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Performance Evaluation of RIP and OSPF Routing Protocol

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Abstract

Routing protocols play a key role in ensuring efficient data transfer within computer networks. They allow routers to determine the most appropriate path for data packets, enabling reliable communication between devices. Among the commonly used protocols, Interior Gateway Protocols such as Open Shortest Path First (OSPF) and Routing Information Protocol (RIP) are essential for routing within autonomous systems. RIP operates as a distance-vector protocol, utilizing hop count as a routing metric, making it best suited for smaller networks due to its simplicity. In contrast, OSPF is a link-state protocol that leverages a more advanced algorithm, providing faster convergence and better scalability, particularly for larger networks. This paper offers a detailed comparison of RIP and OSPF in terms of routing strategies, network performance, convergence speed, scalability, and their application in different network setups. By analyzing their advantages and drawbacks, this study identifies the most effective protocol for reliable and efficient data routing.

INTRODUCTION

A computer network is a system where multiple computers and related devices are connected through wired or wireless communication channels, enabling the sharing of information and resources. It facilitates communication and collaboration among users from different backgrounds by electronically linking devices to exchange data. Computer networks are utilized across various sectors and are categorized into several types. This study focuses on four main categories of networks: **PAN (Personal Area Network)**, **LAN (Local Area Network)**, **WAN (Wide Area Network)**, and **MAN (Metropolitan Area Network)**.

Personal Area Network (PAN) connects an individual's personal devices, such as computers, smartphones, smartwatches, and earbuds, within a short range. It allows seamless communication between these devices, either through wired or wireless connections.

Local Area Network (LAN) usually consists of two or more computers connected within a limited area, such as a home, office, or school. LANs typically operate over short distances and are privately managed. Common network topologies used in LANs include bus, ring, star, and tree.

Wide Area Network (WAN) connects multiple LANs across large geographical areas, such as cities, states, or countries. WANs rely on communication methods like satellite links, leased telephone lines, and other network media channels to create a global network that enables long-distance data transmission.

LITERATURE REVIEW

Efficient data transmission across networks requires the use of appropriate routing techniques. Studies have analyzed the performance of **Routing Information Protocol (RIP)** and **Open Shortest Path First (OSPF)** in various network scenarios. Both protocols are commonly used and perform well in terms of network throughput for different packet sizes. However, hybrid networks, which consist of both wired and wireless components, present unique challenges. Researchers have explored the behavior of RIP and OSPF in such hybrid environments.

While both protocols demonstrate good performance, OSPF consistently shows lower latency compared to RIP. Network simulators like **Graphical Network Simulator-3 (GNS3)** and **Enterprise Network Simulation Platform (ENSP)** are often used to compare and evaluate the performance of these protocols in controlled environments. These simulations provide valuable insights into their behavior under specific conditions.

Most research focuses on fixed network configurations with a set number of devices. Future studies may consider exploring different network sizes and incorporating additional routing protocols for a more comprehensive analysis.

ROUTING PROTOCOLS

- **Routing Information Protocol**

An assessment of the wired RIP and OSPF routing protocols will be provided in this section. Transmitting data packets from the source to the destination is the aim of routing protocols. The key distinctions in the routing protocols that will be covered in this study are focused on route path recovery, maintenance, and searching .Through the use of an algorithm that chooses a certain path to travel, the routing protocol controls delivered data packages and gathers network information. Reducing time delays, power consumption, packet loss rates, routing overload, improving bandwidth utilization, and throughput are all goals of its implementation.

Routing stability, routing timers, routing update procedure, and routing metric are the four key components of RIP. Among its advantages are that it can be applied to all routers, offers load balancing, avoids routing loops by capping the number of hops at 15, and performs well in small networks user Datagram Protocol (UDP), which has port 520 reserved, is the transport protocol used by RIP. RIP uses hop count, a routing metric that counts the number of hops a data packet must make in order to reach its destination, to select the optimum path for routing data packets.

The four types of timers used in RIP networks to control performance are hold-down, route flush, route update, and route invalid timers. A router can communicate its whole routing table to its neighbours at intervals of 30 seconds thanks to the Route Update Timer. When a route hasn't been updated, the Route Invalid Timer sets a 180-second time limit to determine if it is invalid. When an update packet is received but there is an indication that the route is inaccessible, the hold-down timer gives itself a 180-second time limit to decide how long to conceal routing information. When a route is identified as invalid or inaccessible, the flush timer automatically removes the item from the routing table after 240 seconds.

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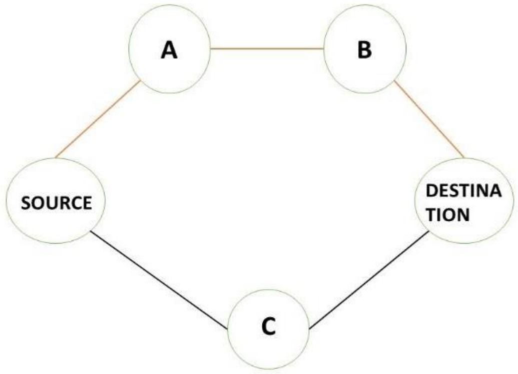


Fig. 3.1 Diagrammatic representation of RIP

- **Open Shortest Path First**

Based on open standards, OSPF is primarily used by corporate networks that use the Link State Advertisement (LSA) routing protocol. It determines the route based on information stored in a Link State Database (LSDB) and applies Djkstra's algorithm to select the most intelligent and shortest path available to deliver packets from source to destination within the LSDB. It then uses the accumulating cost of links in the path to send information to its neighbouring routers. This is due to OSPF routers' knowledge of their topology table, complete adjacency, and OSPF neighbour.

It was developed to reduce inefficiencies and deal with the problems that the RIP network faces, as was previously mentioned. The journal goes on to say that it contains a variety of packets, including greeting packets, topology descriptions, link state requests, updates, and acknowledgements. Additionally, it only offers one kind of timer—the hello timer, which has an interface that lasts for 10 seconds and a dead time of 120 seconds. In order to calculate the routing table, OSPF was designed to detect changes in topology, such as link failures and convergence loop-free, within seconds.

It claims that OSPF's advantages include better convergence, load balancing, no hop count limitations, support for IP-multicast for updating and lightening network load, authentication, and the ability to segment the network. It also overcomes RIP issues by utilizing the Variable Length Subnet Mask. Some of OSPF's drawbacks include the need for more memory to store neighbour information tables, additional CPU processing to run the SPF algorithm, and challenges configuring the distance vector protocol.

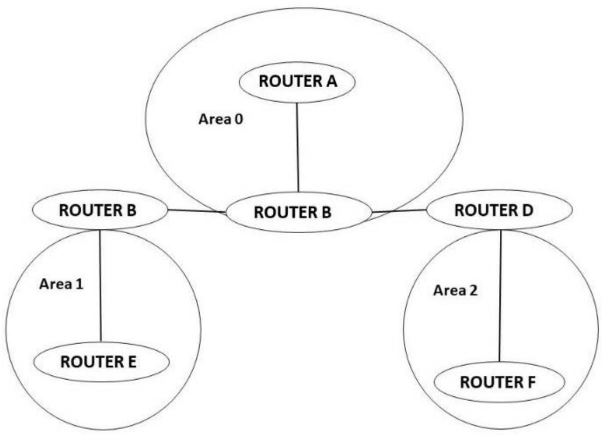


Fig. 3.2 Diagrammatic representation of OSPF

Comparison between RIP and OSPF

TABLE I Comparison between RIP and OSPF

	RIP		OSPF
	RIPv1	**RIPv2**	
Speed of Convergence	Slow		Fast
Scalability-Size of Network	Small		Large
Use of VLSM	No	Yes	Yes
Routing	Classful	Classless	Classless
Administrative distance	120		110
Authentication	No	MD5	MD5
Protocol	UDP		IP
Protocol Variety	Distance vector		Link-state
Transmission	Broadcast	Multicast	Multicast
Standard	Open		Open
Metric	Hop count		Bandwidth/ Delay
Resource Usage	Low		High
Implementation	Simple		Complex
Algorithm	Bellman-ford		Dijkstra
Path Selection	Hop based		Shortest path

METHODOLOGY

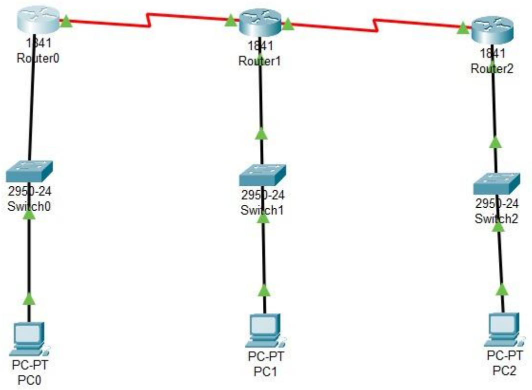
In order to simulate a wired network, physical wires links must be built to interface links that connect to the hosts. Additionally, nodes must be configured using routing protocol configurations in order for traffic to function and flow smoothly. The network engineer or technician must next configure the delay and bandwidth [.

Throughput and latency are the primary measures utilized in the reference research paper [6] to which this study is referring. While delay is amount of time a packet takes to travel from its source to its destination, throughput is the number of packets delivered in a given amount of time [7].

The identical network design topology was used in the reference research paper [8] to give information for the OSPF and RIP protocols. It created a LAN design for both the RIP and OSPF using seven Cisco routers. This design uses both series and parallel cable connections to the routers in order to prevent lower latency and achieve higher throughput. In essence, it connected from R3, R6, and R7 one after the other, then it connected from R1, R2, R4, and R5. Then, R2 to R3 and R5 to R6 are interconnected in parallel. On the other hand, the shortest path was the wired connectivity of R1 – R2 – R3 – R6 – R7, although a long path connectivity of R1 – R2 – R4 – R5 – R6 – R7 exists in the topology.

IMPLEMENTATION

The implementation of network configurations and simulations is facilitated using Cisco Packet Tracer



RESULTS AND CONCLUSIONS.

In the study publication , the RIP protocol was simulated using the network design mentioned above, and the hostname, router version, and interface parameters were provided.

While the purpose of this research is to assess the effectiveness of the RIP and OSPF routing protocols while using wired connections, the research's findings were taken from a reference research paper. While OSPF, or "link state," calculates the first shortest path, RIP, or "distance vector" routing protocol, determines the optimal paths. Throughput and latency were the evaluation performance measures taken into account.

Because of the link and coverage changes, the simulation shows that OSPF performs better than RIP in a wired LAN connection in terms of efficient throughput and packet delay in the networks. [10]. However, RIP performs better than OSPF when it is implemented inside a small number of nodes. The average time was determined using the ping and traceroute commands, and the findings showed that OSPF is quicker than RIP.

TABLE II. The Ping Result in RIP and OSPF

			RIP	**OSPF**	
No.	Router Communication	Number of Test	Average (ms) in GNS 3	Average (ms) in GNS 3	Success
1.	R0 – R1	1 2 3	5 11 23	10 13 26	100
2.	R1 – R2	1 2 3	4 10 24	1 8 15	100
3.	R2 – R3	1 2 3	6 9 17	0 2 17	100

RIP is slower than OSPF likewise from the nearest router to the farthest. It proves that OSPF data transfer time is better than RIP, it has broader reach of networks and more convergence speed.

```
Router#traceroute 192.168.4.3
Type escape sequence to abort.
Tracing the route to 192.168.4.3

  1   192.168.4.3     22 msec   10 msec   5 msec
Router#traceroute 192.168.5.3
Type escape sequence to abort.
Tracing the route to 192.168.5.3

  1   192.168.4.3     23 msec   5 msec    5 msec
  2   192.168.5.3     2 msec    11 msec   11 msec
```

Fig. 7.1 : Traceroute Of RIP

```
Router>enable
Router#traceroute 192.168.2.3
Type escape sequence to abort.
Tracing the route to 192.168.2.3

  1   192.168.2.3     0 msec    4 msec    2 msec
Router#traceroute 192.168.5.2
Type escape sequence to abort.
Tracing the route to 192.168.5.2

  1   192.168.5.3     8 msec    0 msec    0 msec
  2   192.168.5.2     15 msec   24 msec   6 msec
```

Fig. 7.2: Traceroute of OSPF

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