Study Of Various Routing Algorithm On Hybrid Routing Topology By Employing Different Applications

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Abstract - The main cause for the degradation of the network performance in internet is instability in routing, link failures and congestion in the networks [1]. It has been found that most of the disruptions occur during routing changes. Every routing protocol behaves different from each other performance wise. We have evaluated performance of each protocol for real time applications.

I. INTRODUCTION

Increase in large networks increases routed traffic and reduces the stability of the network. The major cause for the degradation of the service performance in internet is network congestion, link failures, and routing instabilities [1]. It has been found that most of the disruptions occur during routing changes. A few hundred milliseconds of disruption are enough to cause a disturbance in voice and video. A disruption lasting a few seconds is long enough for interrupting web transactions [2]. Hence, during routing convergence data packets are dropped, delayed, and received out-of-order at the destination resulting thus in a serious degradation in the network performance [1].

To effectively and efficiently distribute data, the choice of the routing protocol becomes very critical factor to define the success of the network over time. Three classes of routing protocols are common on IP networks as follows:

1) Interior gateway routing over link state routing protocols, such as OSPF.

2) Interior gateway routing over distance vector protocols, such as RIP, IGRP and EIGRP.

3) Exterior gateway routing, such as BGP v4 routing protocol.

The performance of each routing protocol is different from each other. Among all routing protocols, we have chosen RIP, OSPF and EIGRP routing protocols for doing performance evaluation in a simulation based network model for real time application such as voice conferencing.

a. STANDARD APPLICATIONS

To configure a LAN or a workstation, we need to describe their behavior. A user's behavior or "profile" can be described by the applications used and how long and often the applications are used throughout the day. An application can be described in terms of its actions, which are referred to as tasks in OPNET. OPNET ships with pre-defined profiles and applications that may suit the behavior we wish to describe. We may, however, wish to modify the existing definitions to suit our needs or even create new application and profile definitions. [5]

The standard applications in OPNET include Database, E-Mail, FTP, HTTP, Print, Remote Login, Video Conferencing and Voice.

b. Technical Overview of Routing Protocols

In Internet Protocol networks, a routing protocol usually carries packets by transferring them between different nodes. The main idea for routing protocols is to establish the best path from the source to the destination. Routing protocols have the following objectives:

i) To communicate between routers
ii) To construct routing tables
iii) To make routing decisions
iv) To learn existing routes
v) To share information amongst neighbor's routers.

3.1 Classification of Routing Protocols

The classifications of routing protocols are:

i) Static and dynamic routing protocols.
ii) Distance Vector and Link State routing protocols.

3.2 Static Routing

Static routing assumes that the network is fixed and no more nodes are added or removed from the system. Routing tables are manually updated and is mainly used for small networks.

3.3 Dynamic or Adaptive Routing

In this paper we will only consider Dynamic Routing Protocols. Within the class of dynamic protocols we have Interior or Exterior Gateway protocols named EGP and IGP. These protocols can use either link-state or vector state protocols and its hierarchy is shown as below.

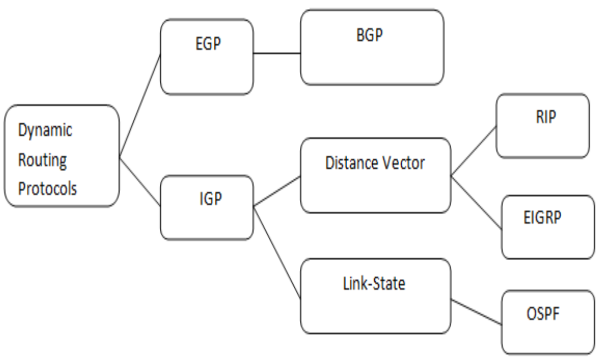

Fig.1 Hierarchy of Dynamic Routing Protocols

3.3.1 Routing Information Protocol (RIP)

Routing Information Protocol is a distance-vector based interior gateway protocols. RIP is one of the first routing protocols implemented on TCP/IP. Information is sent through the network using UDP. Each router has limited knowledge of the network around it and maintains its routing table by sending periodic updates to communicate with its neighboring routers. It updates its routing table after a fixed time intervals, generally after every 30 seconds. Its metric is the number of jumps or hop count to find an optimal path for packet routing. The maximum number of jumps in RIP is 15 to avoid routing loops. Therefore, this protocol works best for small networks.

3.3.2 Open Shortest Path First (OSPF)

Open Shortest Path First Protocol is a very widely used link-state interior gateway protocols (IGP). OSPFroutes Internet Protocol packets by gathering link-state information from neighboring routers and constructing a map of the network. OSPF router sends many messages including hello messages, link state requests and updates and database descriptions. Main advantage of OSPF is that its many configurable parameters make it flexible and robust protocol. As compare to RIP, OSPF is a complex protocol.

3.3.4 Enhanced Interior Gateway Routing Protocol (EIGRP)

In this protocol Diffusing Update Algorithm (DUA) is used for routing optimization, fast convergence, as well as to avoid routing loops. Routers using this protocol automatically distribute route information to all neighbors. When a router is unable to find a path through the network, it sends out a query to its neighbors, which propagates until a suitable route is found. This need-based update is an advantage over other protocols as it reduces traffic between routers and therefore saves bandwidth. The disadvantage of EIGRP is that it is a Cisco proprietary protocol.

II. SYSTEM DESIGN

To create a simulation model and examine the performance of the applications deployed in the network, a scenario is created in which there is an RnD Site and Main Site Employees. The system is designed using Riverbed Modeler Academic 17.5 Edition.

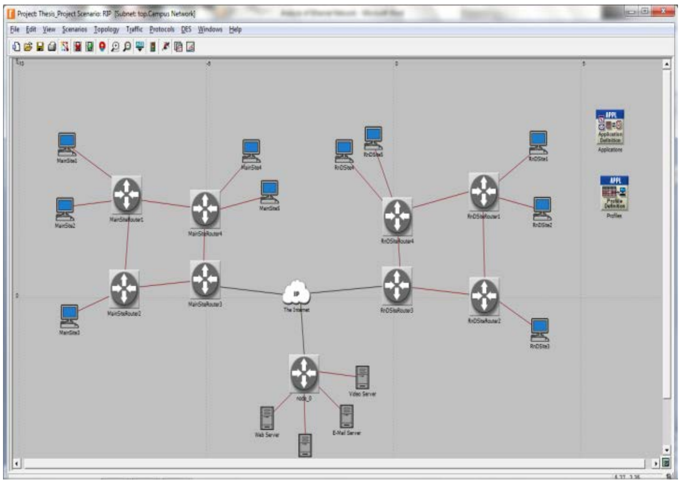

Fig1. Ethernet Model

LINK FAILURE/RECOVERY

The major cause for the degradation of the service performance in internet is network congestion, link failures, and routing instabilities. It has been found that most of the disruptions occur during routing changes. A few hundred milliseconds of disruption are enough to cause a disturbance in voice and video. A disruption lasting a few seconds is long enough for interrupting web transactions. Hence, during routing convergence data packets are dropped, delayed, and received out-of-order at the destination resulting thus in a serious degradation in the network performance. 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.

Simulation for Link Failure and Recovery	
Status	Time (secs)
Fail	600
Recover	780

We have analyzed above said network topology with node or link failures on the basis of metrics such as network convergence time, jitter, delay variation, end to end delay and throughput while implementing different applications (HTTP response, Email, FTP, VoIP, Video Conferencing) on real time environment. An analysis of node or link failures with mixed protocols of combination of EIGRP_RIP, OSPF_RIP and combination of OSPF_EIGRP has been done.

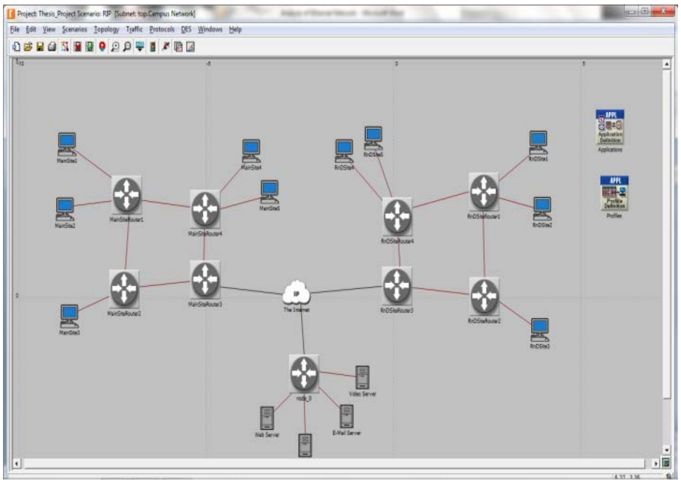

Fig.2. Ethernet Model with Link Failure/Recovery

III. RESULTS

6.1 **Email Download Response Time (seconds)** Time it takes for e-mail messages to arrive from the server in response to a client's request. The time includes the connection setup delay.

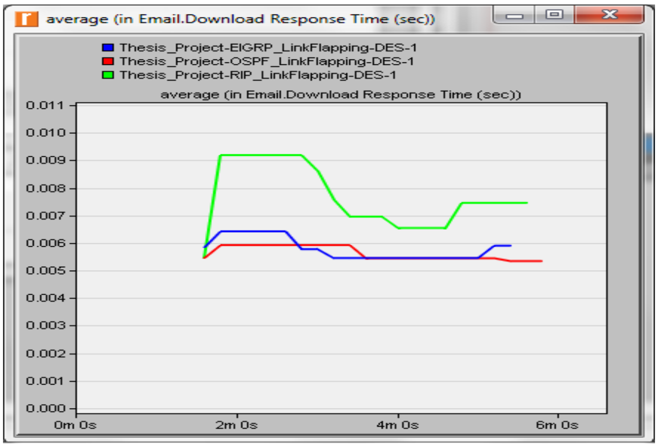

Fig.3 Link Flapping

For Scenario I, OSPF protocol is showing better performance for Email download application in link failure and recovery analysis followed by EIGRP and RIP. RIP protocol shows the poor performance since it takes time for convergence and hoping of hosts between the networks. For Scenario II, OSPF_RIP hybrid protocol is showing better performance for Email download application in link failure and recovery analysis followed by EIGRP_RIP and OSPF_EIGRP. With the implementation of OSPF_RIP hybrid protocol on different topologies we can compare or improve performance of the network showing poor performance with single protocol.

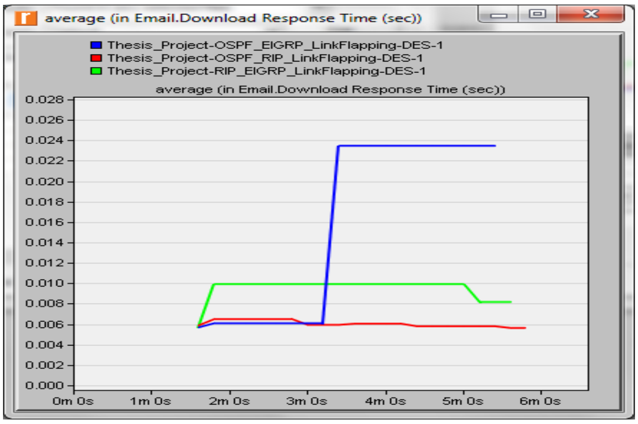

Fig.4 Hybrid Protocols with Link Failure/Recovery

6.2 **HTTP Page Response Time (seconds)**
Time it takes to retrieve an entire HTML page including all in-lined objects.

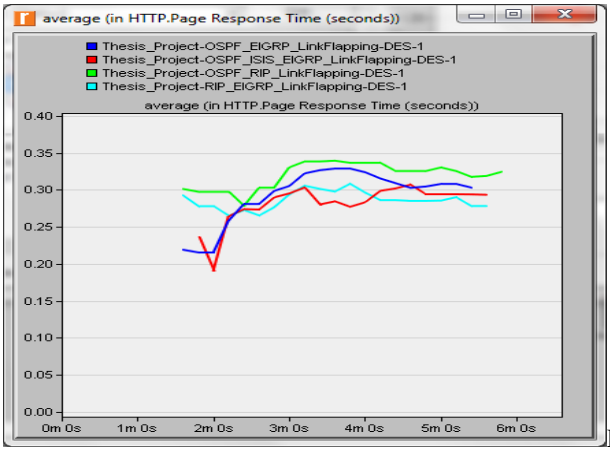

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fig.5 Link Flapping

For Scenario I, EIGRP protocol has the less delay response for http application followed by OSPF protocol. For Scenario II, EIGRP_RIP hybrid protocol gave the less delay response for http application. This hybrid protocol has taken less time with respect to single protocol scenario.

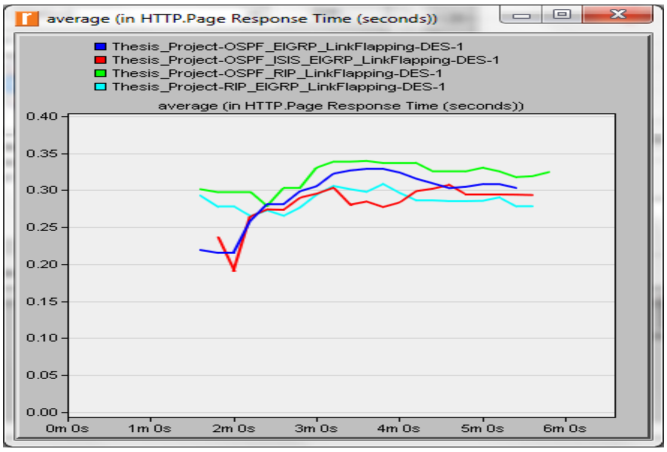

Fig.6 Hybrid Protocols with Link Failure/Recovery

6.3 Network Convergence Duration (sec)

A convergence time is the time to construct the attack path (Kim et al., 2006). The time needed for all routers in the network should be small so that the routing specific information can be easily known.For Scenario I, EIGRP has better performance followed by OSPF protocol. RIP protocol has shown the poor performance in the convergence of the network. In Successive link failure scenario Network hybrid protocols OSPF_EIGRP and EIGRP_RIP shows almost same performance by taking less convergence time for IP network.

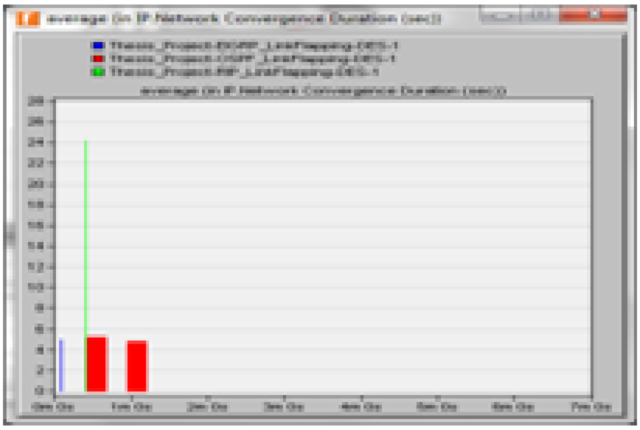

Fig.7 Link Flapping

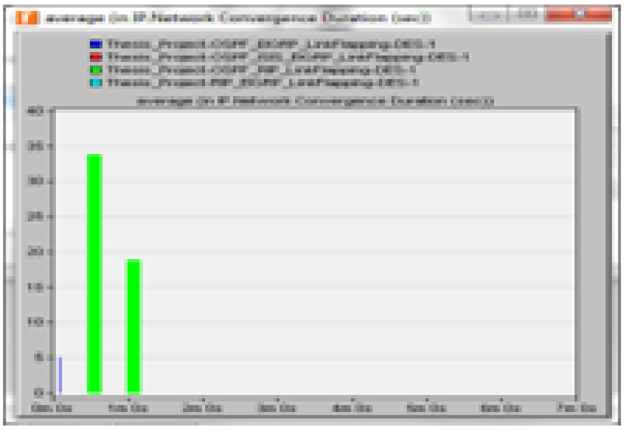

Fig.8 Hybrid Protocols with Link Failure/Recovery

6.4 Remote Login Response Time (sec)

The Remote Login Application allows the user to connect to a remote server and performs various operations on it by issuing commands from a local machine.

Fig.9 Link Flapping

For Scenario I, EIGRP protocol takes the less time. For Scenario II, Hybrid OSPF_RIP protocol takes less time with respect to other two hybrid protocols. This time is even less than the total time taken by EIGRP single protocol? Telnet response of a network varies with the change in protocols and hybrid protocols give better performance and can be considered for applications where Remote Login response time is a major factor

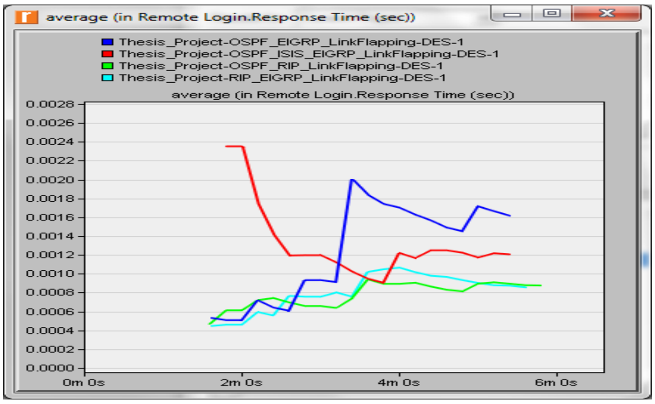

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Fig.10 Hybrid Protocols with Link Failure/Recovery

6.5 Video Conferencing Packet End-to-End Delay (sec)

The Video Conferencing application models transmission of video traffic between two nodes in the network.

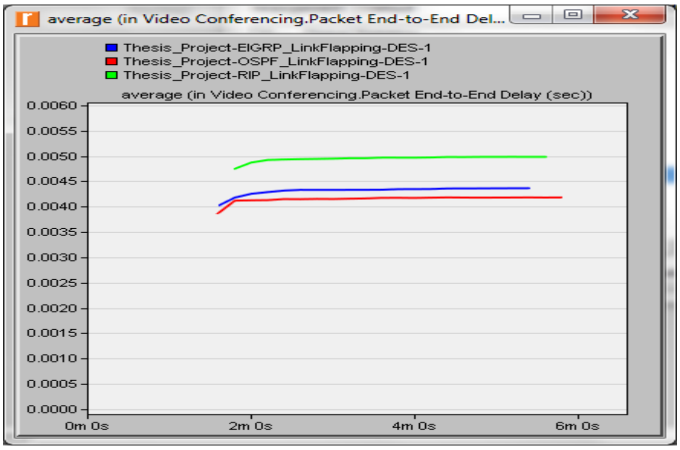

Fig.11 Link Flapping

In the Link Failure/Recovery scenario OSPF has better performance and has less end-to-end delay time as compare to other two protocols. Whereas performance of hybrid protocol scenarios is marginally equiavlent to performance of single protocols. We can study on hybrid protocol performance by implementing different topologies like by increase in number of hosts, simulation time period etc.

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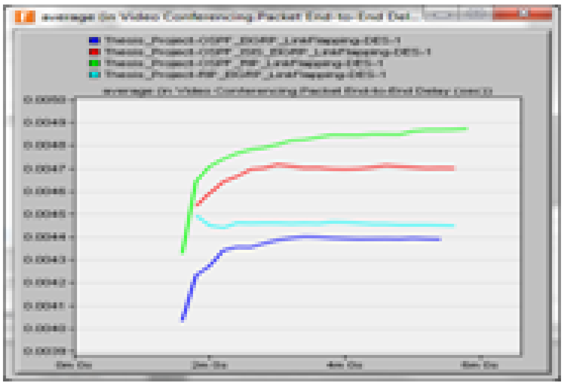

Fig.12 Hybrid Protocols with Link Failure/Recovery

6.6 Queuing Delay (sec)

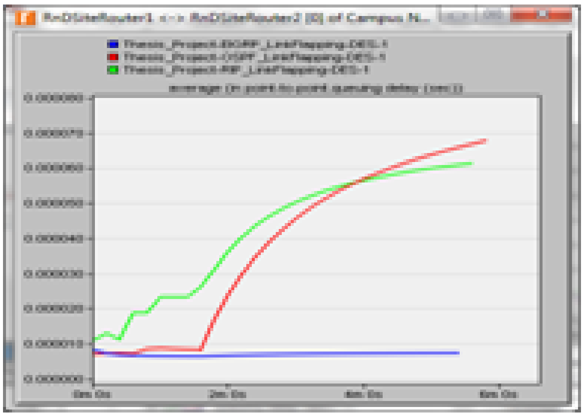

Fig.13 Link Flapping

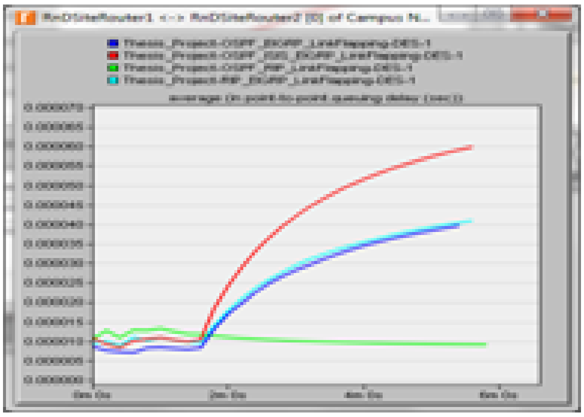

Fig.14 Hybrid Protocols with Link Failure/Recovery

For Scenario I, EIGRP has least queuing end-to-end delay whereas For Scenario II, OSPF_RIP has least queuing end-to-end delay time as compare to other two combined/hybrid protocols. Comparing both figures queuing delay in Hybrid Protocol scenario is comparively less with respect to single protocol scenario. Therefore, Hybrid Protocol gives better performance in Queuing delay.

IV. CONCLUSION/RESULT

This paper, we use a bottom-up-top design approach where we concluded each routing protocols would serve best based on different applications currently running in the networks and its performance varies as the successive/link failure is applied. We have seen Hybrid Protocols performance is comparatively better than the performance of single protocol.

Table.1 Link Flapping (Successive Link Failure Scenario)

Applications/Routing Protocols	EIGRP	OSPF	RIP
Email Download Response Time (seconds)	0.005792	0.005627	0.007672
HTTP Page Response Time (seconds)	0.286705	0.286944	0.337529
Network Convergence Duration (sec)	5.001506	5.001824	24.20612
Remote Login Response Time (sec)	0.000924	0.001022	0.00102
Video Conferencing Packet End-to-End Delay (sec)	0.004314	0.004151	0.004949
Queuing Delay (sec)	7.10012 E-06	3.80621E-05	4.18895 E-05

Table.2 Hybrid Protocols with Successive Link Failures

Applications/ Routing Protocols	OSPF_EIGRP	OSPF_RIP	RIP_EIGRP
Email Download Response Time (seconds)	0.015626	0.006033	0.009468
HTTP Page Response Time (seconds)	0.292856	0.319494	0.286071
Network Convergence Duration (sec)	5.001505	26.29552	5.001505
Remote Login Response Time (sec)	0.001235	0.000779	0.000804
Video Conferencing Packet End-to-End Delay (sec)	0.004354	0.004794	0.004458
Queuing Delay (sec)	2.31533E-05	1.05232E-05	2.50571E-05

V. FUTURE SCOPE

In the future, behavior of routing protocols can be analyzed by employing different network topologies with respect to number of hosts, distance between routers, number of routers in the network, number of links etc. A security analysis of these routing protocols can be done in future. A comparison can be done on protocols by varying simulation time of the networks.

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