Analyzing the steady state behaviour of RIP and OSPF routing protocols in the context of link failure and link recovery in Wide Area Network

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Abstract- In this paper an attempt has been made to analyze the steady state behavior of RIP and OSPF routing protocols for WAN in terms of convergence duration with respect to simulation time in the context of link failure and recovery using OPNET simulator. The time that is required for the network to converge is referred to as convergence duration. Convergence is one of the key factors that determine the performance of the routing protocol. From the experimental results we found that convergence activity and convergence duration is maximum for OSPF and minimum for RIP.

Keywords— *RIP, OSPF, WAN, OPNET*

I. INTRODUCTION

Routing is the process of selecting paths in a network. In packet switching networks, routing directs traffic forwarding of logically addressed packets through intermediate nodes from their source to their ultimate destination. Routing protocols are designed to select and determine the best path to each router in the network. Routers should learn the next hop to send the packets. Forwarding data should be efficient and effective.

Consequently, the routing decision of a protocol is very important for network performance.

Convergence time [3] is the time which a group of routers reach the state of convergence. Optimally the routing protocols must have fast convergence time.

II. ROUTING PROTOCOLS

In computer networks, the routing protocol specifies how routers communicate to select the routes for information or data transfer for that, the routing algorithm is more important.

First, the routing protocol informs or shares the information with their associative neighbors and then throughout the network, in which topology. Different types of routing protocols are as follows,

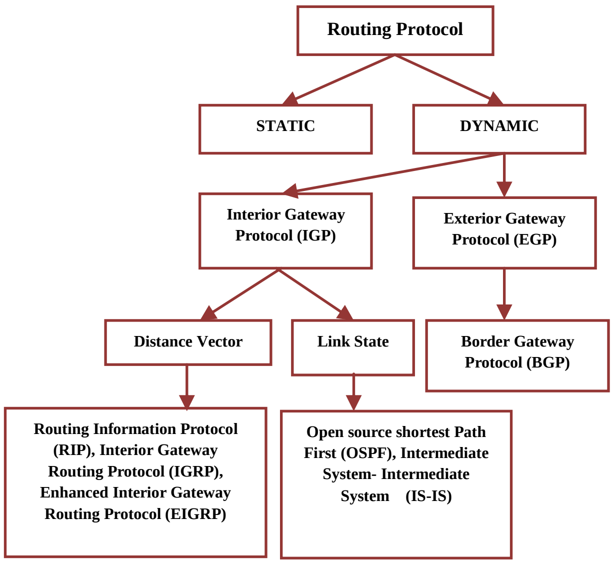

Figure: 1 Routing protocol classification

a) Dynamic Routing Protocols Overview

Dynamic routing protocols [2] play an important role in today's networks. They are used to facilitate the exchange of routing information between routers. They dynamically share information between routers, automatically update routing table when topology changes, and determine the best path to a destination. Compared to static routing, dynamic routing protocols have better scalability and adaptability and require less administrative overhead. Dynamic routing protocols [4] allow routers to dynamically advertise and learn routes, determine available routes and identify the most efficient routes to a destination. Dynamic routing protocols have the capability to maintain the network operation in case of a failure or when network configuration or topology change.

"Distance vector" and "link state" are used to describe routing protocols used by routers to forward packets. There are two groups of routing protocols, based on whether the routing protocol selects the best routing path based on a distance metric (the distance) and an interface (the vector) or selects the best routing path by calculating the state of each link in a path and

finding the path with the lowest total metric to the destination.
Distance vector protocols evaluate the best path based on distance, which can be measured in terms of hops or a combination of metrics calculated to represent a distance value.

The IP Distance vector routing protocols in use today are RIP and IGRP. In link state routing, every node constructs a map of the connectivity to the network in the form of a graph showing connectivity of the nodes to each other. Each node then independently calculates the next best logical path to every possible destination in the network. The collection of best paths forms the node's routing table. Link state protocols have the routers announce their closest neighbors to every router in the network. Only a part of the table pertaining to its neighbors is distributed.

b) Routing Information Protocol (RIP)

RIP stands for Routing Information Protocol in which distance vector routing protocol is used for data/packet transmission. In Routing Information protocol (RIP), the maximum number of Hop is 15, because it prevents routing loops from source to destination [1]. Mechanism like split horizon, route poisoning and holdown are used to prevent from incorrect or wrong routing information. Sally Floyd and Van Jacobson [1994] suggest that, without slight randomization of the timer, the timers are synchronized overtime. Compared to other routing protocol, RIP (Routing Information Protocol) is poor and limit size i.e. small network. The main advantage of using RIP is it uses the UDP (User Datagram Protocol) and reserved port is 520.

c) Open Shortest Path First (OSPF)

OSPF stands for Open Shortest Path First which uses link-state routing algorithm. Using the link state information which is available in routers, it constructs the topology in which the topology determines the routing table for routing decisions. It supports both variable-length subnet masking and classless inter-domain routing addressing models. Since it uses Dijkstra's algorithm, it computes the shortest path tree for each route. The main advantages of the OSPF (Open Shortest Path first) is that it handles the error detection by itself and it uses multicast addressing for routing in a broadcast domain.

III METHODOLOGY

Simulation is one of the most widely used techniques in network design and management to predict the performance of a network system or network application before the network is physically built or the application is rolled out.
Instead of building a physical model of a network, we build a mathematical model representing the behavior and the logical and quantitative relations between network elements. By changing the relations between network elements, we can analyze the model without constructing the network physically, assuming that the model behaves similarly to the real system, i.e., it is a valid model.

a) Simulation Tool

"Optimized Network Engineering Tool (OPNET)" [5] will be used to measure and analyze the performance of routing protocol in simulation.
The tool used for the simulation study is OPNET 17.5 modeler. OPNET [6] is network and application based software used for network management and analysis. OPNET models communication devices, various protocols, architecture of different networks and technologies and provide simulation of their performances in virtual environment. OPNET provides various research and development solution which helps in research of analysis and improvement of wireless technologies like WIMAX, Wi-Fi, UMTS, analysis and designing of MANET protocols, In our case we used OPNET for modeling of network nodes, selecting its statistics and then running its simulation to get the result for analysis.

b) Modeling of Network

At first network is created with a blank scenario using startup wizard. Initial topology is selected by creating the empty scenario and network scale is chosen by selecting the network scale. In our case we have selected campus as our network scale. Size of the network scale is specified by selecting the X span and Y span in given units. Further technologies are specified which are used in the simulation. We have selected MANET model in the technologies. After this manual configuration various topologies can be generated by dragging objects from the palette of the project editor workspace. After the design of network, nodes are properly configured manually.

c) Simulation Setup

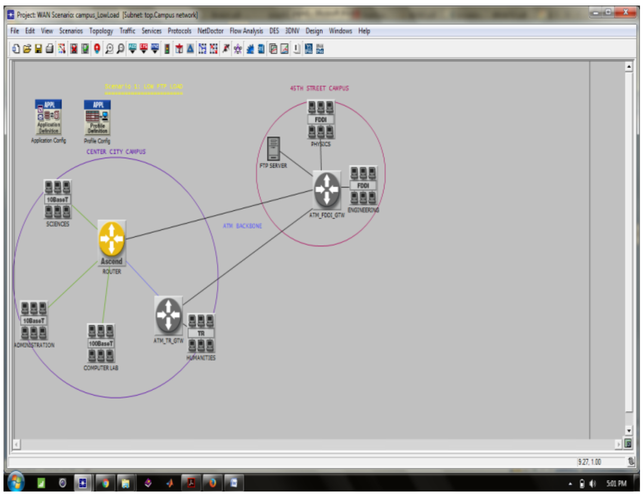

Figure 2: scenario of wide area network

We designed the network model in OPNET Modeler V 17.5. The simulation parameters are given in the following table.

IV. SIMULATION ENVIRONMENT

Table I: Simulation Parameters

Parameters	Values
Examined protocols	RIP, OSPF
Simulation time(m)	5, 10, 15,20
Simulation area (m x m)	1000x1000
Performance Parameters	Convergence activity Convergence duration

V. RESULTS AND DISCUSSION

Two types of statistics are involved in OPNET simulation. Global and object statistics, global statistics is for entire network's collection of data, Where as object statistics involves individual nodes statistics. After the selection of statistics and running the simulation, results are taken and analyzed. In our case we have used global discrete event statistics (DES).

To evaluate the performance of routing protocols, the following metrics are considered.

a) Network Convergence Activity: Records a square wave alternating between the ordinates 0 and 1. It is 0 during a time interval in which no signs of convergence activity are detected in the entire network. It is 1 during a time interval in which signs of convergence are detected somewhere in the network.

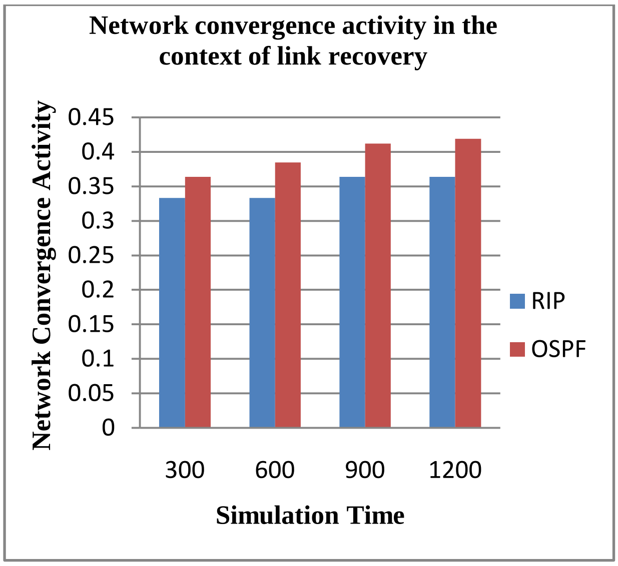

Figure 3: A graph showing variation in network convergence activity with respect to simulation time in the context of link recovery.

b) Network Convergence Duration: Records the duration of convergence cycles for the routing tables across the whole network.

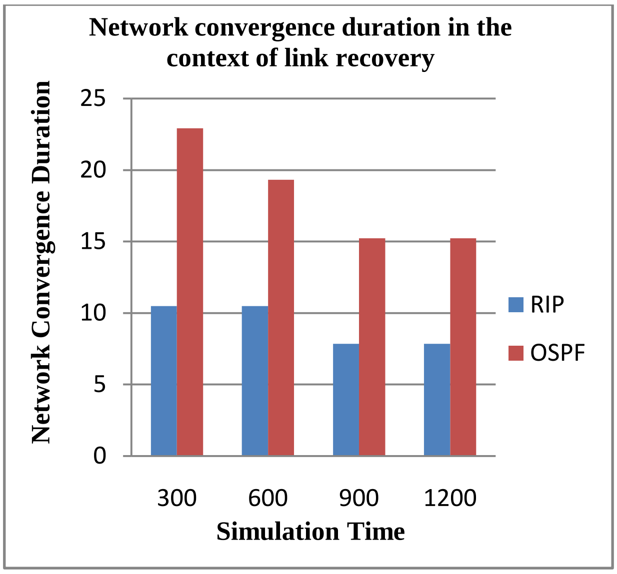

Figure 4: A graph showing variation in network convergence duration with respect to simulation time in the context of link recovery.

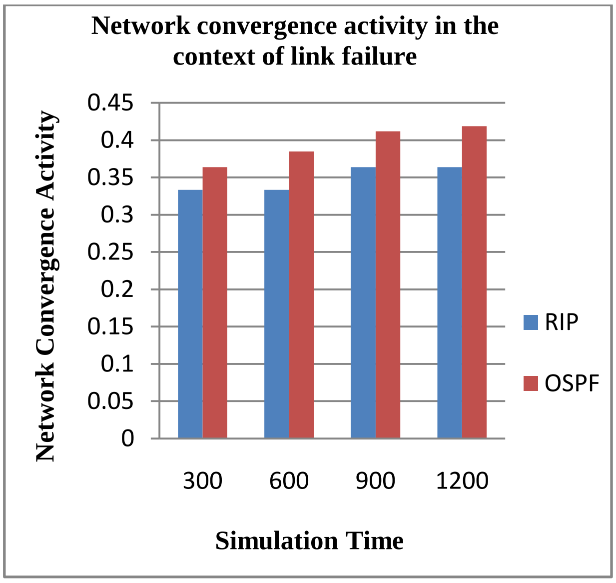

Figure 5: A graph showing variation in network convergence activity with respect to simulation time in the context of link failure.

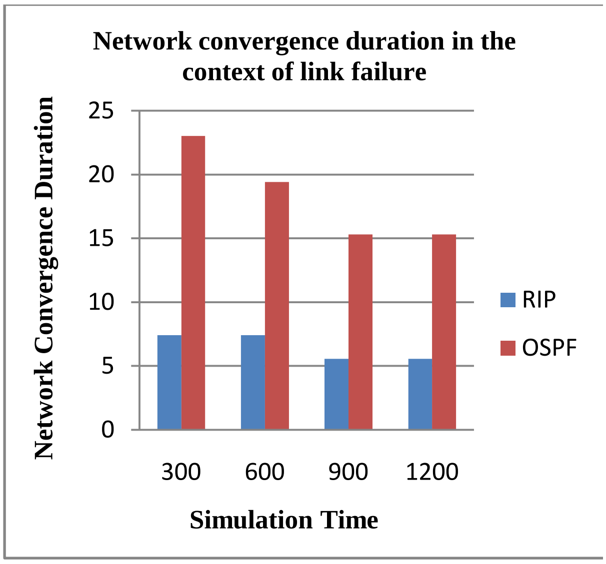

Figure 6: A graph showing the variation in network convergence duration with respect to simulation time in the context of link failure.

VI. CONCLUSION

When a link fails, it is important that the dynamic routing protocol recognizes that failure, and converges upon a new topology to allow for the network segment to still be online. This paper tests the scenario of a link failure and recovery and quantifies the convergence duration.

From the experimental results, we found that network convergence duration is maximum for OSPF in the context of link failure. When the simulation time is varied from 5 minutes to 20 minutes, network convergence time is 4 sec for OSPF in the context of link failure, 2 sec in RIP. Similarly the link recovery is 6 sec in OSPF and 2 sec in RIP.

REFERENCES

[1] Ayub, N., F. Jan, et al. (2011). "Performance Analysis of OSPF and EIGRP Routing Protocols with Respect to the Convergence." European Journal of Scientific Research 61(3):434-447.

[2] Dynamic Routing Protocol Implementation Decision between EIGRP, OSPF and RIP Based on Technical Background Using OPNET Modeler.

[3] Nohl, A.R, Molnar, G "The convergence of the OSPF routing protocol" (Ericsson Res., Ericsson Hungary Ltd., Budapest, Hungary); Source: Periodica Polytechnica Electrical Engineering, v 47, n 1-2, p 89-100, 2002

[4] Bahl, Vasudha. "Performance Issues and Evaluation considerations of web traffic for RIP & OSPF Dynamic Routing Protocols for Hybrid Networks Using OPNET TM." International Journal 2, no. 9 (2012).

[5] http://www.opnet.com [accessed in October, 2012] http://www.opnet.com [accessed in October, 2012.

[6] "Introduction to OPNET Simulator" http://bolero.ics.uci.edu/~ypan/OPNET/Introduction%20to%20OPNET%20simulator.pdf