Performance Analysis of RIP and OSPF in Network Using OPNET

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Abstract

Routing plays important role in internet communication and it is based on routing protocols, now a day's many routing protocols exist, among these routing protocols most famous are RIP (Routing information protocol) and OSPF(Open shortest path first). In this research work we analyze the performance of these protocols in term of their convergence, traffic, CPU utilization by changing special parameters within network. OPNET simulation tool is used to design the network; analysis of the results is examined using standard tools.

Keywords: *OSPF, RIPV1, RIPV2, Performance Analysis, OPNET.*

1. Introduction:

Communication is a method of sharing information to each other. Thousand years back, sharing information was very complicated. In early life of mankind man and women used body language and speech for talk to each other, but inventions made it easy for the people to communicate with each other very easily. In a petite time mankind developed a rules and languages to communicate with each other. Combination of these rules and languages are called protocols. Now a day's telephone, internet, is use to communicate with each other. Inventions became very essential that life without them is stiff. Today the communication between computers has increased and it is poignant the heights of sky. Users sitting in one place of word can communicate to other place of the word by using a variety of communication channels. Most important aspect of communication is routing and routing is done by routing protocols. In this research we study two different routing protocols OSPF and RIP in detail; we collect compare and analyze the performance of RIP and OSPF in term of their convergence, time, CPU utilization, and network traffic.

2. Routed Protocols:

When data are send from one location which is normally one network to other location routed term is used Routed protocols are network layer protocols it uses to move traffic among networks. Example of routed protocols are IP, IPX, AppleTalk, Telnet, RPC, SNMP, SMTP, Novell, IPX, OPI networking protocol, Decent, AppleTalk, Banyan Vines, Xerox Network System (XNS). These protocols are used to communicate between different networks.

3. Dynamic Routing:

Dynamic routing means destination is decided at the run time. In dynamic routing, routing information is share with other routers. Dynamic routing protocols

learn route automatically by neighbor routers. Because in autonomous system (AS) neighbor routers send route information to each other. Router choose best path, hop number and delay, in dynamic routing link cost depend on bandwidth. Updated values send to other routers. It is very easy for network administrator for maintaining and configuring routes in dynamic routing. Dynamic routing protocols have some disadvantages like routing loops, short time. Dynamic routing protocols have the capability to maintain the network operation in case of a failure or when the network configuration topology change [1].

3.1 Open Shortest Path First (OSPF)

Among routing protocols OSPF is very famous protocol which is fall in IGRP (interior routing protocol) category. OSPF is based on link state routing. Its reference no is RFC 2328. Internet engineering group IGP developed it, OSPF used with in large autonomous system to dole out information. OSPF is non-proprietary routing protocol. OSPF first version was defined in 1989 which is called OSPFv1, Its reference no is RFC 1131.In 1998 second version comes its reference is RFC 2328.In IPV6 networks OSPFV3 introduces, and its reference is RFC 2740. VLSM (variable length subnet mask) or CIDR (class inter domain routing) addressing models uses OSPF. In OSPF there is no concept of hop count OSPF structure is hierarchical. OSPF is dynamic routing protocol therefore it learn route automatically and send route information to other routers OSPF uses link state as algorithm local information is contains in link state packets to share each other. Procedure for generating shortest path tree is very simple every router sends local and external link state information to each other. It is ensuring every router to calculate shortest path with in AS (autonomous system) that it uses correct topology. If any changes within AS than recalculation process starts

3.2 Routing Information Protocol (RIP)

RIP routing information protocol is known as dynamic routing protocol and it was come in the field of routing in 1988 of June and its reference is RFC 1058.It was developed by C. Hedrick from Rutgers University.RIP is protocol for WAN and LAN and its category is IGP interior gateway routing protocol and uses distance vector(DV) and hope as its metric In RIP irregular copies of routing tables is send to their neighbor routers metric for each link as hop count for routers for example there are three routers C, D, E connected to each other, when router D receives routing table from router C it added one metric and send it again to router C.D router again perform same function as router C performs and send this routing table to router E this operation perform all routers in neighbor. RIP has three versions, RIPV1, RIPV2, and RIPNG.

4. Convergence

Convergence is broad term which has several meanings but according to the network convergence, means that in an internet work all routers have same topological information about their network. When routers start convergence they collect topological information for other routers through implemented routing protocol. One important thing is that this information is not contradicted on the real time information available in network. We Find out real state of network by using this information. Converged network is defined as

"It is a network in which all routers know that what type of topology is running and according to the topology they share packets to each other.

4.1 Convergence Time:

Time that is required for the routers to learn routes of entire inter network is called convergence time. Convergence time is very important thing because this time tells researchers when some network goes in failure condition that how much time it takes to come in normal condition.

4.2 Convergence Process:

At the start of routing when routing enables topological information of inter network interaction between routers. This process is very important for sending, receiving information this type of information is required depends upon routing protocols like, RIP, OSPF, BGP, IS-IS.

5. Simulation

Simulation is a software package in which we predict the behavior of network, and we have no need of actual network. In simulation we set different parameters related to our network. Simulation of routing protocols is one of them. Simulation is not as real network but it is a standard for research purpose It provides environment like physical which is not possible in real.

In real we cannot create 200 routers, 100 switches, 200 LAN nodes etc. but in simulation it is possible. Main advantage of simulation is that it gives you your results in Mathematical, and graphical form by using these graphs summarizes the research results. Another advantage of simulation is that any type of routing protocol like OSPF, MPLS, IS-IS, BGP RIP simulate in any network the researcher wants. Simulation has three types, live simulations, Virtual simulations, Constructive simulations. Simulation is tool which provides a facility to draw a network which is copy of actual network and set different parameters for it and there is no need of real network.

5.1 OPNET SIMULATION:

During this research we use OPNET simulator IT GURU V14. OPNET is high level simulation tool it has been used in many high level researches. It enables simulation of heterogonous networks by employing a various protocols [2] Operation of simulation starts at packet level; it is built for predetermined networks at its beginning. There are many feature of OPNET in which, OPNET commercially used fixed network, protocols and hardware is available In OPNET there is also functionality of simulating wireless networks OPNET is also used for competing future researches by adding more things in it. End users and researchers take benefit in their work because it is high level research tool

6. Simulation Methodology

Simulated network topology is shown in fig1.Below figure shows overall over view of topology in which on location is shown. In this research work we have been created five scenarios. These scenarios consist of three OSPF scenarios and two RIP scenarios. Each router in scenario configures with OSPF and RIP protocols. Detail of network and configuration devices is as under.

We have 7600 series routers by Cisco. Ping parameters Application configuration, Profile configuration, Link failure utilities.

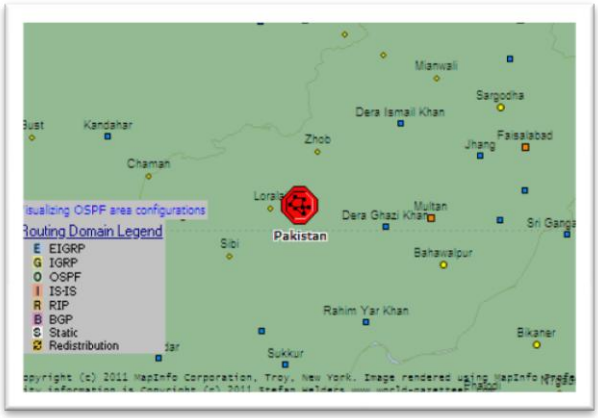


Fig.1 Overall view of network topology

Figure 2 shows the detail structure of topology. Network topology design for this research is based on six different locations with in Pakistan. These locations are the cities of Pakistan, name of the locations are Quetta, Peshawar, Islamabad, Faisalabad, Lahore, and Karachi.

Fig.2 Detail View of network topology

These six locations connect with center location which is called network core. Internal structure of core is shown in Figure 3. In core three routers of 7600 attached with each other these routers named south cluster, which covers south area, north cluster covers north area and central cluster covers east area of network topology.

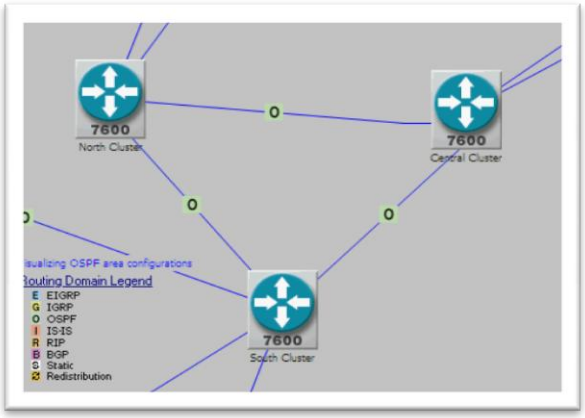


Fig 3.Core network internal structure

6.2 OSPF Faisalabad Location internal structure.

Fig 4 OSPF multi areas at Faisalabad location shows that there are two types of routers is placed Access routers and Edge routers. The figure clearly shows that network topology used at Faisalabad location is Tree topology. Access routers directly attach with LAN network. LAN network send its outgoing traffic directly to access routers. Access routers attach with each other and they also attach with edge router. Edge router is responsible for sending LAN traffic outside the OSPF area. Edge router sends traffic to Core, and core send this traffic to other locations.

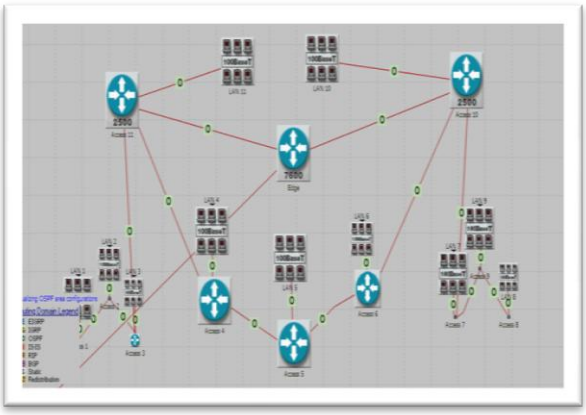


Fig.4 Faisalabad Location internal structure

6.3 RIP Peshawar Location internal Structure.

At Peshawar location by using RIP protocol star topology is used as shown in figure. Two types of routers used access router and edge routers. Access routers directly attach with LAN network. LAN network send its outgoing traffic directly to access routers. Access routers attach with each other and they also attach with edge router. Edge router is responsible for sending LAN traffic outside the RIP network. Edge router sends traffic to Core, and core send this traffic to desire location.

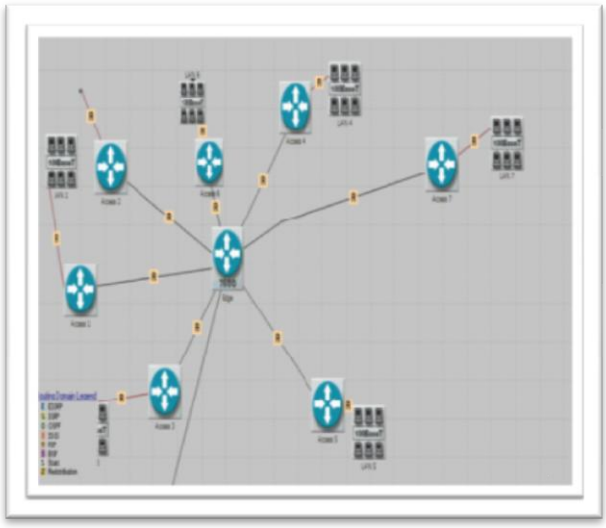


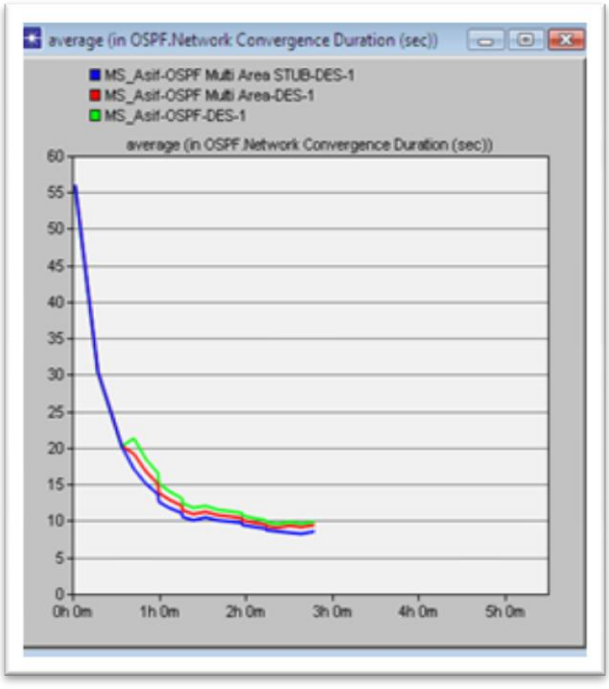
Fig.5 Peshawar Location internal structure

7. Results and Discussion.

7.1 OSPF Convergence

X-axis: Represents time duration of convergence activities Y-axis: Represents percentage of convergence activity at specific time

From the below graph and table we analyze the convergence time of OSPF protocol. This convergence time is in seconds. In the graph blue line shows OSPF multi stub area convergence time, Green color shows convergence of OSPF single area and Red color shows OSPF multi area convergence time. The graph clearly shows that OSPF multi stub area takes more time for convergence as compare to OSPF single area and OSPF multi area. OSPF multi stub area take 55 sec for convergence, OSPF single area and OSPF multi area take equal time in convergence which is 20 sec. Graph clearly shows as time passing OSPF multi stub area convergence time reduces and a point come in network in which OSPF single area, multi area OSPF and OSPF multi stub area takes equal time in convergence. When taking average reading of network convergence it is clear that OSPF multi stub area takes less time as compare to OSPF single area and OSPF multi area which is 12.683 sec, OSPF single area takes 13.495 and OSPF multi area takes 12.683 sec .Reading tells us that OSPF multi area and OSPF multi stub area take equal time in convergence.



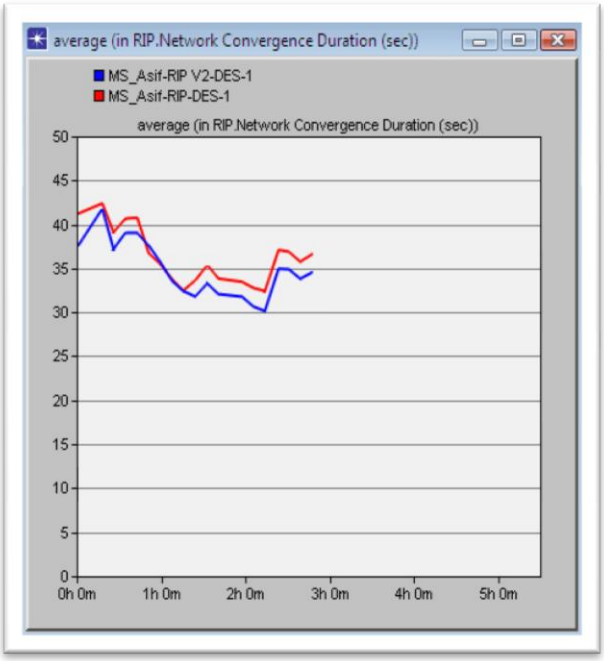
Graph.1 OSPF convergence

Statistic	Average
OSPF single area network	13.495
OSPF Multi Area Network Convergence(sec)	12.683
OSOF Multi stub Area convergence	12.683

Table 1.OSPF convergence Time

7.2 RIP convergence

Graph2 shows the convergence time of RIP and RIP v2.In the Graph red line describe RIP and blue line describe RIPv2.This convergence is measure in seconds. The Graph shows that RIP take slight more time in convergence as compare to the RIPv2. During whole convergence time period which is approximately three hours Graph shows that RIP takes more time as compare to RIPV2.At some moments see in Graph at hour 1 there is slight over lapping in which RIP convergence goes down but in over all scenario RIP take more time in convergence. Tabular reading shows more clear view

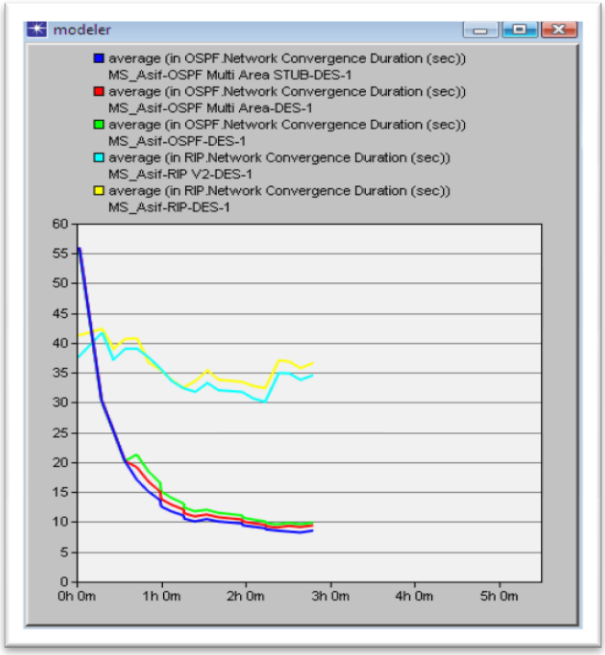


Graph.2 RIP convergence

Statistic	Average
RIP Network Convergence (sec)	42.33
RIPV2 Network Convergence (sec)	39.38

Table 2.RIP convergence Time

7.3Network Convergence Time OSPF vs.RIP



Graph 3. RIP vs. OSPF convergence

Above graph describes OSPF and RIP network convergence time Blue line in graph express OSPF multi stub area, red line express convergence time of OSPF multi area, Green line express OSPF single area, Yellow line express RIP v2 and Pink line shows RIP network convergence. Graph clearly shows that RIPS and RIPS v2 takes more time in convergence as compare with OSPF single area and OSPF multi area. But one important thing is that at the start OSPF multi stub area takes more time as compare with RIP due to the link failure utility, but as time passes and RIP network fully converged its convergence time increased. Tabular data clearly shows RIP network

takes half more time in convergence as compare to the OSPF network.

Statistic	Average
OSPF single area network convergence (sec)	13.495
OSPF Multi Area Network Convergence (sec)	12.683
OSPF Multi Area stub Network Convergence (sec)	12.683
RIP Network Convergence (sec)	42.33
RIPV2 Network convergence	39.38

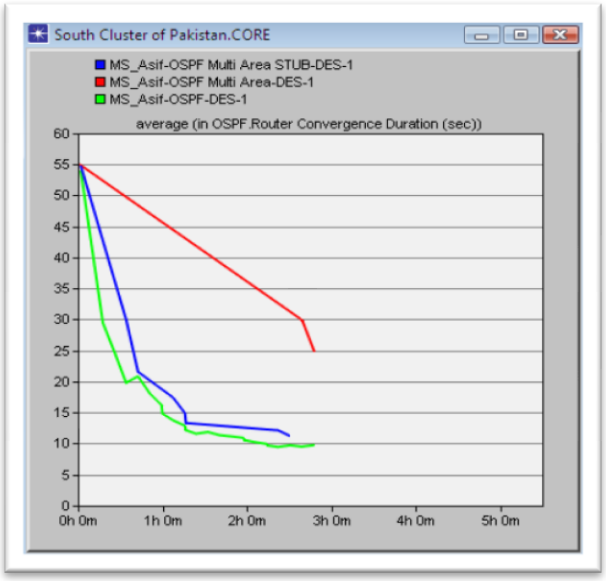
Table3.RIP vs.OSPF convergence

8 OSPF Convergences inside Core

Convergence behavior inside core is different from network convergence outside the core area. Graph and reading shows inside core area behavior OSPF single area takes 16.39 seconds as compare to outside core which takes 13.49 seconds. OSPF multi area takes 36.63 inside core area and 12.68 seconds outside core area. OSPF multi stub area takes 25.39 sec inside core area and outside core area it takes 12.68 sec. Graph clearly shows that OSPF multi area network convergence time decoration is constant comparatively OSPF single area and OSPF multi stub area.

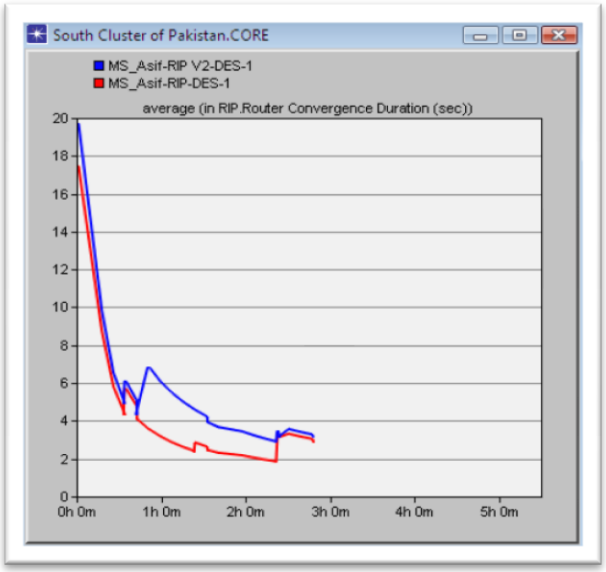
Statistic	Average
OSPF single area network convergence (sec)	16.39
OSPF Multi Area Network Convergence (sec)	36.63
OSPF Multi Area stub Network Convergence (sec)	25.39

Table 4.RIP Convergence inside core



Graph 4.OSPF convergence inside core

8.1RIP Convergence inside Core network



Graph.5. RIP convergence inside core

Statistic	Average
RIP network convergence	4.000
RIPv2 network convergence	5.109

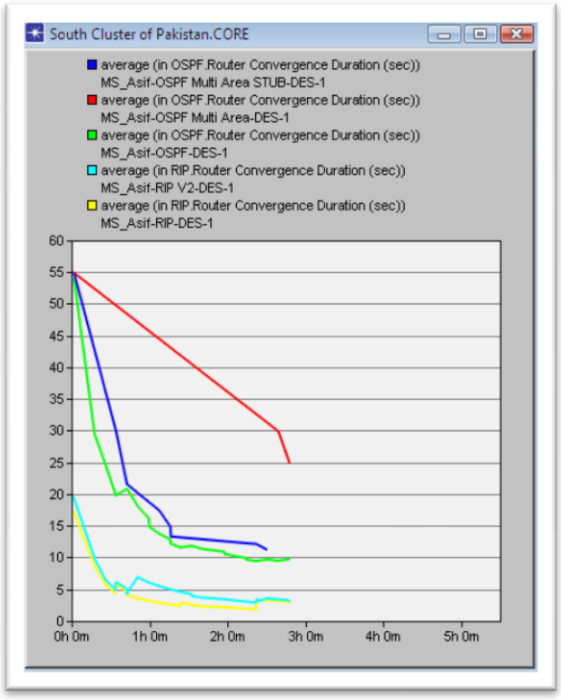
Table 5.RIP Convergence inside core

Graph 5 and table shows the RIP network convergence inside core RIPV2 takes 5.10 sec in side core but outside core it takes 39.38 sec.RIP takes 4.00 sec inside core but outside core it takes 42.33 seconds.

8.2 Network Convergence OSPF vs. RIP inside core

X-axis: Represents time duration of convergence activities Y-axis: Represents percentage of convergence activity at specific time

Graph6 describes the network convergence time of OSPF single area, OSPF multi area and OSPF multi stub area vs. RIP, RIPv2 inside core. Graph shows that in core network convergence behavior changes inside core OSPF takes more time in convergence as compare to RIP and RIPV2 network converged faster inside core area as compare to OSPF.



Graph.6. RIP and OSPF convergence inside core

Statistic	Average inside core	Average outside core
OSPF Network Convergence (sec)	16.39	13.49
OSPF Multi Area Network Convergence (sec)	36.63	12.68
OSPF Multi Area stub Network Convergence (sec)	25.39	12.68
RIP Network convergence(sec)	4.00	42.33
RIP v2 Network Convergence (sec)	5.10	39.38

Table 5.RIP Convergence inside core

Conclusion

OSPF (Open shortest path first) and RIP (Routing information protocol) commonly used protocols in networking. During this research work, accessible the comparative study of two elected protocols OSPF and RIP. Proportional investigation conducted for real time data by using RIP and OSPF protocols within same network. In simulation environment specific parameters has been set for check performance of routing protocols especially RIP and OSPF. Network topology called three tires has been used. Simulation result shows that in any network environment convergence time of OSPF single area is greater as compare to OSPF multi area and OSPF multi stub area. Result shows that OSPF takes 13.495 seconds in convergence OSPF multi area and OSPF single area takes 12.683 seconds which approximately .812 seconds which means OSPF single area takes .812 seconds more in convergence. Another result is RIP and RIP v2 network convergence results shows that

RIP takes 42.33 seconds and RIPv2 takes 39.38 seconds which means RIPV2 network converged 2.95 seconds early as compare to RIP the result is 100% accurate the reason is that RIP is older version and RIPv2 is next version of RIP with some enhancements. Comparison between OSPF convergences with RIP convergence shows that OSPF network convergence is faster as compare to RIP convergence and it is not depend that what type of network topology has been used. For future point of view we can continue this research work by analyzing CPU utilization inside core and outside core as well as network traffic.

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