing loops between source to destination. RIP inherently allows a maximum of 15 hops from source to destination, this invariably limits the size of networks that RIP can support. "RIP implements the split horizon, route poisoning and holddown mechanisms to prevent incorrect routing information from being propagated" (Lammle, 2007). Routers running RIP by default broadcast updates with their routing table every 30 seconds, RIP has not been successful in scaling as networks have grown due to bursts in data transmission experienced every 30 seconds even if the routers had been initialized at random times (Balchunas, 2014) . It is however relatively easy to configure RIP because its configuration parameters are not many in number compared with other routing protocols. RIP is classful and as such does assume the default subnet mask during broadcast updates of the routing tables.

RIP version 2(RIPv2) was introduced as a result of challenges in implementation of RIP, RIP version 2 was developed with the ability to transmit subnet information during the exchange of routing updates for routing tables, thereby supporting Classless Inter-Domain Routing (CIDR) . To make sure that it was backward compatible with RIP, the hop count limit of 15 was maintained. "RIPv2 has facilities to fully interoperate with the earlier specification" (Atkinson & Fanto, 2007). To avoid a situation where unnecessary load is put on hosts that do not participate in routing, RIPv2 multicasts the entire routing table to all adjacent routers at the address 224.0.0.9 unlike RIPv1 which uses broadcast.

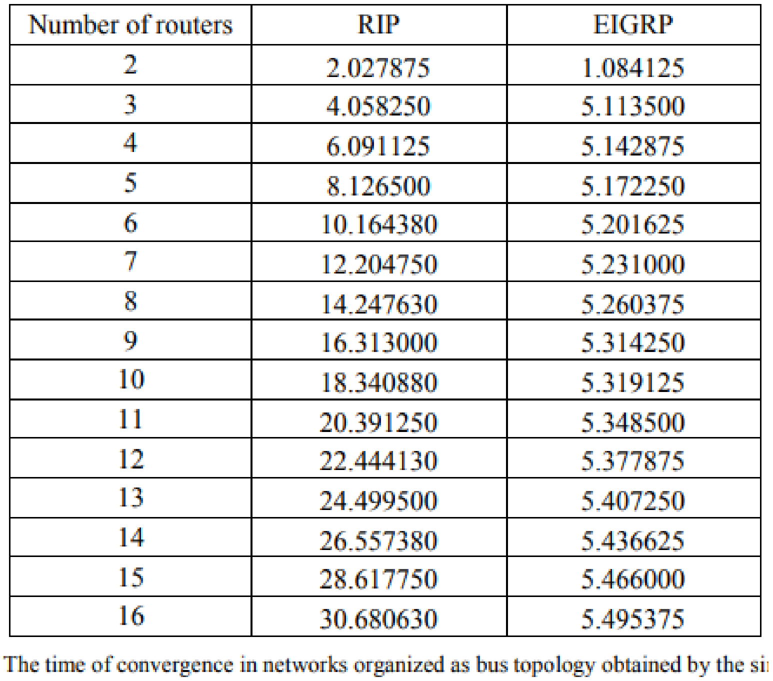
"Enhanced Interior Gateway Routing Protocol (EIGRP) is an advanced distance-vector routing protocol that is used on a computer network for automating routing decisions and configuration" (Lammle, 2007). The protocol was originally designed by Cisco Systems, it was also originally a proprietary routing protocol which was used to share routes with other routers within the same autonomous system. It was designed to only share incremental routing updates thereby reducing the workload on the routers and the amount of data that needs to be transmitted.

EIGRP operates in such a way that almost all routers contain a routing table which has embedded rules by which traffic is forwarded in a network. Technically, it leverages on the tables called neighbour, topology and routing table to store information about the network and how to reach destinations. "When a router running EIGRP is connected to another router also running EIGRP, information is exchanged between the two routers and a relationship is formed known as an adjacency. The entire routing table is exchanged between both routers at this time. After this has occurred, only differential changes are sent" (Pepelnjak, 2000). EIGRP is often considered a hybrid protocol because it is also sends link state updates when link states change. EIGRP is considered relatively optimal as compared to RIP in large networks because it updates only when a topology changes but not periodically unlike old Distance-Vector protocols such as RIP.
The EIGRP metric is based on its bandwidth, delay, reliability, load and Maximum Transmission Unit (MTU).

2.3 Related Research Work

(Scepanovic & Vukotic, 2013) compared RIP and EIGRP in their study and produced the figure 2 as the output of convergence time for the two routing protocols. This was evidently based on inherent functionalities of the routing protocols.

Table 1: Time of Convergence in Network



Number of routers	RIP	EIGRP
2	2.027875	1.084125
3	4.058250	5.113500
4	6.091125	5.142875
5	8.126500	5.172250
6	10.164380	5.201625
7	12.204750	5.231000
8	14.247630	5.260375
9	16.313000	5.314250
10	18.340880	5.319125
11	20.391250	5.348500
12	22.444130	5.377875
13	24.499500	5.407250
14	26.557380	5.436625
15	28.617750	5.466000
16	30.680630	5.495375

The time of convergence in networks organized as bus topology obtained by the si

Source: Scepanovic S. And Vukotic I. (2013)

In Scepanovic et al. (2013)'s same research work, the simulated topologies displayed in figure 1 were used to test the message sending times when bandwidth of RIP path is 56Kbps and also when bandwidth of EIGRP path is 10Mbps. This output is shown in figure 4 and message sending times when bandwidth of RIP path is 10Mbps and bandwidth of EIGRP path is 100Mbps is shown in figure 5.

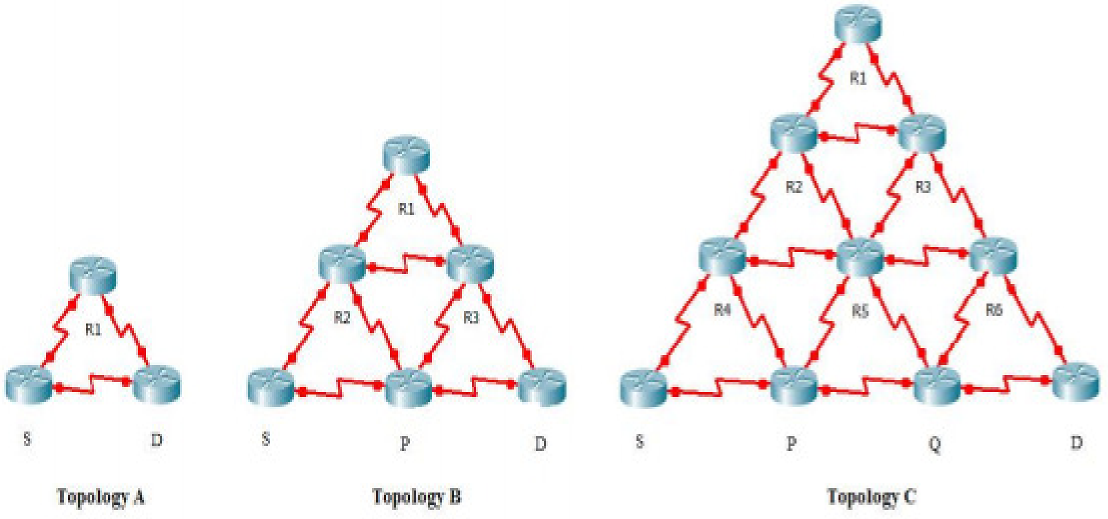
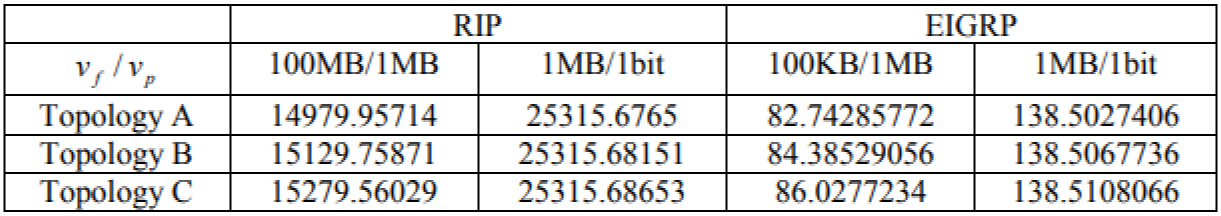


Figure 1: Source is Scepanovic S. And Vukotic I. (2013)

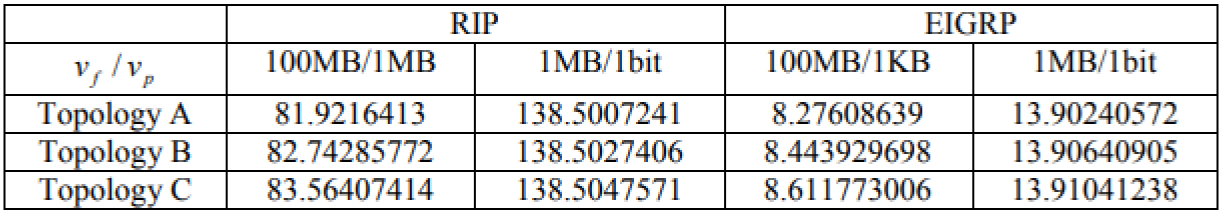
Table 2: Results when 100 packages are sent between the source and the destination



	RIP		EIGRP	
v_f / v_p	100MB/1MB	1MB/1bit	100KB/1MB	1MB/1bit
Topology A	14979.95714	25315.6765	82.74285772	138.5027406
Topology B	15129.75871	25315.68151	84.38529056	138.5067736
Topology C	15279.56029	25315.68653	86.0277234	138.5108066

Source is Scepanovic & Vukotic, 2013

Table 3: Results when 8388608 packages are sent between the source and the destination



	RIP		EIGRP	
v_f / v_p	100MB/1MB	1MB/1bit	100MB/1KB	1MB/1bit
Topology A	81.9216413	138.5007241	8.27608639	13.90240572
Topology B	82.74285772	138.5027406	8.443929698	13.90640905
Topology C	83.56407414	138.5047571	8.611773006	13.91041238

Source is Scepanovic & Vukotic, 2013

Results in tables 2 and 3 depended on “the number of packages which had to be sent and two situations were considered, when 100 packages are sent between the source and the destination and when 8388608 packages are sent between the source and the destination” (Scepanovic et al, 2013).

Deng & Sun (2014) in their study instructively concluded that EIGRP is the best choice for both large and small networks since it has the fastest convergence and EIGRP uses the bandwidth efficiently.

3. METHODOLOGY

Simulated methodologies are typically classified from three perspectives in literature. One answer is that all talk of “simulation” and “numerical experiments” is purely hyperbolic or metaphorical—simulation is nothing more and nothing less than using brute-force computational means to solve analytically intractable equations. A second view, in which the terms “simulation” and “numerical experiment” are taken quite literally, a simulation is a stand-in, or mimic, of a real-world system, and can therefore be experimented on just like any other experimental target. The third is the view that simulation is a brand new “third mode” of science, neither experimental nor theoretical. (Winsberg, 2003). This research specifically uses a simulator called Packet Tracer developed by cisco systems to technically generate and compare the output of routing protocols as they converge and route data. The comparison is done using the round trip time and time to live.

Round-trip time (RTT) is defined as the length of time taken for a signals to be sent plus the length of time it takes for an acknowledgement of the signal to be received. The time delay in this context also includes the propagation times for the paths between the two communication endpoints (Comer, 2000). Time to live (TTL) on the other hand is a mechanism that limits the lifespan or lifetime of data in a computer or network. TTL is typically deployed either as a counter or timestamp in the data. In some instances, it may be attached to the data. The objective of implementing TTL is the effectively ensure that data is discarded or revalidated when the prescribed event count or the prescribed timespan has elapsed.

The simulator is used to setup a network consisting of a set of computers on two separate local area networks interconnected via two optional paths consisting of four routers. The paths are segmented into paths one and two with bandwidths of 64Kbps and 1024000Kbps respectively. The configuration of RIP and EIGRP are effected on all routers separately and connectivity between the two networks is tested. Specifically, connectivity is tested between PC2 and PC0, thus, 20.0.0.1/8 and 10.0.0.1/8. This test is done via paths one and two separately to record round trip times and time to live values for purposes of comparison. The ultimate comparison of the feedback depicts the efficiency of the specific routing protocols comparatively, the model of routers used was cisco 2900 at all routing points.

A visual representation of the network topology is displayed in figure 2 below.

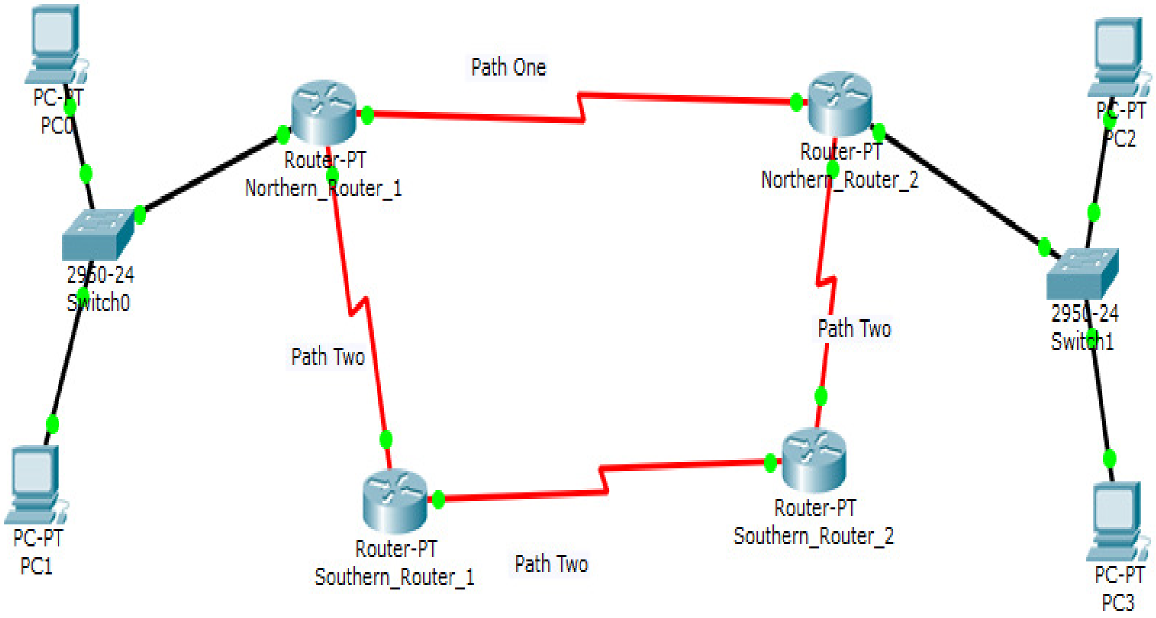


Figure 2: Source is Scepanovic & Vukotic, 2013

The specific machine names and their respective configurations are provided below, the essence is to provide a broad overview of the simulated environment.

Table 4: Address Configuration of Computers

No	Computers	IP Address
1	PC0	10.0.0.1/8
2	PC1	10.0.0.2/8
3	PC2	20.0.0.1/8
4	PC3	20.0.0.2/8

Table 5: Configuration of Routers on RIP and EIGRP Platforms

No	Router	Configuration for RIP	Configuration for EIGRP
1	Northern_Router_1	interface FastEthernet0/0 ip address 10.0.0.10 255.0.0.0 duplex auto speed auto interface Serial2/0 bandwidth 64000 ip address 30.0.0.1 255.0.0.0 clock rate 2000000 interface Serial3/0 bandwidth 1024000 ip address 40.0.0.1 255.0.0.0 clock rate 2000000 router rip network 10.0.0.0 network 30.0.0.0 network 40.0.0.0	interface FastEthernet0/0 ip address 10.0.0.10 255.0.0.0 duplex auto speed auto interface Serial2/0 bandwidth 64000 ip address 30.0.0.1 255.0.0.0 clock rate 2000000 interface Serial3/0 bandwidth 1024000 ip address 40.0.0.1 255.0.0.0 clock rate 2000000 router eigrp 10 network 10.0.0.0 network 30.0.0.0 network 40.0.0.0 auto-summary
2	Northern_Router_2	interface FastEthernet0/0 ip address 20.0.0.10 255.0.0.0 duplex auto speed auto interface Serial2/0 bandwidth 64000 ip address 30.0.0.2 255.0.0.0 interface Serial3/0 bandwidth 1024000 ip address 60.0.0.2 255.0.0.0 clock rate 2000000 router rip network 20.0.0.0 network 30.0.0.0 network 60.0.0.0	interface FastEthernet0/0 ip address 20.0.0.10 255.0.0.0 duplex auto speed auto interface Serial2/0 bandwidth 64000 ip address 30.0.0.2 255.0.0.0 interface Serial3/0 bandwidth 1024000 ip address 60.0.0.2 255.0.0.0 router eigrp 10 network 20.0.0.0 network 30.0.0.0 network 60.0.0.0 auto-summary
3	Southern_Router_1	interface Serial2/0 bandwidth 1024000 ip address 40.0.0.2 255.0.0.0 interface Serial3/0 bandwidth 1024000 ip address 50.0.0.1 255.0.0.0 clock rate 2000000 router rip network 40.0.0.0 network 50.0.0.0	interface Serial2/0 bandwidth 1024000 ip address 40.0.0.2 255.0.0.0 interface Serial3/0 bandwidth 1024000 ip address 50.0.0.1 255.0.0.0 clock rate 2000000 router eigrp 10 network 50.0.0.0 network 40.0.0.0 auto-summary
4	Southern_Router_2	interface Serial2/0 bandwidth 1024000 ip address 50.0.0.2 255.0.0.0 interface Serial3/0 bandwidth 1024000 ip address 60.0.0.1 255.0.0.0 router rip network 50.0.0.0 network 60.0.0.0	interface Serial2/0 bandwidth 1024000 ip address 50.0.0.2 255.0.0.0 interface Serial3/0 bandwidth 1024000 ip address 60.0.0.1 255.0.0.0 clock rate 2000000 router eigrp 10 network 50.0.0.0 network 60.0.0.0 auto-summary

4. RESULTS AND ANALYSIS

The configurations shown in table 6 led to the generation of the routing tables depicted in tables 2 and 3 below;
Applicable Codes for Displayed Routes

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

Table 6: Routing Table for RIP Configuration

No	Router	RIP Routing Table
1	Northern_Router_1	C 10.0.0.0/8 is directly connected, FastEthernet0/0 R 20.0.0.0/8 [120/1] via 30.0.0.2, 00:00:25, Serial2/0 C 30.0.0.0/8 is directly connected, Serial2/0 C 40.0.0.0/8 is directly connected, Serial3/0 R 50.0.0.0/8 [120/1] via 40.0.0.2, 00:00:03, Serial3/0 R 60.0.0.0/8 [120/1] via 30.0.0.2, 00:00:25, Serial2/0
2	Northern_Router_2	R 10.0.0.0/8 [120/1] via 30.0.0.1, 00:00:26, Serial2/0 C 20.0.0.0/8 is directly connected, FastEthernet0/0 C 30.0.0.0/8 is directly connected, Serial2/0 R 40.0.0.0/8 [120/1] via 30.0.0.1, 00:00:26, Serial2/0 R 50.0.0.0/8 [120/1] via 60.0.0.1, 00:00:09, Serial3/0 C 60.0.0.0/8 is directly connected, Serial3/0
3	Southern_Router_1	R 10.0.0.0/8 [120/1] via 40.0.0.1, 00:00:00, Serial2/0 R 20.0.0.0/8 [120/2] via 50.0.0.2, 00:00:12, Serial3/0 [120/2] via 40.0.0.1, 00:00:00, Serial2/0 R 30.0.0.0/8 [120/1] via 40.0.0.1, 00:00:00, Serial2/0 C 40.0.0.0/8 is directly connected, Serial2/0 C 50.0.0.0/8 is directly connected, Serial3/0 R 60.0.0.0/8 [120/1] via 50.0.0.2, 00:00:12, Serial3/0
4	Southern_Router_2	R 10.0.0.0/8 [120/2] via 50.0.0.1, 00:00:27, Serial2/0 R 20.0.0.0/8 [120/1] via 60.0.0.2, 00:00:16, Serial3/0 R 30.0.0.0/8 [120/1] via 60.0.0.2, 00:00:16, Serial3/0 R 40.0.0.0/8 [120/1] via 50.0.0.1, 00:00:27, Serial2/0 C 50.0.0.0/8 is directly connected, Serial2/0 C 60.0.0.0/8 is directly connected, Serial3/0

Table 7: Routing Table for EIGRP Configuration

No	Router	EIGRP Routing Table
1	Northern_Router_1	C 10.0.0.0/8 is directly connected, FastEthernet0/0 D 20.0.0.0/8 [90/554496] via 30.0.0.2, 00:07:00, Serial2/0 C 30.0.0.0/8 is directly connected, Serial2/0 C 40.0.0.0/8 is directly connected, Serial3/0 D 50.0.0.0/8 [90/1026304] via 40.0.0.2, 00:07:02, Serial3/0 D 60.0.0.0/8 [90/1063936] via 30.0.0.2, 00:07:00, Serial2/0
2	Northern_Router_2	D 10.0.0.0/8 [90/554496] via 30.0.0.1, 00:07:40, Serial2/0 C 20.0.0.0/8 is directly connected, FastEthernet0/0 C 30.0.0.0/8 is directly connected, Serial2/0 D 40.0.0.0/8 [90/1063936] via 30.0.0.1, 00:07:40, Serial2/0 D 50.0.0.0/8 [90/1026304] via 60.0.0.1, 00:07:42, Serial3/0 C 60.0.0.0/8 is directly connected, Serial3/0
3	Southern_Router_1	D 10.0.0.0/8 [90/540160] via 40.0.0.1, 00:06:23, Serial2/0 D 20.0.0.0/8 [90/1052160] via 50.0.0.2, 00:06:23, Serial3/0 D 30.0.0.0/8 [90/1063936] via 40.0.0.1, 00:06:23, Serial2/0 C 40.0.0.0/8 is directly connected, Serial2/0 C 50.0.0.0/8 is directly connected, Serial3/0 D 60.0.0.0/8 [90/1026304] via 50.0.0.2, 00:06:23, Serial3/0
4	Southern_Router_2	D 10.0.0.0/8 [90/1052160] via 50.0.0.1, 00:05:33, Serial2/0 D 20.0.0.0/8 [90/540160] via 60.0.0.2, 00:05:33, Serial3/0 D 30.0.0.0/8 [90/1063936] via 60.0.0.2, 00:05:31, Serial3/0 D 40.0.0.0/8 [90/1026304] via 50.0.0.1, 00:05:33, Serial2/0 C 50.0.0.0/8 is directly connected, Serial2/0 C 60.0.0.0/8 is directly connected, Serial3/0

The results obtained from the connectivity tests are as detailed below;

RIP Results via Path One

```
C:\>tracert 10.0.0.1
Tracing route to 10.0.0.1 over a maximum of 30 hops:
  1   2 ms      0 ms      0 ms      20.0.0.10
  2   1 ms      0 ms      0 ms      30.0.0.1
  3   1 ms      2 ms      1 ms      10.0.0.1
Trace complete.

C:\>ping 10.0.0.1
Pinging 10.0.0.1 with 32 bytes of data:
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms

C:\>tracert 10.0.0.1
Tracing route to 10.0.0.1 over a maximum of 30 hops:
  1   0 ms      1 ms      1 ms      20.0.0.10
  2   0 ms      1 ms      1 ms      60.0.0.1
  3   3 ms      1 ms      2 ms      50.0.0.1
  4   2 ms      1 ms      1 ms      40.0.0.1
  5   11 ms     11 ms     11 ms     10.0.0.1

Trace complete.

C:\>ping 10.0.0.1
Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time=3ms TTL=124
Reply from 10.0.0.1: bytes=32 time=11ms TTL=124
Reply from 10.0.0.1: bytes=32 time=11ms TTL=124
Reply from 10.0.0.1: bytes=32 time=11ms TTL=124

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 11ms, Average = 9ms
```

RIP Results via Path Two

```
C:\>tracert 10.0.0.1

Tracing route to 10.0.0.1 over a maximum of 30 hops:

  1   0 ms      1 ms      1 ms      20.0.0.10
  2   0 ms      2 ms      0 ms      30.0.0.1
  3   1 ms      0 ms      0 ms      10.0.0.1

Trace complete.

C:\>ping 10.0.0.1

Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
```

```
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms
```

EIGRP Results via Path One

```
C:\>ping 10.0.0.1
Pinging 10.0.0.1 with 32 bytes of data:

Request timed out.
Reply from 10.0.0.1: bytes=32 time=2ms TTL=126
Reply from 10.0.0.1: bytes=32 time=2ms TTL=126
Reply from 10.0.0.1: bytes=32 time=10ms TTL=126

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss), Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 10ms, Average = 4ms

C:\>tracert 10.0.0.1
Tracing route to 10.0.0.1 over a maximum of 30 hops:
  1   1 ms      0 ms      0 ms      20.0.0.10
  2   1 ms      0 ms      2 ms      30.0.0.1
  3   0 ms      0 ms      0 ms      10.0.0.1
Trace complete.
```

EIGRP Results via Path Two

```
C:\>tracert 10.0.0.1
Tracing route to 10.0.0.1 over a maximum of 30 hops:
  1   0 ms      0 ms      0 ms      20.0.0.10
  2   1 ms      2 ms      0 ms      60.0.0.1
  3   0 ms      1 ms      1 ms      50.0.0.1
  4   3 ms      10 ms     0 ms      40.0.0.1
  5   11 ms     12 ms     11 ms     10.0.0.1

Trace complete.

C:\>ping 10.0.0.1

Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time=4ms TTL=124
Reply from 10.0.0.1: bytes=32 time=11ms TTL=124
Reply from 10.0.0.1: bytes=32 time=11ms TTL=124
Reply from 10.0.0.1: bytes=32 time=11ms TTL=124

Ping statistics for 10.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 4ms, Maximum = 11ms, Average = 9ms


C:\>tracert 10.0.0.1

Tracing route to 10.0.0.1 over a maximum of 30 hops:

  1   0 ms      0 ms      1 ms      20.0.0.10
```

```
 2   1 ms     2 ms     0 ms     30.0.0.1
 3   0 ms     1 ms     1 ms     10.0.0.1

Trace complete.

C:\>ping 10.0.0.1

Pinging 10.0.0.1 with 32 bytes of data:

Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=1ms TTL=126
Reply from 10.0.0.1: bytes=32 time=2ms TTL=126

Ping statistics for 10.0.0.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss), Approximate round trip times in milli-seconds:
Minimum = 1ms, Maximum = 2ms, Average = 1ms
```

Table 8: Empirical Comparison Simulation Results

Metric	**RIP Platform Values** (milli-seconds)	**EIGRP Platform Values** (milli-seconds)
Path One Time to Live (Average)	4	4
Path One Round Trip (Average)	1	4
Path Two Time to Live (Average)	11	11.3
Path Two Round Trip (Average)	4	9

Table 8 shows a summarized comparison of the test output, the metrics for comparison are the average time to live and average round trip from the “tracert” and “ping” results. Evidently, the average time to live is consistent by default for both routing protocols however, the round trip produces significantly varying results. RIP tends to produce quicker round trips averaging 4 milli-seconds whereas EIGRP produces 9 milli-seconds on a bandwidth of 1024000Kbps. On the bandwidth of 64Kbps, RIP tends to produce quicker round trips averaging 1 milli-seconds whereas EIGRP produces 4 milli-seconds. The results obtained imply a speed of over 100% faster in transmission over an RIP network as against an EIGRP network.

Scepanovic et al. (2013) posited that “in most cases (when network is configured as bus, point-to-point, ring or hierarchy topology) message sending time is equal for the RIP and for the EIGRP protocols and does not depend on the bandwidth of links or on the number of sent packages. But in cases when because of the greater bandwidth of links, EIGRP chooses faster but longer path, message sending time through those paths is much fewer than through paths which RIP chose. Based on all results which were obtained, it was concluded that in most cases EIGRP is preferable protocol, especially when great amount of data has to be sent through the network”.

The findings in this research is however not absolutely consistent with that of Deng et al (2014) as cited under “Related Research” and Scepanovic et al (2013) above, this is mainly because emphasis in this experiment is on round trip and time to live and not convergence time. The results clearly depicts a different picture where RIP is experienced as having a faster round trip compared to EIGRP under the topology shown in figure 1.

5. CONCLUSION

This paper set out to empirically compare the two routing protocols Routing Information Protocol (RIP) and Enhanced Interior Gateway Routing Protocol (EIGRP). Having developed a simulated environment with a network setup to test and compare overall round trip times and time to live values experienced on a single topology and different bandwidths, the results of the experiment showed that RIP provides faster transmission and response times as compared to EIGRP implementation under the simulated environment in the event of all conditions are equal. Compared to earlier research work done predominantly on inherent metrics of the routing protocols, this research output tells a relatively different story from that experienced by simulations done with inherent features as the focus. The researcher would recommend that this research is done on multiple topologies for further validity and reliability of findings.

6. DIRECTION FOR FUTURE WORK

Given the outcome of this research, it is evident that inherent metrics of routing protocols do not necessarily translate into overall throughput and performance. A necessary future work would be to replicate the research in different topologies and also an attempt to compare other routing protocols from a throughput and performance perspective.

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