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Analysis of IPv6 Network by enabling RIP and OSPF

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ABSTRACT*:* The goal of this paper is to investigate the behavior of routing convergence. It begins with an explanation of IP addressing. Next, the report discusses the two routing protocols: Routing Information Protocol (RIP) and Open Shortest Path First (OSPF) into great detail. The report then examines the structure of a routing table and the route selection process. In order to be practical in the investigation of the routing convergence, we perform an experiment that involved seven Cisco routers. It is assumed that an end customer requires redundancy for its Wide Area Network (WAN) connection. The customer purchases WAN connectivity from two different ISPs that are, unfortunately, running two different routing protocols; hence, routing information should be redistributed. We conduct the experiment such that network convergences under different failure situation are observed. We will also modify the timers of RIP to inspect any improvement.

KEYWORDS*:* RIP, OSPFv3, IPv6, IPv4, Routing Table.

I. INTRODUCTION

The goal of this paper is to analysis the behavior of routing convergence [1]. It begins with an explanation of IP addressing. The paper discusses the two routing protocols: Routing Information Protocol (RIP) [2] and Open Shortest Path First (OSPF) [3] into great detail. The report then examines the structure of a routing table and the route selection process.

In order to be practical in the investigation of the routing convergence, we perform an experiment that involved routers. It is assumed that an end customer requires redundancy for its Wide Area Network (WAN) connection. The customer purchases WAN connectivity from two different ISPs that are, running two different routing protocols hence routing information must be reallocated. We conduct the experiment such that network convergences under different failure state are examined. We will also change the timers of RIP and OSPF to inspect any improvement [4].

In Existing System Network plays a vital role that helps to share information and resources and implement centralized management system. To enable the network features, all organizations and ISPs have designed and implemented IPv4 network to share their voice/data/video applications. IP is internet protocol and works on third layer of OSI model and forward packet from one node to another.IPv4 enables encapsulation and add more information that helps for efficient transmission of data. IPv4 address is32 bit address and have maximum of 2^32 combination address.

IPv4 address is configured in devices either manually or automatically (DHCP) [5]. Subnetting, VLSM and supernetting concepts are used to increase the Network performance. Router has memory and stores routing more information due to expansion of network. NAT is used to better utilization of IPv4 address. IPv4 network supports mobility but generates O/H information.IPv4 network supports dynamic routing by enabling protocols such as OSPF and RIP.

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II. PROPOSED SYSTEM

Internet Protocol version 6 (IPv6) [5] is a version of the Internet Protocol (IP). It is designed to succeed the IPv4 (Internet Protocol version 4). The Internet operates by transmitting data between hosts in small packets that are independently routed across networks as specified by an international communications protocol known as the Internet Protocol. Each host or computer on the Internet needs an IP address in order to communicate. The development of the Internet has created a need for more addresses than are possible with IPv4. IPv6 was established by the Internet Engineering Task Force (IETF) to deal with this long- anticipated IPv4 address exhaustion [6]. Like IPv4, IPv6 is an Internet Layer protocol for packet- switched internet working and provides end-to-end datagram transmission across multiple IP networks. It also eliminates the primary need for network address translation(NAT),which gained wide spread deployment as an effort to all eviate IPv4 address exhaustion.

III. IPv6

A. IPv6 Address Format

IPv6 logical addresses have two parts. 64-bit network prefix and 64-bit host address part. The host part address is often generated automatically from the MAC interface address. IPv6 address is represented by 16- bit hexadecimal values separated by colons (:)
shown as follows: a101:0db8:85a3:0210:000:8a2e:0370:7334[7][8][9].
The hexadecimal digits are case-insensitive. The 128-bit IPv6 address can be abbreviated with the following cases:

- Case one Leading zeroes within a 16-bit value may be omitted. For example, the address fe80:0000:0000:2000:2020:b3ff:fe1e:8329 May be the written as fe80:0:0:2000:2020:b3ff:fe1e:8329
- Case two: One group of successive zeroes within an address may be replaced by a double Colon (::) examp le fe80:0:0:0:202:b3ee:fe1e:8329 becomes fe8::202:b3ee:fele:8329
- A single IPv6 address can be represented in several different ways, such as 2101:db8::1:0:0:1 and 2101:0DB8:0:0:1::1.[10][11]

IV. SYSTEM MODEL IN IPV6

A. Routers

A router is a device that forwards data packets between computer networks, creating an overlay internetwork [12]. A router is connected to more data routs from different networks. When a data packet arrives in a route the router senses the address in the packet and determines its true destination. Using this information the router route the packet to the next network on its journey. Routers perform the "traffic directing" functions on the Internet. A data packet is typically promoted from one router to another through the networks that constitute the internetwork until it gets to its destination node [13].

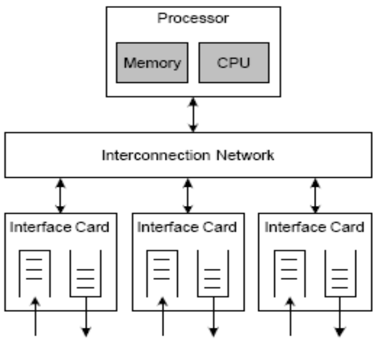

Fig 1. Router components.

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The basic hardware components of a router include network interfaces [14][15][16] an interconnection network, and a processor with memory and a CPU. This is illustrated in Figure 1When a datagram is received by an (incoming) interface card, it is stored in memory, processed, and then transmitted on an (outgoing) interface card. The interconnection network carries datagram between the processor and the interface. Dependent on the type of router, interface cards may have additional memory and processors. Also, instead of a single centralized processor, a router may have additional processors and distribute its workload across multiple processors.

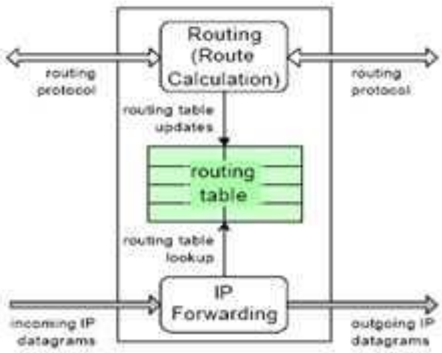

Fig 2. Functions of a router.

Recall the two main processes of a router : routing and IP forwarding. Routing functions include route calculation, maintenance of the routing table and implementation of routing protocols. The workload acquired by routing is sufficiently small that it can be handled by a central general purpose processor, which is called the route processor. The workload due to IP forwarding. on the other hand, is directly proportional to the amount of IP traffic at a router. A single processor with centralized main memory can forward several hundred of megabits of data per second, however, higher data rates require a different architecture, which parallelizes the processing related to IP forwarding. This is done by assigning some or all of the IP forwarding functions to the interface cards and by using interconnection networks that can handle multiple simultaneous datagram transmissions.

B. GNS3- Graphical Network Interface

GNS3 is a Graphical Network Simulator that allows emulation of complex networks. We may be familiar with VMware or Virtual PC that are used to emulate various operating systems in a virtual environment. These programs allow us to run operating systems such as Windows XP Professional or Ubuntu Linux in a virtual environment on our computer. GNS3 allows the same type of Emulation using Cisco Internetwork Operating Systems. It allows us to run a Cisco IOS in a virtual environment on our computer. GNS3 is a graphical front end to a product called Dynagen. Dynamips is the Core program that permits IOS emulation. Dynagen runs on top of Dynamips to generate a more user friendly, text-based situation. A user may create network topologies using simple Windows in-type files with dynagen successively on top of Dynamips. Graphical Network Simulator takes this a step further by providing a graphical environment.

V. ROUTING IN IPv6

The term routing encapsulates two tasks [15] [16]. These tasks are deciding the paths for data ransferred and sending the packets on these paths. The routing process is a carried out at layer 3 of the OSI reference model [12][13]. The routing algorithm chooses the output line to transfer the received packets. The routing algorithms are based on the routing protocol that uses metrics to assess whether a particular path is the optimal path available for transfer of the data packets. The metrics used for assessing the paths are reliability, delay and bandwidth. The routing algorithms use these protocols to determine an optimal path from the source to the destination. The routing tables preserve all the information related to routing. There are different routing algorithms. Depending on these routing algorithms, the data stored in the routing table varies. Every router has its private routing table and it fills this table with the required

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information to calculate the best path between the source and the destination router.

A. Dynamic Routing

Dynamic routing protocols are used by routers to share information about the reach ability and status of distant networks. Dynamic routing protocols perform various activities.

i. Automatic Network Discovery

Network discovery is the ability of a routing protocol to share information about the networks that it knows about with other routers that are also using the same routing protocol. A dynamic routing protocol allows the routers to automatically learn about these networks from other routers. These networks and the best path to every network are added to the router's routing table and denoted as a network learned by a specific dynamic routing protocol.

ii. Routing Tables

After the first network discovery, dynamic routing protocols update and preserve in routing table. Dynamic routing protocols make a best path determination to several networks, and determine a new best path if the initial path becomes unusable (or if the topology changes). For these causes, dynamic routing protocols have a benefit than static routes. Routers use dynamic routing protocols routinely to share routing information with other routers and compensate for any topology changes without connecting the network administrator.

VI. ROUTING PROTOCOLS

Routing protocols are related based on some following character. Time to convergence states, how quickly routers in the network share routing information and reach a reliable knowledge. The faster the convergence is more preferred in a protocol. Loops can occur when unpredictable routing tables are not updated due to slow convergence in a changing network. Scalability defines how large a network can grow based on the routing protocol that is installed. The larger the network is, the more scalable the routing protocol needs to be. Classless routing protocols include the subnet mask in the updates. This article supports the use of VLSM (Variable Length Subnet Masking) and better route summarization. Classful routing protocols don't include the subnet mask and cannot support VLSM. Resource usage includes the necessities of a routing protocol such as memory CPU, space, and link bandwidth utilization. Higher resource requires more powerful hardware to support the routing protocol operation in addition to the packet forwarding processes. Maintenance and Implementation describes the level of knowledge that is required for a network administrator to maintain implement the network based on the routing protocol deployed.

A. RIP

iii. Distance Vector characteristics

The routing by distance vector gathers data of the information of the routing table of its neighbors. The routing by distance vector determines the best route adding the metric value that receives as the routing information occurs from router to alternative one. With most of the protocols of routing by distance vector, the updates for the changes of topology consist of periodic updates of the tables. The data happens from router to another one, giving mostly like result one more a slower convergence. RIP and EIGRP are examples of vector distance protocols.

iv. Link state characteristics

The link state routing obtains a great vision of the topology of complete internetwork accumulating all the necessary LSA. In the link state routing, each router it works independently to calculate its own shorter route towards the networks destiny. With the protocols of routing of connection state, the updates are caused normally by changes in the topology. The relatively small LSA that is going to all the others routers generally give like result faster times of convergence with any change of topology of the internet work. OSPF is example of link state protocol.
RIP is a dynamic, distance vector routing protocol based around the Berkely BSD application routed and was developed for smaller IP based networks. RIP uses port 520 UDP for route updates. RIP analyzes the best route based on hop count. RIP takes some time to converge like all routing protocols. But it requires less RAM Memory and CPU power compared to other protocol.

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As the number of jumps is only metric of routing used by the RIP, not essentially it selects the fastest route towards its destiny. A metric one is a measurement unit that allows making decisions and next will learn that other protocols of routing use other metric ones in addition to the number of jumps to find the best route of data transfer.
RIP MESSAGES

RIP updates uses UDP payload inside an IP datagram. Below shows the format of a RIP message.

Command	Ver No	0	Addr Family ID	0	Address	0	0	Metric
1	1	2	2	2	4	4	4	4

Fig 3. RIP Packet

REQUEST (1) - Request for a partial or full table update from another RIP router.
RESPONSE (2) - Response to a request. Used in command field by all router.
TRACEON (3) / TRACEOFF (4) - Obsolete and ignored.
RESERVED (5) – Reserved for Sun Microsystems

i. RIPng

This is the Next Generation version of RIP support, which is meant for IPv6. And it comes under Distance Vector routing protocol and uses Hop Count just like RIPv1 and RIPv2. RIPng not designed to be used in large networks, but should work fine in utmost small and medium sized networks. It does not support more than 15 hops just like RIPv1 and RIPv2. RIPng does not authenticate packets (it doesn‟t need to because it makes use of IPsec). It does not use subnet masks but uses a prefix length instead. RIPng uses the multicast address FF02::9 RIPng uses UDP port

B. OPEN SHORTEST PATH FIRST (OSPF)

In 1988, the group: Internet Engineers Task Force (IETF) began to develop a new protocol of routing that it would replace the protocol RIP. Then they developed the Open Shortest Path First protocol (OSPF) [17]. Open Shortest Path First (OSPF) is an adaptive routing protocol for Internet Protocol networks. It is use a link state routing algorithm and falls into the group of interior routing protocols, functioning within a single autonomous system. OSPF is an interior gateway protocol that routes Internet Protocol (IP) packets solely within a single routing domain autonomous system. It gathers link state information from existing routers and constructs a network topology map. The topology defines the routing table presented to the Internet Layer which makes routing decisions based solely on the destination IP address found in IP packets. OSPF was designed to support VLSM - variable length subnet masking or CIDR - Classless Inter-Domain Routing addressing models.
OSPF senses changes in the network topology, such as link failures very quickly and converges on a new loop-free routing structure within few seconds. It uses Dijkstra's algorithm to find the shortest path tree for each route, a shortest path first algorithm.

OSPF Message

1	1	2	4	4	2	2	8
Ver No	Type	Pkt Length	Router ID	Area ID	Checksum	Authen. Type	Authentication

Fig 4. OSPF Packet

COMMAND types (field value)
VERSION field - Describes which version of the OSPF protocol it is (1 or 2)
TYPE- Describes the type of packet. It includes Hello, Database description, LS request, LS update and LS acknowledgement
PACKET LENGTH - Packet length including header
ROUTER ID-IPof the generated router and IP of the interface over which the message has to be sent

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AREA ID-Area to which the message belongs
AUTHENTICATION TYPE- No authentication, Simple password, Cryptographic authentication.

VII. SIMULATION DESIGN AND RESULT

A. Analyzing performance with 5-CISCO Routers

To be practical in the examination of the routing convergence, we use five cisco routers to perform experiment. Here the experiment is conducted under different failure situationand the results are examined. Also the improvement is inspected by varying the timers of RIP. The setup is shown in the Figure 5

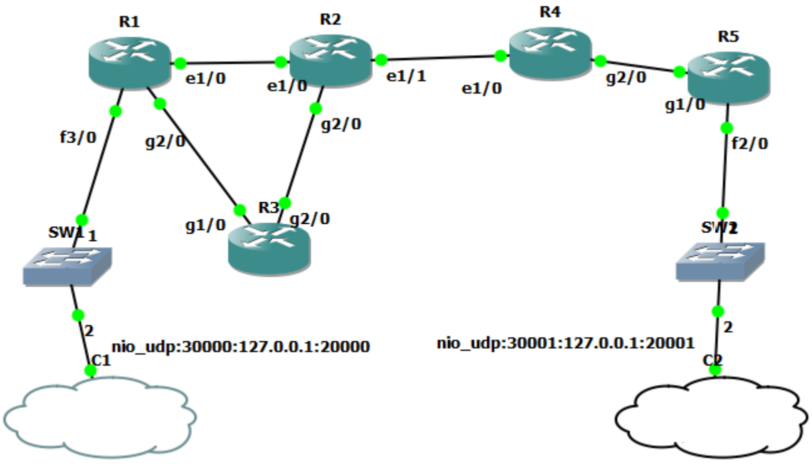

Fig 5 Network with 5 routers

This experimental setup shown above is a hybrid topology. Here an Ethernet link is used to connect R2 and R1 routers. Gigabit link is used to connect other remaining routers. Fast Ethernet link is used to connect host and routers. Both OSPF and RIP protocols are enabled in the network topology, while transferring data from one router to another router, due to less Administrative Distance OSPF protocol is selected. The costs for the links are mentioned in the topology.

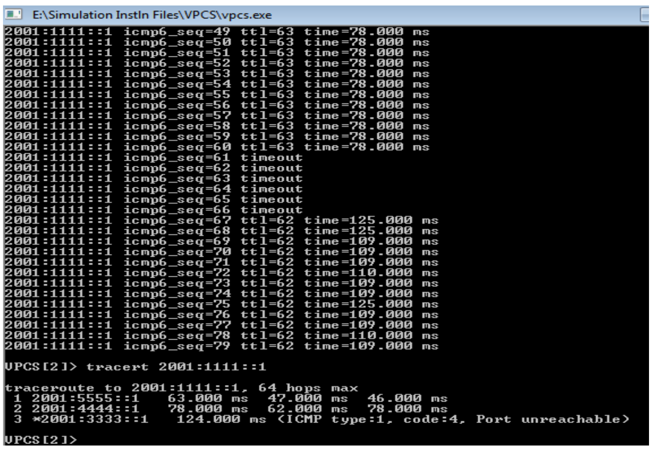

Fig 6 R5 Console port

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C. Comparison Of 3, 4 And 5 Routers

D. Convergence Time

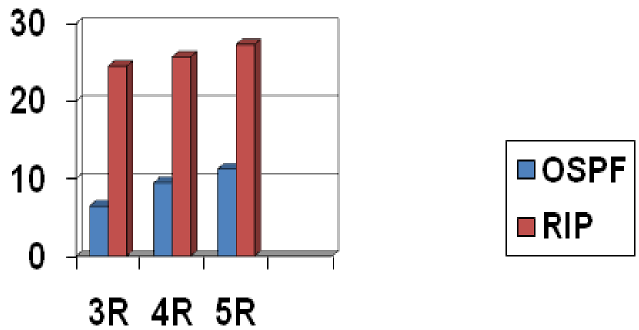

Fig 7 Graph of the comparison of convergence time with 3, 4 & 5 routers

E. Packet Loss

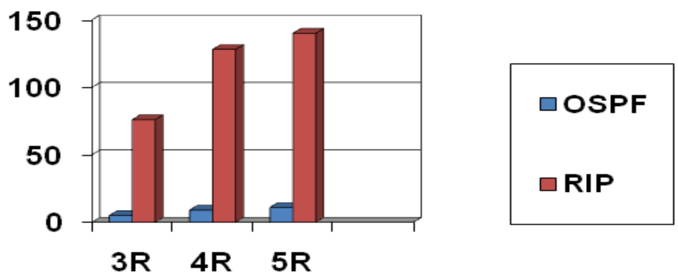

Fig 8. Graph of the comparison of packet loss with 3, 4 & 5 routers

C. Comparison Between Rip And Modified Rip With 3, 4 And 5 Routers

i. Convergence Time

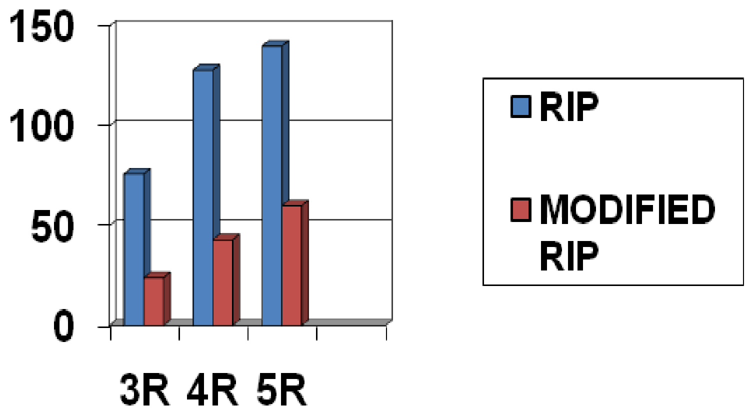

Fig 9. Graph of the comparison of convergence time with 3, 4 & 5 routers.

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ii. Packet Loss

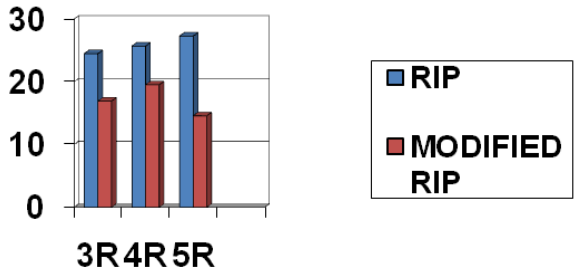

Fig 10 Graph of the comparison of packet loss with 3, 4 & 5 routers

VIII. CONCLUSION

Routing tables across the entire network should converge in minimum time in order to avoid extreme traffic loss. This is the main interest of this paper. We also discussed IP addressing and the various components of the routing table. Different networks are created with different number of nodes and configured with OSPF and RIP protocol. Once any gateway or interface gets failed, the router will choose alternative path. RIP modernizes routing information for every 30 seconds. OSPF updates for every 90 seconds or when modification in network which ever is earlier Hello protocol. Since the converging time in OSPF is less, the packet loss is also less. Thus there will be growth in reliability and efficiency hence we will have better Quality of Service.

We also observed that the RIP timers impact the OSPF/RIP redeployment convergence behavior significantly. We recommend that a shorter RIP timer be programmed whenever possible. Otherwise, the end devices (server, work station, PC) should be programmed with a longer idle time-out whenever the WAN connection involves a multi - routing protocol because the convergence requires up to several hundred seconds. Both RIP and OSPF are widely used in the today's networks. OSPF has fast convergence and its hierarchical routing makes it more efficient in the large networks. Even though RIP has slow convergence, but for the small networks whose hop count less than 16 can deploy RIP effectively by changing the RIP's timer's values.

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