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An Evaluation of OSPF and EIGRP Routing Protocols Using Opnet Simulator

Ibrahim Mahdi Ibrahim
School of Technology, Katsina State Institute of Technology and Management, P.M.B 2101 Katsina, Nigeria

Abstract

Routing protocols are the key for communication network. OSPF and EIGRP are dynamic routing protocols used in a network to propagate topology information to neighbouring routers. There are a large number of dynamic and static routing protocols to be configured on a network but making the right choice of the protocol still remains an issue. This paper plans to evaluate the network performance of EIGRP and OSPF routing protocols. In order to achieve accurate results, two network scenarios are designed and configured respectively with EIGRP and OSPF and are simulated to observe how the performance varies between the two protocols. This is measured based on four parameters: FTP, Web browsing (HTTP), E-mail and Database. The results derived from these experiments aims to provide better understanding on Interior gateway protocols and general knowledge on how or which routing protocol should be configured on a given network.

Keywords: *Open Shortest Path First (OSPF); Enhanced Interior Gateway Protocol (EIGRP); Discrete Event Simulation (DES); Routing Protocols; Network Performance.*

Introduction

Routing is simultaneously the most complicated function of a network and the most important. Routing is the process routers perform when receiving packets, analyzing the destination address information, using the address information to select a path for the packets, and then forwarding the packet on to the next router on the selected network. A packet use hops to reach next device on the network (McDonald et al,

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2015). Packets can hop between different routers before reaching their final destination. At each hop, the router examines the destination IP address for each packet and the check the routing table for forwarding information.

Routing protocols are the key conveyor for protocol data unit in any communication network. OSPF and EIGRP are dynamic routing protocols used in a network to propagate topology information to neighbouring routers. There are a large number of dynamic and static routing protocols to be configured on a network but making the right choice of the protocol still remains an issue. This research evaluates the network performance of EIGRP and OSPF routing protocols. In order to achieve accurate results, two network scenarios are designed and configured respectively with EIGRP and OSPF and are simulated to observe how the performance varies between the two protocols. This is measured based on four parameters: FTP, Web browsing (HTTP), E-mail (SMTP) and Database Access.

EIGRP routing protocol is often regard to as a hybrid protocol because it advertises its routing table to its neighbors as distance vector protocols do, however it uses the HELLO packets and creates neighbor relationships, similarly to link state protocols. Routers use EIGRPs' link discovery and recovery mechanism to learn about other routers on their network (X. Che et al, 2014). On the other hand, OSPF routing protocol is often known as hierarchical routing protocol because of its ability to divide large areas into small multiple areas. This includes the concept of area routers and edge routers. Area routers routes within the area while edge routers provide the facility for routing between the multiple areas (Gupta and Kaur, 2012).

Several simulations based studies have been performed to evaluate the performance of routing protocols on a Network using certain applications and parameters. However, most of these studies tends use the following parameters (Convergence Time, Jitter, End-to-End Delay, Throughput, Video Conferencing and Voice Conferencing) to evaluate performance of the routing protocols. As OSPF and EIGRP are the most common routing protocols used on the network, this study aims at providing the basic understanding of these Routing protocols and provides a guideline for optimal use while choosing

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routing protocols to obtain the best performance through implementation. This is measured based on four parameters: FTP (File Transfer), Web browsing (HTTP), E-mail and Database (Access). This paper is organized as follows. Section 2 discusses the related work. Section 3 illustrates the Methodology of this work. Simulation results are discussed in Section 4, and Section 5 concludes the paper along with the future scope.

Related Work

Muhammad and Ashique (2016) performed a simulation analysis of EIGRP and OSPF routing protocols based on real time applications. The comparative experiment was performed based on quantitative metrics (Convergence Time, Jitter, End-to-End Delay, Throughput and Packet Loss) on a proposed network topology. Based on their experiment, they proposed that network stability can be enhanced by reducing network convergence time of the routing protocol. Their experiment shows that EIGRP routing protocol has a much faster convergence time than OSPF routing protocol because EIGRP network learns about the topology information and sends updates faster the OSPF.

Furthermore, based on their results (Jaafar and Blair, 2015) proposed that the implementation of both EIGRP and OSPF routing protocols on a network performs better than implementing just one routing protocol on the network. This is due to the results of their simulations that show that End-to-End delay is relatively less; Delay variation is better; Packet Loss is less in a Network configured with both routing protocols. However, implementing both EIGRP and OSPF might make a network perform better, but this can only be on a large network and how about small networks? This requires higher implementation cost, higher CPU utilization and also requires the services of a network administrator with the knowledge of both EIGRP and OSPF routing protocols.

A comparative study by Yehia et al. (2011) proposed EIGRP routing protocol over OSPF routing protocol in terms of Network Convergence. Network convergence is the time it takes all routers in a network to recover back to operation after there is a change in the network topology (Basu and Rieke, 2008). The main focus of this study is to provide basic understanding of Interior

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gateway protocols regarding best possible efficiency and to provide a guideline for use while choosing routing protocols to obtain faster convergence and improved performance. The authors pointed out that OSPF routing protocol has a better behaviour in terms of Route Addition compared EIGRP. The reason is that OSPF deals with fewer routes addition than EIGRP. They also point out that OSPF routing protocol performs better when it comes to route deletion, Hop updates and Time between Updates. The authors concluded that EIGRP found much better on basis of its good CPU utilization, less time consumption, better convergence performance and ease in management. Effect of dividing OSPF Network into several areas in real-time applications was also studied by (Inderjeet and Sharma, 2011). This study focuses on the effect of OSPF areas on the quality of service of Voice over IP as an application layer level. Based on their results, the authors find that dividing an OSPF autonomous system (AS) into independent routing areas allow topology abstraction, reducing route overhead, table size and convergence time, while providing an isolation from incorrect routing data. Also, areas reduce connectivity thus increasing configuration complexity, routing path length and traffic concentration.

Methodology

This research followed a quantitative approach which involves the generation of data in quantitative form which can be subjected to rigorous quantitative analysis in a formal and rigid fashion. The data collected will be tabulated and presented according to the parameters used in the experiments. A simulation approach is adopted in which the network scenarios will be modeled using network simulation Tool. Discrete Event Simulation (DES) approach was adopted in order to evaluate the overall performance of the routing protocol. OPNET IT Guru is built on top of discrete event system and it simulates system behavior by modeling each event in the system and processing it through user defined processes (OPNET, 2012). Figure 1 shows the research operational framework and the phases involved;

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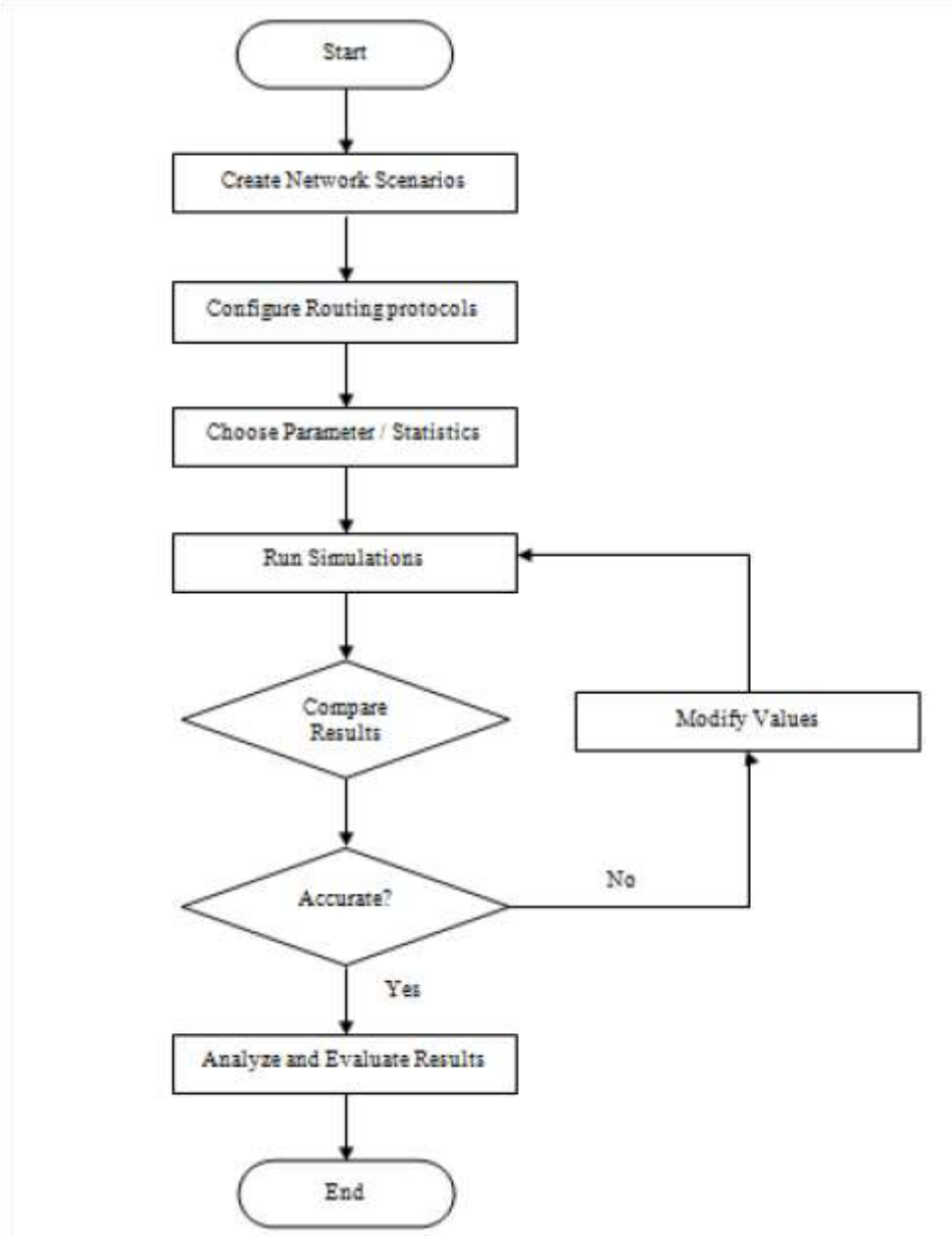

Fig. 1. Operational Framework

Simulation Parameters

The table below describes the relevant network Applications and Parameters used in performing the simulation experiments.

Table 1. Application Parameters

Application	Parameter	Unit
Email	Email upload response time	Seconds
	Email download response time	Seconds

FTP	FTP download response time	Seconds
	FTP upload response time	Seconds
HTPP	HTTP page response time	Seconds
	HTTP object response time	Seconds

OPNET Routing Protocol Model

To achieve accurate results, two network scenarios are designed and configured respectively with EIGRP and OSPF and are simulated to observe how the performance varies between the two protocols. This is measured based on four parameters: FTP, Web browsing (HTTP), E-mail and Database. The network model is designed based on a Campus with different departments. Five departments and an admin block are considered when designing the network. All the departments contain routers, switches, printer and workstations. An application object is configured with different applications to allow generating traffic to the network. The applications are defined in the profile definition object. A server is added to the topology and configured to support the preconfigured applications.

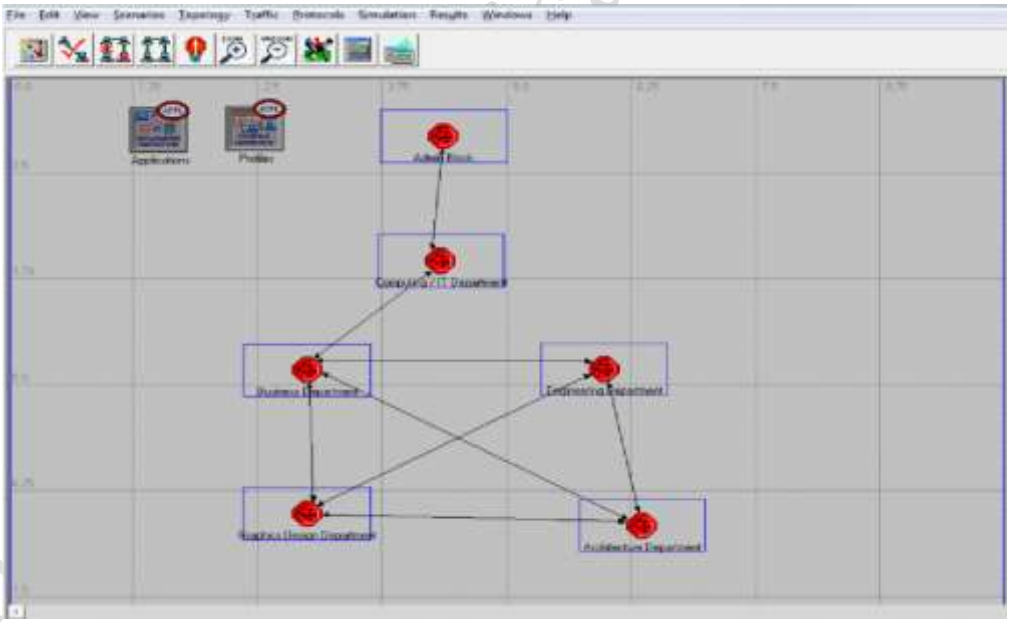

Fig. 2. OPNET network Topology

Simulation Results and Discussion

This section presents the comparative analysis of EIGRP and OSPF routing protocols. As mentioned earlier, two different scenarios were modelled to

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perform the experiment. One scenario is configured with EIGRP protocol and the other with OSPF protocol, each scenario is set to run simulation for 15 minutes. The data and statistics gathered from the simulation would be carefully analysed in this section.

Figure 3 shows the HTTP Page Response Time for the two network scenarios. EIGRP page response time is recorded from 1min 39secs to 14min 50secs. It has been noticed that at the starting point, it increases up to around 1min 48secs and then decreases down at around 5min 13secs from where it remains constant. Similarly, for OSPF, it is recorded from 1min 38secs to 14min 50secs. It increases up at to 1min 47secs and decreases down at around 4min 36secs from where it remains constant. This shows that OSPF routing protocol has a faster page response time than EIGRP routing protocol.

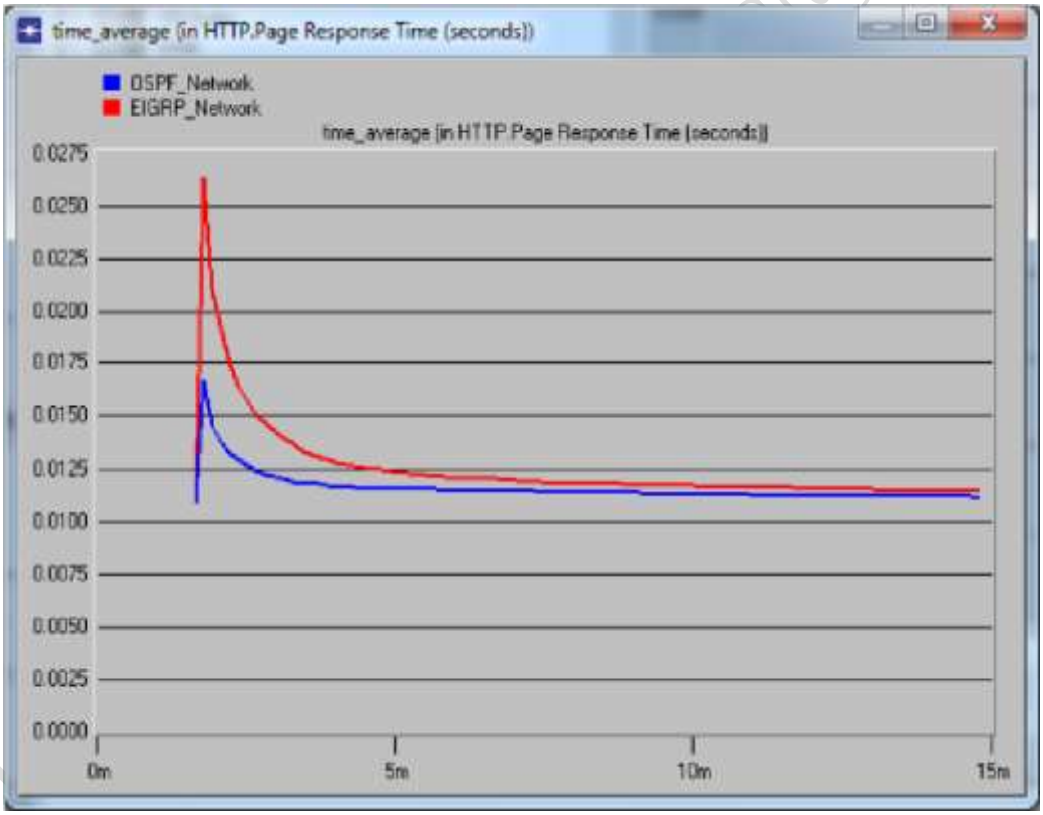

Fig. 3. HTTP page response time (sec)

In figure 4 the HTTP Object Response Time; OSPF is recorded from 1min 38secs to 14min 50secs and EIGRP with 1min 39secs to 14min 50secs. OSPF has the faster object response time.

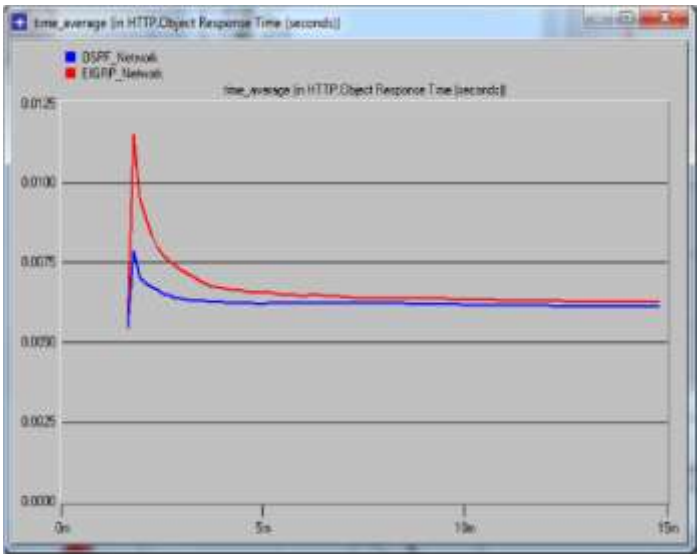

Fig. 4. HTTP object response time (sec)

In figure 5, OSPF FTP download response is recorded from 1min 38secs to 14min 50secs. From starting point, it increases to 1min 48secs and decreases down to 2min 22secs. It starts increasing at 2min 22secs and then decreases again at around 4m 38secs from where it remains constant. In EIGRP network, the Download response time is recorded between 1min 38secs to 14min 50secs, it increases up at 1min 46secs and decreases down at 2min 14secs. It starts increasing again at 2min 50secs from where it varies from time to time.

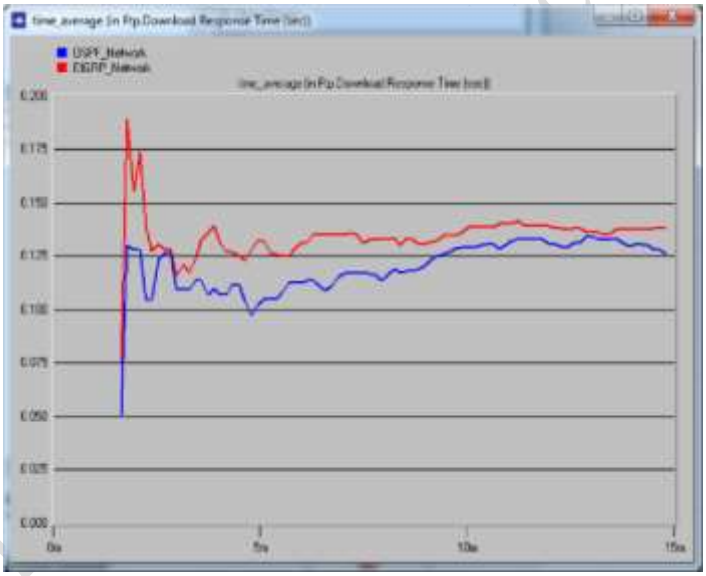

Fig. 5. FTP download response time (sec)

In figure 6, the FTP upload response time for EIGRP is recorded from 1m 38secs to 14m 50secs. From starting point, it increases up at 2m 5secs and starts decreasing at around 2m 50secs. Another increase was noticed at around 4m 48secs from where it starts to remain constant. OSPF is recorded from 1m 38secs to 14m 50secs also, it increases at 2m 42secs and decreases at around 4m 56secs, from where it remains constant. This graph reveals that OSPF protocol is a little bit faster than EIGRP protocol because it has a steadier reading than EIGRP.

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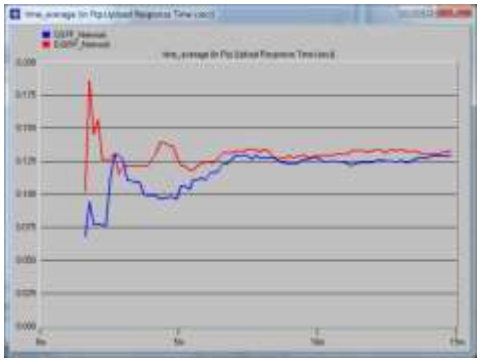

Fig. 6. FTP upload response time (sec)

In figure 7, the Email download response time with OSPF is recorded from 1m 38secs to 14m
50secs. It increases at 2m 6secs and decreases down at 2m 51secs from where it remains constant. In the Network with EIGRP, download response time is recorded from 1m 39secs to 14m 50secs. An increase is observed at 1m 47secs and decrease at 3m 18secs from where it remains constant.

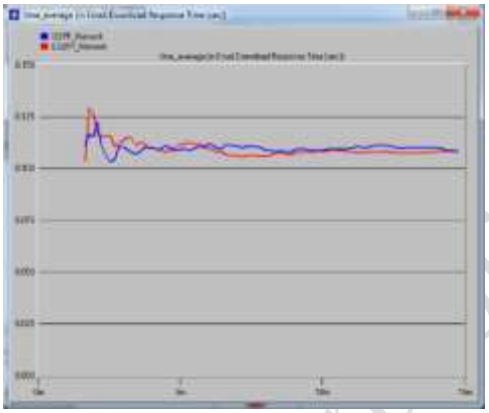

Fig. 7. Email download response time (sec)

In figure 8, the EIGRP upload response time is recorded from 1m 38secs to 14m 50secs. From starting point, there is increase at 1m 48secs and decreases at around 4m 38secs where it continues to be constant. The upload response is recorded from 1m 39secs with OSPF. It increases at 1m 57secs from starting point and decrease at 4m 48secs from where it remains constant. This show that Email upload response time is better with EIGRP routing protocol than OSPF protocol.

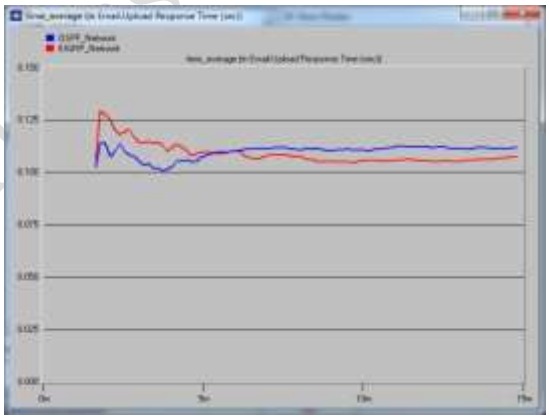

Fig. 8. Email upload response time (sec)

Conclusion

This paper has presented a comparative analysis of EIGRP and OSPF Routing protocols. The comparative analysis was done on a simple campus network with different protocols using real time applications.

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The overall performance was measured based on some parameters that aimed to figure out the effects of implementing certain routing protocols. Based on OPNET, the simulation result for Web browsing (HTTP) shows that the Network having OSPF routing protocol has a faster page response time. Thus, it is also evident that the use of OSPF routing protocol is useful and recommended for Downloading and Uploading processes on the Network.

Another performance metric measured is Email Upload response time, which measures the time required to compose and upload an email on the Network. In this case, the results reveal that Network with EIGRP Routing protocol has a better performance than the OSPF Network. It has also been observed that, Database entry response time is better with EIGRP Network. Database entry response time is the time required for entry by the client to be stored into the server. However, in the case of Query response time, OSPF Routing has a better performance.

Based on the simulation experiment performed and the results achieved, OSPF routing protocol has a better performance than EIGRP protocol. Even though the performance of each routing protocol is different from each other, the author recommends OSPF protocol to be useful on a campus network. Not only in terms of network performance, but also in terms of configuration cost, because OSPF can be configured on any router where as EIGRP is a proprietary protocol and can only be configured on a Cisco Device.

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