

Research Article

Performance Analysis of EIGRP via OSPF Based on OPNET and GNS3

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Abstract: In this study we present a simulation based comparative performance analysis between OSPF and EIGRP for real time applications by using Optimized Network Engineering Tools (OPNET) and Graphical Network Simulator (GNS3). In order to evaluate OSPF and EIGRP's performance, we have designed three network models where the first, second and third Network model are configured, respectively with OSPF, EIGRP and combination of EIGRP and OSPF. This study shows the estimation of proposed routing protocols based on the quantitative metrics such as Convergence Time, Throughput, End to End delay, Jitter and Packet Loss through the simulated network models. The evaluation results show that EIGRP routing protocol provides a better performance than OSPF routing protocol for real time applications.

Keywords: Convergence time, EIGRP, OSPF, routing protocol, throughput

INTRODUCTION

The routing protocol presents the way to transfer the messages from point to point over the network. So, the main purpose of the routing protocol is to transfer the data packets over the network (Celik *et al.*, 2013).

There are many routing protocols such as DSR routing protocol, Papaj *et al.* (2013), Wireless Mesh Network WMN routing, protocol (Tan *et al.*, 2013), RIP routing protocol, BGP routing protocol (Celik *et al.*, 2013) and also OSPF protocol which is presented in this study comparing with EIGRP protocol.

Open Shortest Path First (OSPF) is an adaptive tool to transfer routing information within a single autonomous system (Malik *et al.*, 2012). The main purpose of using OSPF protocol is done where this protocol divide the domain of the network into two levels of areas where the root presents a level which is connected with the rest areas in the second level (El-Sayed *et al.*, 2006). OSPF protocol is a dynamic protocol that gives the network more stability and compatibility (Heydarian, 2012).

The second protocol which is used in this study is the Enhanced Interior Gateway Routing Protocol (EIGRP), it is a classless protocol. This protocol is widely used in enterprise networks considering that this protocol has many advantages; this protocol is IPv6 ready and it is provide a quick convergence times. As mentioned in Pethe and Burnase (2011) there is an affective algorithm in EIGRP which is called Diffusing Update Algorithm (DUAL). This protocol

controls the routing process by finding an alternative path for routers without waiting. OPNET simulator is a powerful tool to obtain the results of the analysis by getting graphs for various network elements such as: video and voice traffic, switches, links and also the routers.

The main objective of this study is to show through the series of experiments the main advantages of the EIGRP protocol compare with the OSPF protocol regarding the performance of the network. EIGRP achieves better results regarding the convergence time, end-to-end delay time and throughput.

LITERATURE REVIEW

There are many studies discussed the ability and the compatibility of the network protocols and algorithms by using many concepts and methods were used to be a useful methods. Many researchers present many methods to enhance the routing protocols and in another hand there are studies analyze these procedures; here we briefly discussed some of them.

Sukhov and Chemodanov (2013) present a study to describe the routing process over a network using variation principles from physical theories and they used the universal metric to derive the metrics of many routing protocol such as OSPF protocol, EIGRP protocol and RIP protocol.

In Hacene and Lehireche (2011) the authors present a new technique to minimize the delay for data packets over a network, this technique is cleaning

process of route caches for nodes within an active route. They used the GLOMOSIM simulator to implement this technique which showed a good performance so this technique succeeds in solving the delay problem.

Another study that search for an optimal solution of the shortest path routing problem. The proposed algorithm reduced the delay of packets transfer over the network. They present a combinatorial algorithm that found an optimal link metrics in the shortest path routing (Ramakrishnan and Rodrigues, 2001).

METHODOLOGY

Simulation study: The protocols used in this project are EIGRP and OSPF routing protocols. The

proposed routing protocols (OSPF and EIGRP) are compared with each other and evaluated routing protocols. The proposed routing protocols (OSPF and EIGRP) are compared with each other and evaluated based on many quantitative metrics such as convergence duration, packet delay variation, Loss packet, jitter, end-to-end delay and Throughput. These protocols are used to get better performance of one over the other in the real time traffic especially voice conferencing and video streaming find in the entire network.

Network topology: As shown in the Fig. 1 there are An Application Definition object which is named Application attribute and a Profile Definition Object

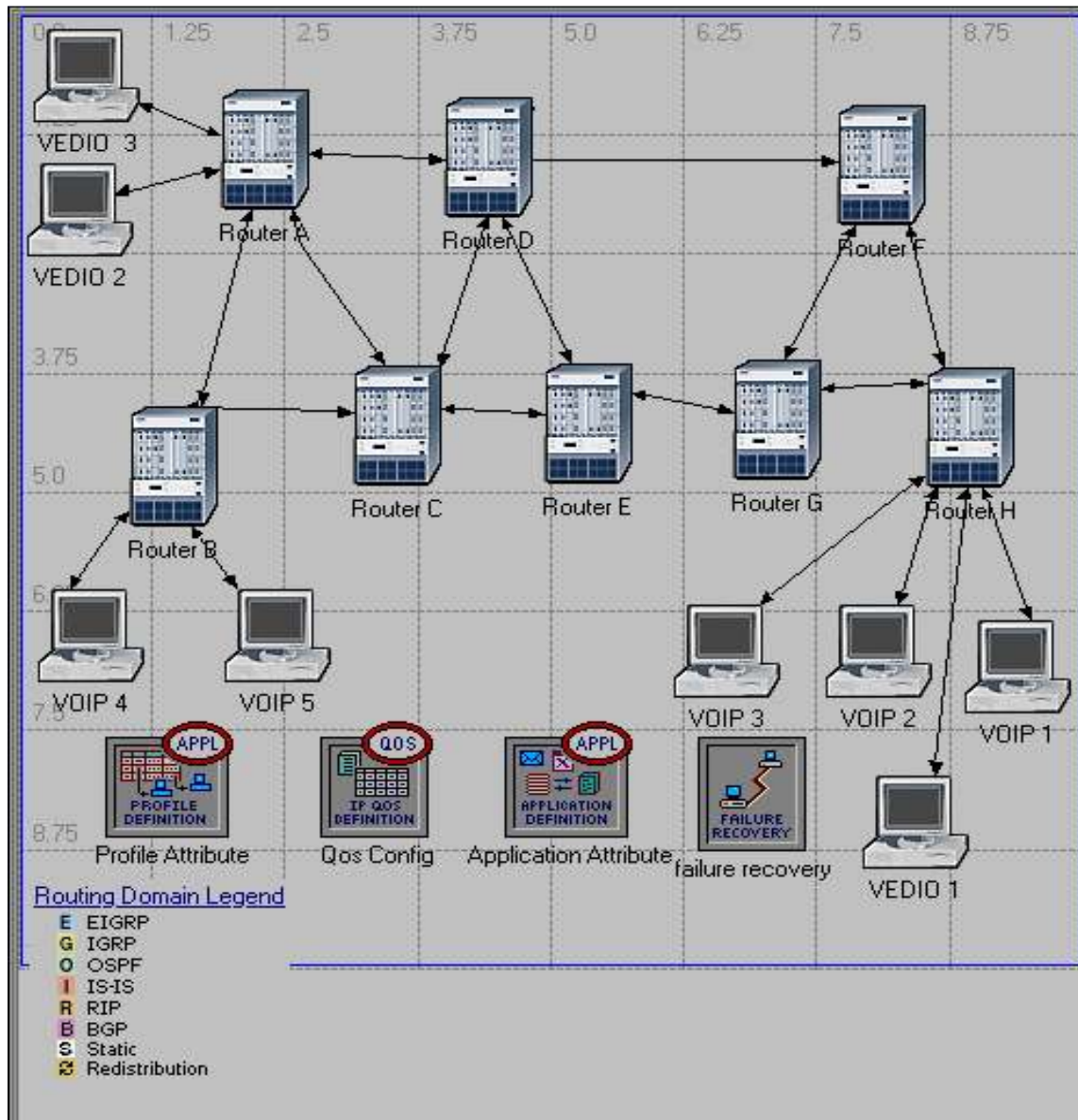


Fig. 1: Network topology

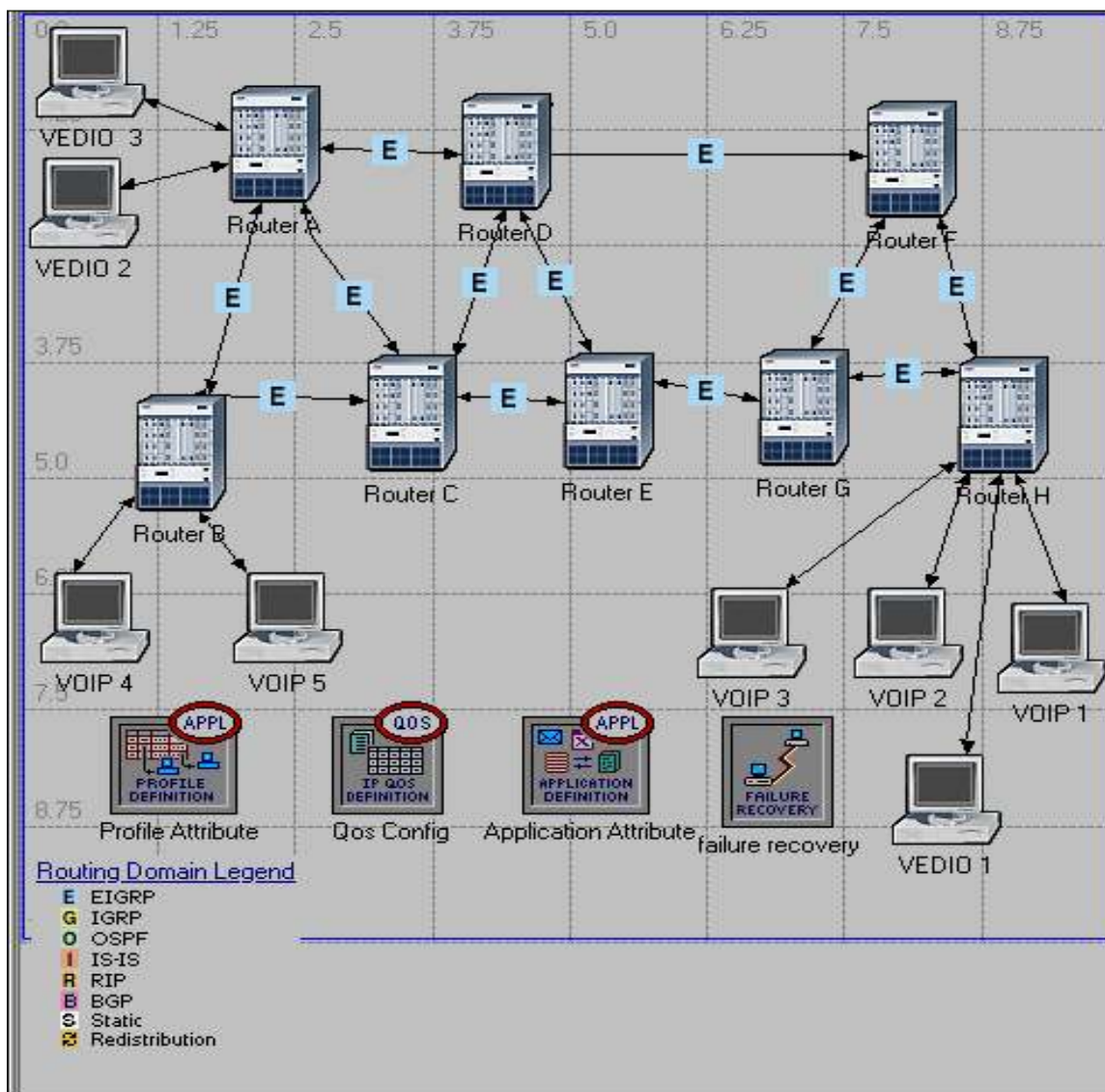


Fig. 2: Network model for EIGRP

which is named Profile attribute. These objects are added from the object palette into the workspace.

The different types of application traffic can be generated by the Application attribute. The Application Definition Object is set to support Video Streaming and Voice Conferencing.

Two profiles are created with the profile attribute. These profiles support the video streaming and the voice conferencing. The link connected between Router D and Router F is set to be failure for 400 sec and recovered after 800 sec. Eight workstations are connected to the Routers that are set to the Video Streaming under the supported services of the Video Server. To provide a better quality and to guarantee a minimum amount of bandwidth during Congestion in the network, the Quality of Service (QoS) is applied in this network.

EIGRP case: First, the routing protocol is configured by activate the EIGRP protocol for all routers in the network. After that, the performance metrics are evaluated by choosing a DES statistics and observed the behavior of this protocol. The simulation run time is set to 900 sec. The Network model for EIGRP is shown in the next Fig. 2.

OSPF case: First, we should set OSPF protocol as a routing protocol for this network topology. Then the results from the DES menu will be chosen. And also, the time duration of the simulation is set to 900 sec. The network model for OSPF is shown below in Fig. 3.

Performance metrics: In this section, we will discuss which parameters are used to measure the

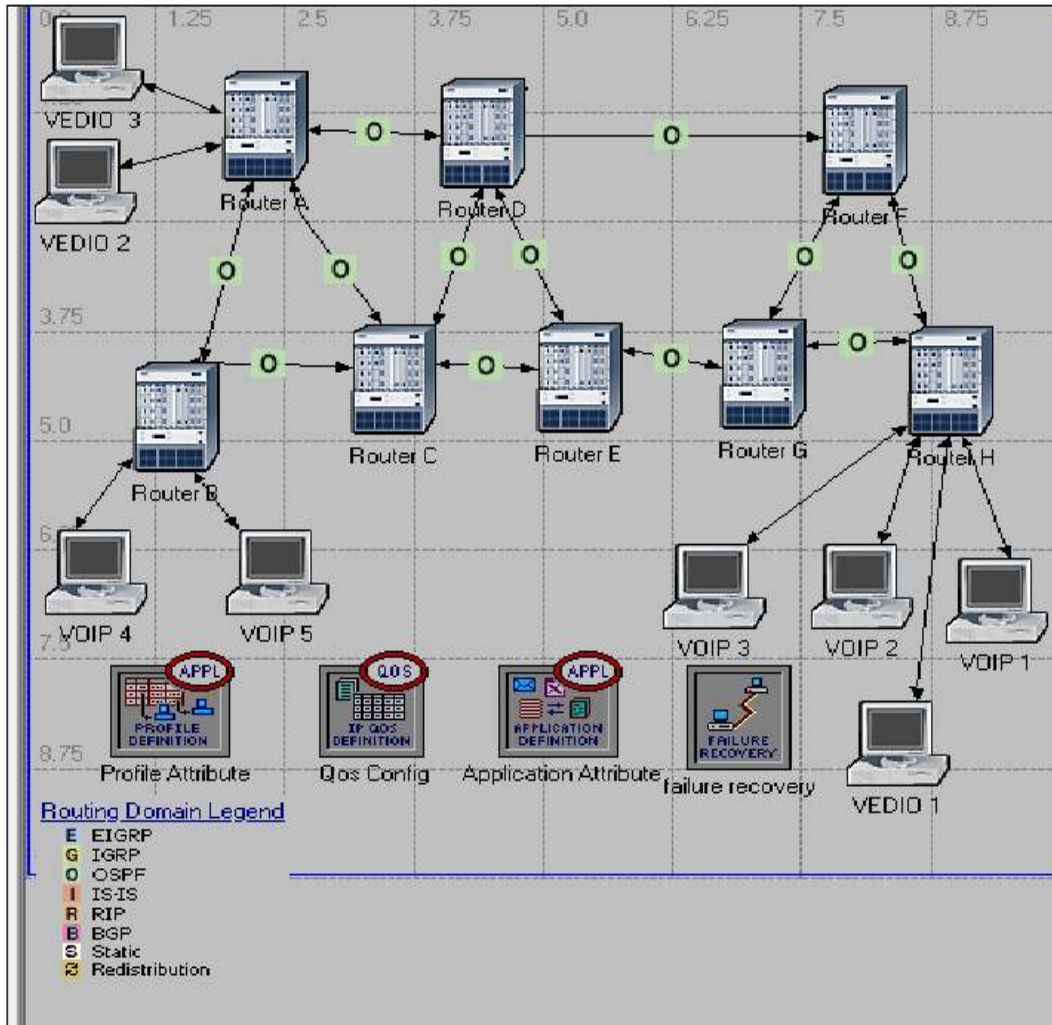


Fig. 3: Network model for OSPF

performance while studying protocols on the selected network model. There are four key performance metrics such as convergence duration, packet delay variation, jitter and end-to-end delay which are considerably affected by routing algorithm.

SIMULATION RESULTS AND ANALYSIS

In this study there are two Network models, which are firstly configured and run EIGRP protocol and the other simulation is with OSPF protocol. The links that have been punctuation used in these scenarios are PPP DS1. The data rate for PPP DS1 link is 1.544 Mbps. The simulation processes hold on for 700 sec duration. The link utilization ranges between 0 and 80%.

Convergence duration: As shown in Fig. 4 the convergence time of EIGRP has a better Performance than OSPF networks. Notice that the height of the bar at a particular time represents the convergence time of the protocol. As shown in the figure, the convergence time

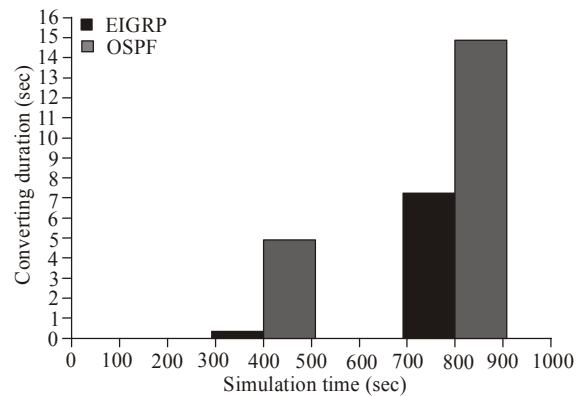


Fig. 4: Convergence duration

of EIGRP has less time than OSPF. Where the link fails at 355 sec and recovers at 700 sec according to the link utilization.

Graph below shows that the network convergence.

Duration ration of EIGRP is lower than OSPF network. Which is related to the change that occurs

through the network. When the network detects the change in its topology and then sends a query to its neighbors, this query will get a successor to broadcast this update to all routers in this network. So the OSPF case take more time according to way that the way that update the network topology and rebuild process of the routing table.

Packet delay variation for video streaming: The difference in the packets delay presents the Delay variation. Graph contains x-axis as simulation run time (In seconds) and y-axis as packet delay variation (in seconds). In Fig. 5, the graph shows that the packet delay variation of OSPF at 400 sec of simulation time begins elevation and it amount to 1 sec.

In another hand, delay variation of EIGRP at 400 sec grows in a slow manner and when it reaches about 10 msec it suddenly growing up. Network load has been set at several steps for instance, 30, 45, 60 and 75% at 200, 400, 600 and 800 sec, respectively. With EIGRP module, the delay increased slowly after 500 sec; whereas the delay of OSPF increased sharply after 500 sec. So, as shown in Fig. 5, the packet delay variation of EIGRP network is less than OSPF network.

End-to-end delay for video streaming: Figure 6 illustrates the End-to-End delay of the networks. End-to-End delay can be defined as the time which is taken to transfer a data packet over the network from the source to the destination.

As shown in Fig. 6, end-to-end delay of EIGRP network and OSPF network is about 90 and 210 msec at 400 sec with 30% network load. The delay for both EIGRP module and OSPF module increases sharply until it reached to 600 sec, after that it increase gradually. It is observed from the Fig. 6 that end-to-end delay of EIGRP protocol has better performance comparing with OSPF protocol.

Traffic sent and received for video streaming: Figure 7 shows the number of sent and received traffic in both EIGRP and OSPF networks. As shown in figure below, it is noticed that EIGRP network provides more throughput than OSPF network.

Voice traffic (jitter): Figure 8 shows that the packet delay variation is increasing faster while packets are being transmitted from source to destination. Interactive voice (PCM Quality) is considered to interact with each other in the network.

As shown in Fig. 8, when the background load is extremely 50%, the voice traffic for both EIGRP and OSPF networks are progressively rising at 350 sec. Whereas this traffic is higher in EIGRP case than in OSPF case when the time is in the range of 550 to 650 sec.

End-to-end delay for voice conferencing: End-to-end delay is defined as the interval between the data packet

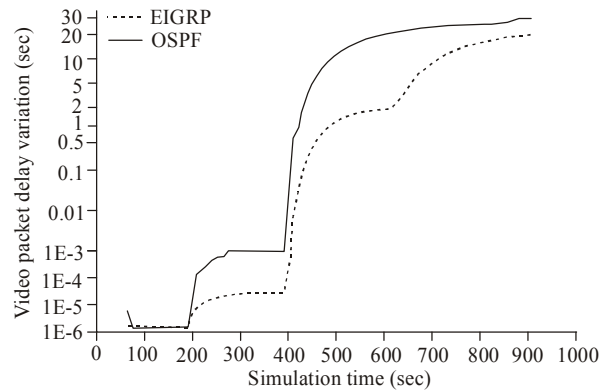


Fig. 5: Video streaming, packet delay variations

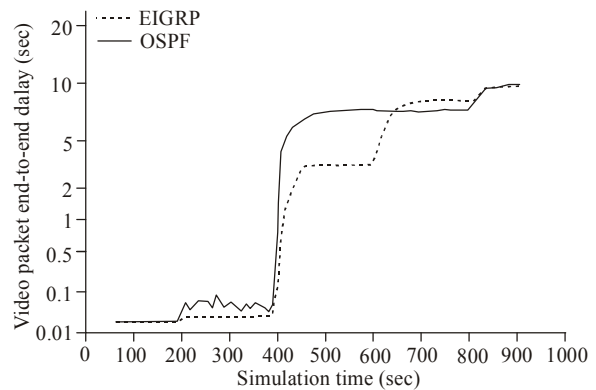


Fig. 6: End to end delay

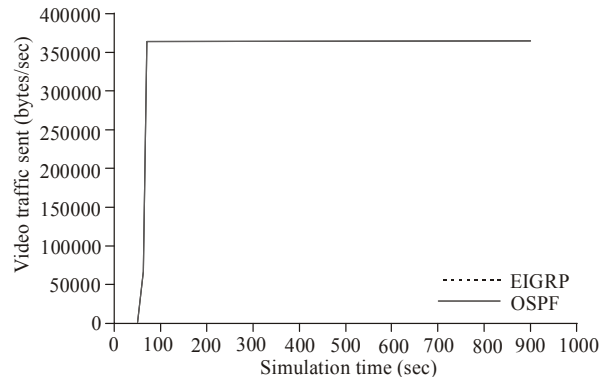


Fig. 7: Traffic sent and received for video streaming

transmission time from source and the arrival time to the destination. Figure 9 shows that the end-to-end delay in EIGRP case is lower than in OSPF networks. This graph depicts that end-to-end delay starts growing at 380 sec for both EIGRP and OSPF with 45% network load.

In addition this figure shows that the OSPF network exceeds 130 msec at 390 sec with 50% background load.

And also, OSPF has more delay in the period between 390 and 640 sec. We can see that the

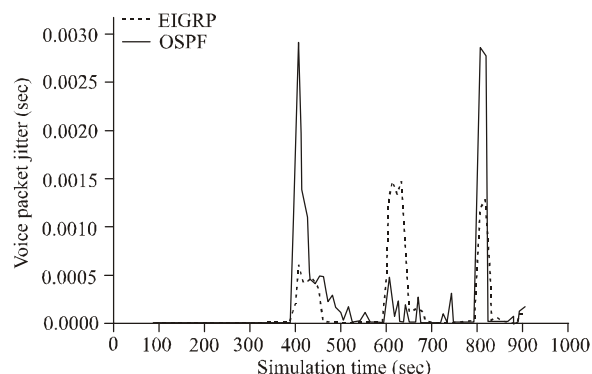


Fig. 8: Voice conferencing (jitter)

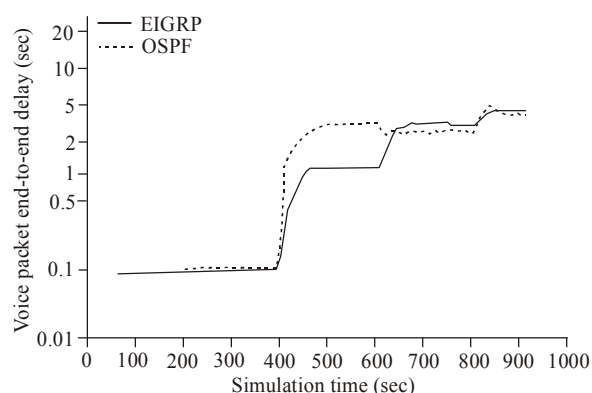


Fig. 9: End to end delay for voice conferencing

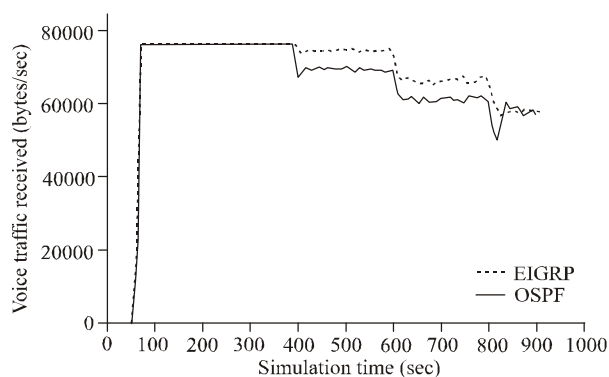


Fig. 10: Voice conferencing received

reducing process of the delay related to the data rate over the links in the network when the voice call begin.

Traffic: As shown in Fig. 10, we can see that at 380 sec, the packet loss of OSPF network has 50% rate with 10% background utilization. Whereas, in EIGRP network the loss is about 3%. We conclude here the EIGRP network has better performance than OSPF where there is congestion in the transferred packets.

CONCLUSION

In this study, we present a comparative study between two routing protocols OSPF and EIGRP. This analysis is applied by using OPNET and GNS3 simulators.

EIGRP protocol shows better convergence time than OSPF protocol. In addition, the simulation results show that the using of EIGRP protocol is better than using OSPF protocol, according to the end-to-end delay time. Simulation shows that the throughput in EIGRP protocol is much better than in OSPF protocol. The traffic in OSPF case is higher than in EIGRP case.

This study prove that the network will be faster and more scalability by using EIGRP protocol than using OSPF protocol, so the performance of the network increase by using EIGRP protocol.

REFERENCES

- Celik, F., A. Zengin and B. Cobanglu, 2013. Discrete event simulation-based performance evaluation of internet routing protocols. *Turk. J. Electr. Eng. Co.*, 21: 1720-1736.
- El-Sayed, H., M. Ahmed, M. Jaseemuddin and D.C. Petriu, 2006. Framework for performance engineering of OSPF software. *IEE Proc-Softw.*, 153: 219-229.
- Hacene, S.B. and A. Lehireche, 2011. Coherent route cache in dynamic source routing for ad hoc networks. *Comput. Sci. J. Moldova*, 19: 304-319.
- Heydarian, M., 2012. A high performance optimal dynamic routing algorithm with unicast multichannel QoS guarantee in communication systems. *J. Supercomput.*, 62: 315-344.
- Malik, S.U., S.K. Srinivasan and S.U. Khan, 2012. Convergence time analysis of open shortest path first routing protocol in internet scale networks. *Electron. Lett.*, 48: 1188-1190.
- Papaj, J., D. Lubomr and C. Anton, 2013. Performance analysis of the enhanced DSR routing protocol for the short time disconnected MANET to the OPNET modeler. *J. Electr. Electron. Eng.*, 6: 103-106.
- Pethe, R.M. and S.R. Burnase, 2011. Technical era language of the networking-EIGRP. *Int. J. Eng. Sci. Technol.*, 3: 1-5.
- Ramakrishnan, K.G. and M.A. Rodrigues, 2001. Optimal routing in shortest-path data networks. *Bell Labs Tech. J.*, 6: 117-137.
- Sukhov, A.M. and D.Y. Chemodanov, 2013. A metric for dynamic routing based on variational principles. *J. High Speed Netw.*, 19: 155-163.
- Tan, W.K., S.G. Lee, J.H. Lam and S.M. Yoo, 2013. A security analysis of the 802.11s wireless mesh network routing protocol and its secure routing protocols. *Sensors*, 13: 11553-11585.