

Network Performance Evaluation for RIP, OSPF and EIGRP Routing Protocols

Ioan Fițigău¹, Gavril Todorean²

Department of Communication, Faculty of Electronics, Telecommunications and Information Technology
Technical University of Cluj-Napoca, Str. George Baritiu, nr. 26-28,
Cluj-Napoca, Romania

¹ioan.fitigau@com.utcluj.ro; ²todorean@pro3soft.ro

Abstract – The main function of a network layer is to route packets from the source machine to the destination machine. Algorithms that are used for route selection and data structure are the main parts for the network layer. In this paper we examine the network performance when using three routing protocols, RIP, OSPF and EIGRP. Video, HTTP and Voice application where configured for network transfer. We also examine the behaviour when using link failure/recovery controller between network nodes. The simulation results are analyzed, with a comparison between these protocols on the effectiveness and performance in network implemented.

Keywords-Network Opnet, Routing, Protocols, RIP

I. INTRODUCTION

Communication in the Internet has become a fundamental part of life. Transmission Control Protocol TCP / IP are the engine for Internet and interconnection networks worldwide. The main objective of the TCP / IP was to achieve interconnection, which led to the provision of universal communication through natural heterogeneous networks. The great benefit of network interconnection was to establish communication links between hosts in different networks, some even separated by large geographic areas as in [2]. Most networks provide support for protocol hierarchies, each level providing services to levels above it and isolating those details the protocols used in the following levels. Protocol stacks are typically based on the OSI model or the TCP / IP model. Both levels have the network, transport and application, but they differ in terms of other levels, as in [1]. At the network layer, the Internet can be seen as a collection of subnetworks or Autonomous Systems (AS-Autonomous Systems sites) that are connected together via the main backbone. The Internet connection is performed using IP protocol (Internet Protocol). Unlike other network layer older protocols, he had from the beginning the role of interconnection between networks with the task of transporting datagram's from source to destination without taking into account whether the equipment is in the same network or networks different as in [3]. Routing protocols determine the mechanism by which routers obtain information on the state of the network topology, respectively. Identify the route should follow a package router function that evaluates routes it to the destination and which of them is optimal. Routing refers to the process of choosing the best route for the transmission of data packets to the destination. All routing protocols aim to share network information between routers

participating. Some protocols transmit only information about direct connections it manages. Also on the performance characteristics and scalability are different from one protocol to another [1].

II. RELATED WORK

Don Xu and Ljiljana Trajković as in [9], testing the routing protocols performance in Opnet Modeller, using various simulation scenarios to compare their performance. Mohamad A. Yehia, Mohammed S. Aziz, Hussein A. Elsayed, as in [10], describes the performance parameters for RIP, OSPF and EIGRP such convergence duration, traffic sent, link utilization for real time applications. Alex Hinds, Anthony Atojoko, and Shao Ying Zhu, as in [11], studied the routing protocols showing differences between IPv6 and IPv4 networks. Suwat Pattaramalai, as in [12], compare the rerouting and retransmission time for OSPF and EIGRP, when there is a failure link in data transmission path.

III. PROTOCOL CONCEPT

A. RIP

Distance vector routing algorithm assumes that each router maintains a table (e.g., a vector) that preserves the best known distance to each destination and the line to be followed to get there, as in [4].

A distance vector protocol maintains and transmits tables routing in which are listed all known networks and the distances to each of them.

Distance vector routing algorithm is also known by other names such as distributed routing algorithm Bellman-Ford or Ford-Fulkerson algorithm; named researchers have proposed (Bellman, 1957 Ford and Fulkerson, 1962). When a router to update its routing table, it sends all the essential information from adjacent routers routing table. When it receives a distance vector, checks for changes from the previous distance vector received from the same neighboring router, in which case the result is positive, it will restore the routing table, packets transmitting distance vectors to neighboring routers, as in [5].

This protocol sends broadcast its routing table every 30 seconds. A packet can contain up to 25 destinations, and the unit measure uses hop count (number of jumps), maximum is 15 routers.

B. OSPF

Link state routing protocols do not change each routing tables, the information provided refers to the state of routers directly connected networks. Routing based on state bonds is widely used in current networks, protocol OSPF (Open Shortest Path First) is used increasingly over the Internet, using an algorithm based on state bonds, as in [6]. Each router discovers that its direct neighbors and communicate this information to other routers, using special packages carrying state links (link state packet). These packets are transmitted by the selective flooding and taken to destination routers update their own data base, the synchronization being performed at intervals of 30 minutes, the LSP packets. Each router maintains a database on which the graph of the network will develop its own routing table, as in [7]. Routers running this protocol accumulates information linkages on the state calculates the shortest path to a given network algorithm is known as Dijkstra algorithm. Each node is labeled with the distance from the source node to it, the over the best way known initially not knowing is no way, all nodes will be labeled with infinity. Initially, all tags are temporary, but when it is discovered that a label is the shortest possible path from the source to that node, it changes its status to become permanent, as in [4].

C. EIGRP

EIGRP (Enhanced Interior Gateway Routing Protocol), considered a hybrid routing protocol, is a class of protocols of "distance vector" and was issued in 1992, was an improvement protocol IGRP, both Cisco proprietary and can only operate on Cisco routers. EIGRP can learn in a dynamic way on the routers directly connected to a network, this is similar to the protocol "Hello" used to discover OSPF neighbors on a network. A network equipment EIGRP packets change "hello" to ensure that each neighbor is operational. As in the case of OSPF, the frequency of the exchange of packets based on the type of network where high bandwidth links exchange is carried out at intervals of 5 seconds, and in the case of connections requiring low bandwidth, the packets are exchanged every 60 seconds, as in [8]. EIGRP does not rely on periodic updates to converge in the topology, instead building a table that will contain announcements on neighbors about changes in topology; data is not removed as in distance vector protocols. Topology table information is processed to determine the best path to each destination network, EIGRP implementing an algorithm known as the diffusion update algorithm (DUAL), as in [3].

IV. SIMULATED NETWORK TOPOLOGY

In this paper, we used Opnet Simulator, a real time simulator specifically designed for network design and analysis, to compare these protocols, when considering a hypothetical network model. The network consists in a number of four interconnected subnets using DS3 links (44.736 Mbps), analyzing the video, http and voice traffic between subnet1 and subnet2. Inside the subnet1 we have four routers, randomly connected, three LAN's connected to a switch. The LAN's are configured to support video transfer for LAN1, HTTP transfer for LAN2 and Voice transfer for LAN3. On the other side of

the network, subnet2, the LAN's where replaced with three servers, each of them configured to accept traffic from the specific LAN. The subnet3 and subnet4 consist only in four routers each, used to route each packet to the destination node, on a first-come-first-serve basis. The link connecting subnets equipments is 100BaseT. We have one Application Definition (node_1), where are defined parameters for Video application (frame size=128x240 pixels and frame interarrival time=15 frames/sec), Voice application (encoder scheme is GSM FR, compression delay=0.02 seconds and type of service is best effort), and HTTP application configured for light browsing. The Profile Definition (node_0) is use to create users profiles to be specified in different nodes on the network and will start fifty seconds after the simulation begin. There are three profiles, for Video, HTTP and Video application, with the operation mode set to simultaneous- they can start all at the same time. We added to our simulation a failure/recovery object, configured on links between subnets, as in Table 1:

TABLE I. FAILURE/RECOVERY SPECIFICATION TIME

Link failure/recovery specification	Failure time	Recovery time
subnet1-subnet2 link	90 sec	120 sec
subnet1-subnet3 link	125 sec	150 sec
subnet1-subnet4 link	155 sec	180 sec

Figure 1 shows the network model with subnets and Figure 2, the subnet1 network components.

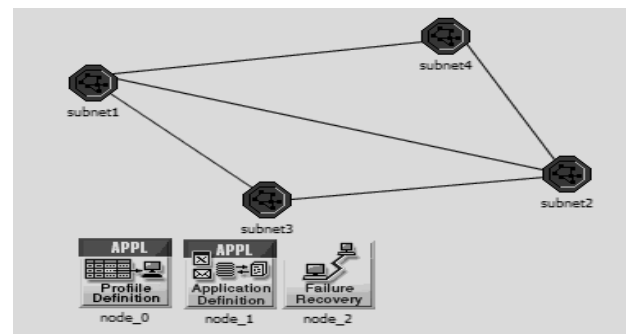


Figure 1. Network model

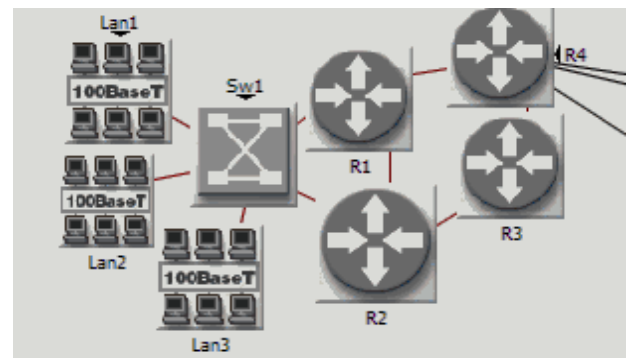


Figure 2. Subnet1 components

V. SIMULATION RESULTS

The simulation time is set to four minutes of Voice, HTTP and Video data transfer between LAN's and servers in RIP, OSPF and EIGRP scenarios. The average voice packets end to end delay is shown in Figure 3:

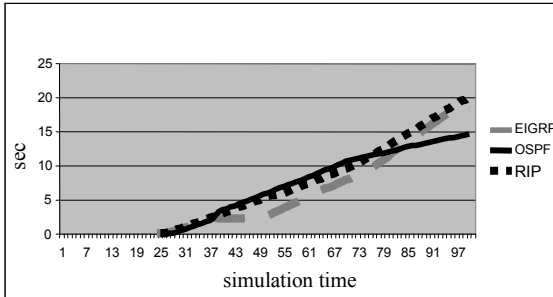


Figure 3. Voice packet end to end delay

The RIP scenario, only depending on hop count metric, has the highest delay, being less efficient comparing with OSPF and EIGRP, which both select better route. Network convergence activity is shown in Figure 4:

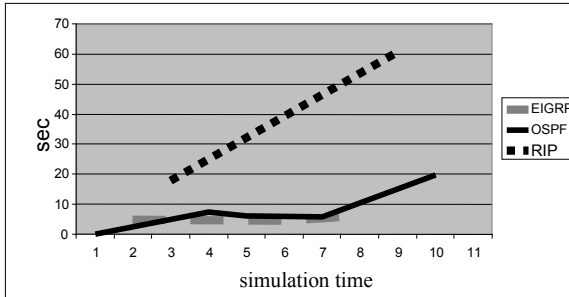


Figure 4. IP network convergence activity

EIGRP perform better in term of network convergence, with a value under 10 seconds. EIGRP has the characteristics of distance vector and link state protocols, using DUAL mechanism and hello packets for neighbor discovering. IP traffic dropped, as in Figure 5, shows a better response for EIGRP and OSPF. When using RIP protocol, queuing delay and data segments retransmission will cause additional overhead on the lower layers and links, causing traffic dropped to be higher.

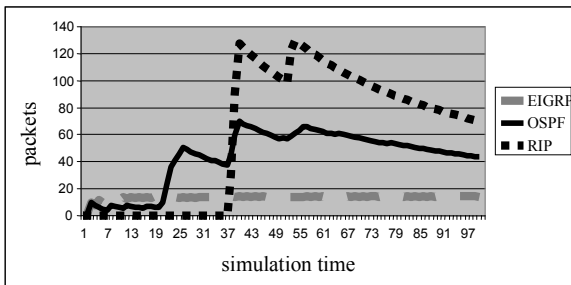


Figure 5. IP traffic dropped

HTTP page response time, Figure 6, shows that RIP scenario has better results for the simulated network, being a simple protocol that is based on distance vector algorithms.

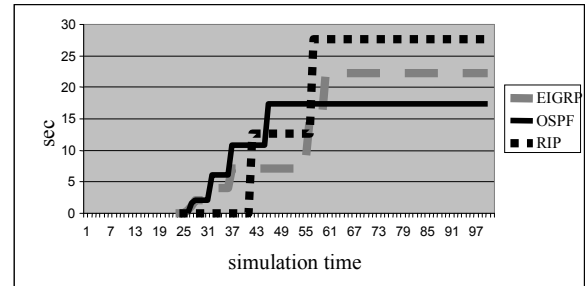


Figure 6. HTTP page response time

OSPF perform better in Video transfer, respond in a quick manner to changes in the network offering the best load balancing and better utilization of bandwidth, leading to a small delay, as in Figure 7:

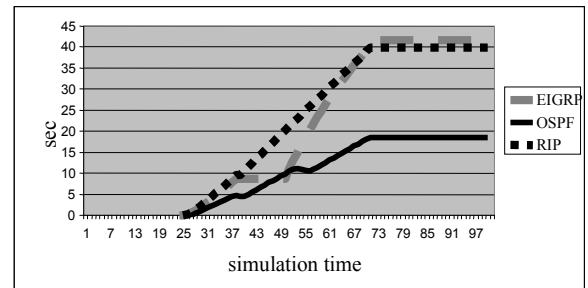


Figure 7. Video packet end to end delay

The Ethernet delay, representing the end to end delay of all packets received by all the stations in the network, is shown in Figure 8:

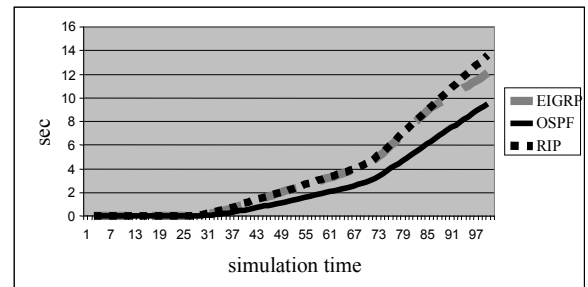


Figure 8. Ethernet delay

VI. CONCLUSIONS

Distance vector algorithms are somehow limited in choosing the best way that support network size, but RIP advantage consists in its simplicity and user experience of using this algorithm. RIP is slower to converge, because routes changes are propagated at regular intervals and not in an instant.

We demonstrated that in network convergence activity, EIGRP provide the best conversion duration, having the best reaction time to link failure and being more reliable for real time applications.

OSPF provides security facilities, multipath facilities, facilitate the use of different cost metrics, integrated support for both routing unicast and multicast to a rapid convergence. OSPF is an open standard protocol, comparing with EIGRP, which is a Cisco proprietary protocol, so we should only Cisco routers to implement EIGRP.

EIGRP is a robust protocol, combines the attributes of distance-vector and link-state protocols attributes, resulting in a hybrid protocol that is easy to configure, efficient, and fast. It has a faster convergence, improved scalability and superior handling in the routing loops. In this paper we have presented a comparative analysis of three routing protocols, on the same network topology.

As future work we will concentrate on simulations with more realistic topologies and optimization accuracy, to improve and demonstrate the effectiveness of routing protocols over the network performance.

EIGRP has all the advantages of flexibility and simple setup while improving speed and resource consumption. In fact, it is capable of being both a single protocol for IP as well as non-IP protocols, eliminating the need to use multiple routing protocols in multi-protocol network. In the event that it is a simulation of a network at a bigger size, with multiple devices in the network, we would see a much larger difference in the operation of the three protocols, proving that EIGRP performance is better.

ACKNOWLEDGMENT

This paper was supported by the project "Improvement of the doctoral studies quality in engineering science for development of the knowledge based society-QDOC" contract no. POSDRU/107/1.5/S/78534, project co-funded by the European Social Fund through the Sectorial Operational Program Human Resources 2007-2013.

REFERENCES

- [1] Andrew S. Tanenbaum, "Computer Networks 4Th Ed.", Prentice Hall, 2003.
- [2] Lydia Parziale, David T. Britt, Chuck Davis "TCP/IP Tutorial and Technical Overview", ibm.com/redbooks, December 2006.
- [3] Sheldon Tom, McGraw-Hill "Encyclopedia of Networking and Telecommunications", New York, 2001.
- [4] Ioan Fițișău, Prof. Dr. Ing.Gavril Todorean, "Internet Protocols. Distance vector and Link State Algorithms", MACRO 2011, Tîrgu-Mureș, România; ISBN: 978-973-1970-54-7, pp 131 – 137.
- [5] Thomas L Case, Larry D. Smith, "Managing LAN", McGraw-Hill, 1995.
- [6] <http://www.cisco.com/en/US/docs/internetworking/>
- [7] Moy – RFC 2328, "OSPF Version 2", April, 1998.
- [8] Walran, J., "An introduction to queuing networks", New Jersey, 1993.
- [9] Don Xu and Ljiljana Trajković, "Performance Analysis of RIP, EIGRP, and OSPF using OPNET", Vancouver, Canada
- [10] Mohamad A. Yehia, Mohammed S. Aziz, Hussein A. Elsayed, "Analysis of IGP Routing Protocols for Real Time Applications: A Comparative Study", International Journal of Computer Applications, Volume 26-No3, July 2011.
- [11] Alex Hinds, Anthony Atojoko, and Shao Ying Zhu, "Evaluation of OSPF and EIGRP Routing Protocols for IPv6", International Journal of Future Computer and Communication, Vol.2, August 2013.
- [12] Suwat Pattaramalai, "Link Recovery comparison between OSPF & EIGRP", ICICN 2012, Vol. 27, Singapore.