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Comparative Analysis Of Convergence Times Between RIP And EIGRP Routing Protocols In A Network

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ABSTRACT

The convergence time of a network is very essential to a network. Networks that converge faster are considered to be very reliable. Users of the network appreciate it when they are always able to access resources. The research was carried out to compare the convergence of two routing protocols namely RIP and EIGRP. Network scenarios were created and a simulation was performed using packet tracer to measure the convergence times of both protocols separately. Results indicated that EIGRP had the fastest convergence time and both protocols' convergences were not affected by a change in topology. This will help network administrators in their choice of protocols.

Keywords: Convergence time, Network, Protocol, RIP, EIGRP, Routing, Topology

1. INTRODUCTION

Computer networks have come to stay with us. A network is believed to have converged when the routing tables on all routers within the network are complete and correct. The period of resource sharing has demanded the adoption of computer networks. In this present age, the eagerness to share data between computer users is rapidly growing. Various forms of social media has taken over with the ability to contact friends and relatives either by video, voice or text in real-time. Since the demand for these kind of internet applications is increasing, it is essential that a better communication framework is implemented to ensure that messages are delivered without delays. Routing protocols play a major role in the delivery of packets from source to destination addresses. In the study, two routing protocols namely Routing Information Protocol (RIP) and Enhanced Information Gateway Routing Protocol (EIGRP) were compared to determine their convergence time in a given network topology.

1.1 AIM

The aim of this research is to comparatively study two routing protocols namely RIP and EIGRP to find their times of convergence in a specific network topology.

1.2 RESEARCH OBJECTIVES

The objectives of this research are as follows:

- To determine the convergence time for RIP in a particular network topology.
- To determine the convergence time for EIGRP for the same topology used for RIP.
- To compare the performance of RIP and EIGRP.

1.3 RESEARCH QUESTIONS

The following are the research questions that were posed in order to accomplish the objectives.

- What is the convergence time for RIP in a given topology?

- What is the convergence time for EIGRP in a given topology?
- Which of the two routing protocols has the fastest convergence time in the topology used?

2. LITERATURE REVIEW

Convergence has many meanings in the English language but in the context of computer networks, a network is said to have converged when all routers in a network have the same topological information about their network they find their selves in. With the help of routing protocols, routers collect topological information (Shah & Waqas 2013). Convergence is a required property in routing especially dynamic routing. There are about three forms of routing namely static, default and dynamic (Lammle 2007). A network topology is said to have converged "when routing tables on all routers within the network are complete and correct" (Todorovic 2011). Convergence has also been observed as a manner in which a network recovers from problems and changes in the network (IXIA 2014).

Convergence time is the time that is required for the routers in a network to learn about routes in a given network. This time is important because it helps administrators of a network to determine in the event that a network downtime occurs due to a failed link between routers or any damage to one router the amount of time it will take for that network to recover and begin to function as a normal network.

(Shah & Waqas 2013) performed analysis of RIP and OSPF using OPNET which is a simulator widely used for networking related analysis. In their research, they analysed the performance of these protocols based on their convergence, traffic and CPU utilization by changing special parameters within the network. From their research, they found out that the convergence of OSPF was faster than that of RIP regardless of the network topology.

(Todorovic & Sepanovic 2011) also analysed the process of convergence on real-time routers configured with RIP version 2 and EIGRP on real-time systems. They ensured that the processes of convergence started simultaneously on all routers involved. They observed that a small number of measurements were consistent with theoretical explanation of routing process.

3. METHODOLOGY

The method for this research was a simulation of scenarios (see **Appendix** for the topologies). To help with this simulation, Packet tracer, a simulator by CISCO was employed. Packet tracer was chosen because it allows network behaviour experimentation and also helps in answering *what-if* scenarios.

3.1 RIP RESULTS

Table 1-6 depict results obtained when RIP was configured on the network topologies as illustrated in the **Appendix**.

Table 1: Convergence time measurement on Network 1 (with 2 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	01:00	01:10	01:16	16	1
2	01:17	01:22	01:20	5	3
3	02:15	02:17	02:19	4	3
4	02:40	02:44	02:43	4	3
5	03:30	03:31	0:34	4	3
6	04:05	04:07	04:09	4	3
7	04:20	04:22	04:24	4	3
8	05:05	05:06	05:07	2	2
9	05:15	05:17	05:19	4	3
10	06:10	06:27	06:17	17	1

Table 2: Convergence time Measurement for Network 2 (with 3 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	04:12	04:49	04:20	04:30	37	1
2	04:26	04:30	04:32	04:31	6	3
3	05:20	05:30	05:57	05:45	37	1
4	05:40	05:45	05:48	05:44	8	3
5	07:20	07:24	07:22	07:23	4	2
6	07:45	07:48	07:51	05:50	6	3
7	08:20	08:22	02:23	08:24	4	2
8	09:12	09:22	09:39	09:30	17	1
9	10:12	10:18	10:14	10:17	6	3
10	11:10	10:16	10:14	10:13	6	3

A change in topology was thought to produce different results but yielded the same results as before.

Table 2b: Convergence time measurement for Network 3 (topology changed for three router)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	04:12	04:49	04:20	04:30	37	1
2	04:26	04:30	04:32	04:31	6	3
3	05:20	05:30	05:57	05:45	37	1
4	05:40	05:45	05:48	05:44	8	3
5	07:20	07:24	07:22	07:23	4	2
6	07:45	07:48	07:51	05:50	6	3
7	08:20	08:22	02:23	08:24	4	2
8	09:12	09:22	09:39	09:30	17	1
9	10:12	10:18	10:14	10:17	6	3
10	11:10	10:16	10:14	10:13	6	3

Table 3: Convergence time Measurement for Network 4 (with 4 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	07:09	07:20	07:22	07:25	07:30	21	1
2	07:35	07:40	07:43	07:42	07:40	8	3
3	08:30	08:35	08:35	08:38	08:36	8	3
4	08:45	08:53	08:50	08:52	08:50	8	3
5	09:15	09:20	09:20	09:21	09:17	6	2
6	09:45	09:51	09:50	09:48	09:48	6	2
7	10:00	10:05	10:06	10:04	10:06	6	2
8	10:30	10:52	10:45	10:40	10:50	22	1
9	11:05	11:10	11:11	11:08	11:11	6	2
10	11:20	11:26	11:22	11:23	11:25	6	2

Table 4: Convergence time Measurement for Network 5 (with 5 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVERGED	R5 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	07:09	07:11	07:17	07:12	07:11	07:15	8	2
2	07:35	07:43	07:42	07:43	07:40	07:42	8	2
3	08:30	08:38	08:38	08:40	08:37	08:40	10	3
4	08:45	08:50	08:52	08:53	08:53	08:50	8	2
5	09:15	09:20	09:25	09:25	09:19	09:20	10	3
6	09:45	09:50	09:53	09:53	09:50	09:52	8	2
7	10:00	10:06	10:06	10:08	10:08	10:07	8	2
8	10:30	10:33	10:40	10:35	10:38	10:40	10	3
9	11:05	11:10	11:10	11:13	11:12	11:10	8	2
10	11:20	11:27	11:27	11:28	11:28	11:26	8	2

Table 5: Convergence time Measurement for Network 6 (with 6 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVER-GED	R5 CONVERGED	R6 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	04:12	04:20	04:22	04:20	04:22	04:21	04:22	10	2
2	04:26	04:40	04:40	04:38	04:39	04:39	04:40	14	3
3	05:20	05:29	05:29	05:30	05:29	05:30	05:29	10	2
4	05:40	05:48	05:48	05:50	05:48	05:50	05:47	10	2
5	07:20	07:34	07:34	07:28	07:30	07:30	07:33	14	3
6	07:45	07:55	07:58	07:59	07:59	07:58	07:58	14	3
7	08:20	08:27	08:30	08:29	08:30	08:29	08:27	10	2
8	09:12	09:22	09:22	09:18	09:19	09:19	09:18	10	2
9	10:12	10:19	10:21	10:22	10:20	10:20	10:18	10	2
10	11:10	11:24	11:24	11:22	11:22	11:23	11:23	14	3

Table 6: Convergence time Measurement for Network 7 (with 7 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVERGED	R5 CONVERGED	R6 CONVERGED	R7 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	07:09	07:18	07:18	07:19	07:19	07:17	07:18	07:18	10	2
2	07:35	07:45	07:45	07:49	07:45	07:49	07:47	07:48	14	3
3	08:30	08:38	08:39	08:40	08:40	08:39	08:38	08:39	10	2
4	08:45	08:55	08:55	08:50	08:54	08:54	08:50	08:55	10	2
5	09:15	09:27	09:28	09:29	09:28	09:28	09:26	09:27	14	3
6	09:45	09:59	09:55	09:59	09:58	09:57	09:50	09:55	14	3
7	10:00	10:13	10:12	10:14	10:12	10:12	10:13	10:14	14	3
8	10:30	10:38	10:38	10:39	10:40	10:39	10:35	10:37	10	2
9	11:05	11:13	11:14	11:12	11:15	11:15	11:10	11:14	10	2
10	11:20	11:28	11:30	11:29	11:29	11:27	11:30	11:28s	10	2

3.2 EIGRP RESULTS

Table 7-12 illustrate results obtained when EIGRP was configured on the same network topologies used for RIP (see **Appendix**).

Table 7: Convergence time Measurement for Network 1 (with 2 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	01:14	01:18	01:19	5	3
2	01:08	01:13	01:11	5	3
3	02:39	02:40	02:41	2	2
4	02:48	02:50	02:49	2	2
5	03:00	03:03	03:05	5	3
6	03:20	03:25	03:25	5	3
7	04:00	04:04	04:05	5	3
8	04:30	04:31	04:32	2	2
9	05:10	05:15	05:14	5	3
10	05:12	05:14	05:17	5	3

Table 8: Convergence time Measurement for Network 3 (with 3 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	07:09	07:13	07:14	07:13	5	3
2	07:35	07:40	07:38	07:38	5	3
3	08:30	08:33	08:35	08:35	5	3
4	08:45	08:55	08:59	08:55	14	1
5	09:15	09:25	09:28	09:28	13	1
6	09:45	09:49	09:49	09:50	5	3
7	10:00	10:04	10:05	10:04	5	3
8	10:30	10:34	10:34	10:35	5	3
9	11:05	11:08	11:09	11:10	5	3
10	11:20	11:29	11:30	11:34	14	1

Table 9: Convergence time Measurement for Network 4 (with 4 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	03:07	03:12	03:12	03:10	03:11	5	3
2	03:15	03:18	03:19	03:20	03:20	5	3
3	04:00	04:10	04:12	04:13	04:13	13	1
4	04:40	04:53	04:50	04:44	04:53	13	1
5	05:15	05:17	05:19	05:19	05:20	5	3
6	05:35	05:40	05:41	05:41	05:40	6	3
7	06:05	06:08	06:08	06:10	06:09	5	3
8	06:30	06:33	06:35	06:33	06:34	5	3
9	07:15	07:28	07:28	07:25	07:26	13	1
10	07:40	07:47	07:48	07:54	07:54	14	1

Table 10: Convergence time Measurement for Network 5 (with 5 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVERGED	R5 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	02:00	02:04	02:04	02:05	02:05	02:05	5	3
2	02:30	02:35	02:35	02:35	02:35	02:35	5	3
3	03:00	03:11	03:11	03:12	03:13	03:13	13	1
4	03:25	03:27	03:27	03:27	03:30	03:28	5	3
5	03:45	03:50	03:50	03:50	03:49	03:48	5	3
6	04:00	04:06	04:05	04:05	04:05	04:06	6	3
7	04:20	04:24	04:25	04:25	04:24	04:24	5	3
8	04:40	04:44	04:43	04:45	04:45	04:45	5	3
9	05:00	05:13	05:13	05:12	05:13	05:12	13	1
10	05:45	05:57	05:57	05:59	05:59	05:59	14	1

Table 11: Convergence time Measurement for Network 6 (with 6 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVERGED	R5 CONVERGED	R6 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	01:00	01:05	01:05	01:05	01:05	01:05	01:05	5	3
2	01:10	01:15	01:15	01:15	01:15	01:15	01:15	5	3
3	01:15	01:28	01:25	01:28	01:27	01:28	01:28	13	1
4	02:00	02:05	02:04	02:05	02:05	02:04	02:04	5	3
5	02:20	02:24	02:25	02:25	02:25	02:25	02:25	5	3
6	02:30	02:36	02:36	02:36	02:36	02:36	02:35	6	3
7	03:00	03:04	03:05	03:05	03:05	03:04	03:05	5	3
8	03:10	03:15	03:15	03:15	03:15	03:14	03:15	5	3
9	04:00	04:13	04:14	04:14	04:14	04:14	04:14	14	1
10	04:20	04:33	04:33	04:33	04:33	04:33	04:33	13	1

Table 12: Convergence time Measurement for Network 7 (with 7 Routers)

MEASUREMENT	START TIME	R1 CONVERGED	R2 CONVERGED	R3 CONVERGED	R4 CONVERGED	R5 CONVERGED	R6 CONVERGED	R7 CONVERGED	CONVERGENCE TIME	RESULTS GROUP
1	01:00	01:05	01:05	01:05	01:05	01:05	01:05	01:05	5	3
2	01:10	01:15	01:15	01:15	01:15	01:15	01:15	01:15	5	3
3	01:15	01:26	01:28	01:28	01:28	01:28	01:28	01:28	13	1
4	02:00	02:05	02:05	02:05	02:05	02:05	02:05	02:04	5	3
5	02:20	02:24	02:25	02:25	02:25	02:25	02:25	02:25	5	3
6	02:30	02:36	02:35	02:36	02:36	02:36	02:36	02:36	6	3
7	03:00	03:04	03:05	03:05	03:05	03:05	03:05	03:05	5	3
8	03:10	03:15	03:14	03:15	03:15	03:15	03:15	03:15	5	3
9	04:00	04:13	04:14	04:14	04:14	04:14	04:14	04:14	14	1
10	04:20	04:32	04:33	04:33	04:33	04:33	04:33	04:33	13	1

The measurements results were placed into three main groups (Todorovic 2011). The first group consist of measurements that was rejected. These were mainly where interfaces were changing from a down state to an up state. These changes do not give way for an accurate reading. The second group of measurement were those measurements that were consistent with theory. The third group are the groups that contained some certain amount of delay.

3.3 READING FROM RIP

The final value that was chosen as the convergence time is the highest or the worst-case value. In the first scenario where two routers were used, the convergence time was 5ms. When the routers were increased to three, the time was 8ms. For four routers, the time for convergence was 8ms. When the number of routers was increased to five, the convergence time recorded 10ms. 14ms was recorded for six and seven routers respectively.

3.4 READING FROM EIGRP

Values chosen as convergence times for EIGRP were in accordance with how those values were chosen for RIP. 5ms was recorded for two, three, and four routers respectively. When five routers and six routers were used, 6ms was recorded for each. When a seventh router was added, 7ms was recorded.

4. DISCUSSION AND CONCLUSION

From the experiment, it can be observed that, regardless of the topology, the convergence time remains the same whether for RIP or EIGRP. Another interesting observation made with EIGRP was that as the number of routers increases, the time for convergence were almost the same. This can be seen from the tables in the results section.

Also from the figures obtained from the various scenarios, it turned out that between RIP and EIGRP, EIGRP has the fastest convergence time which is 7ms whilst RIP has 14ms as its convergence time.

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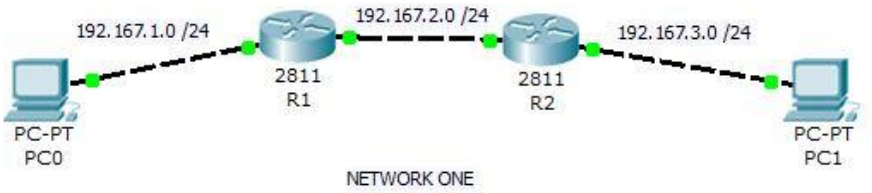
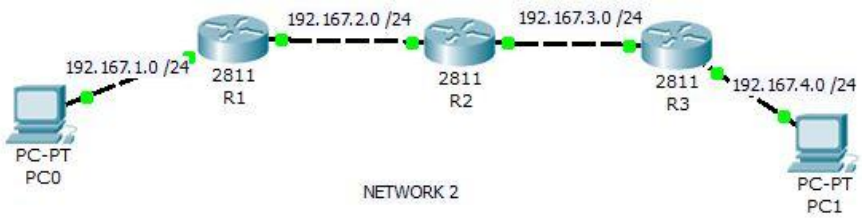
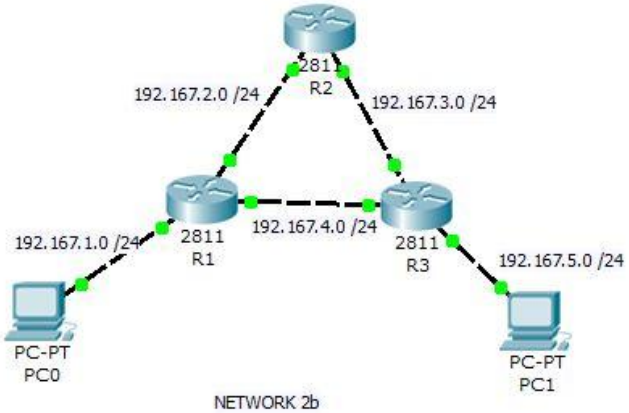
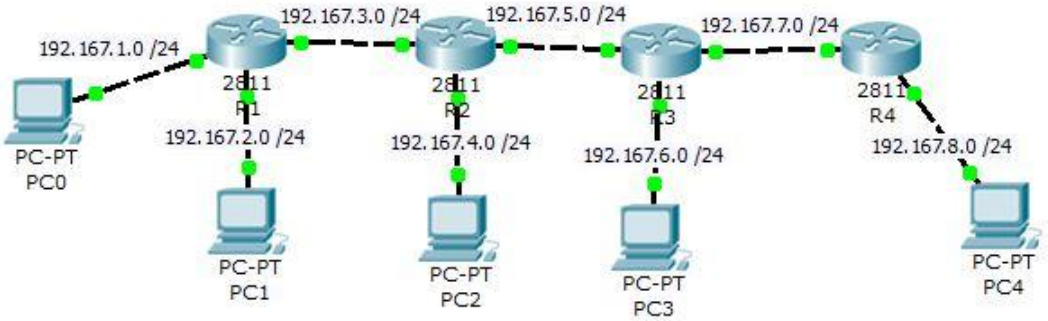
APPENDIX

The following are network topologies used in the experiments.

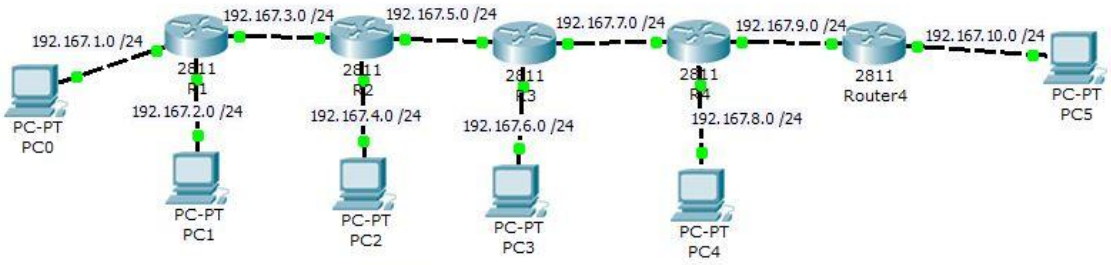








NETWORK 3



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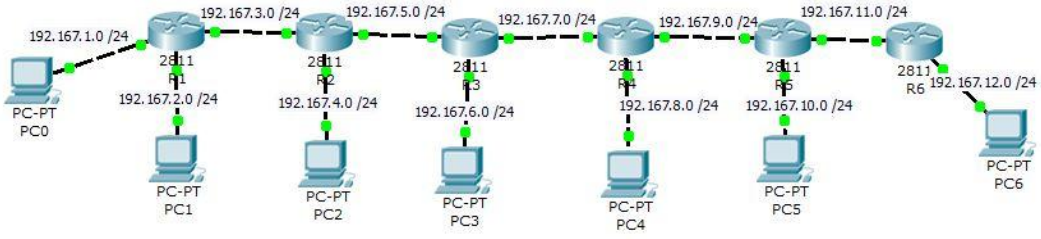

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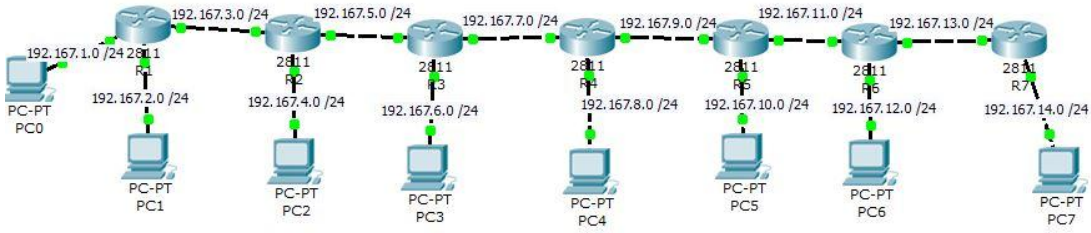

NETWORK 7