COMPARATIVE PERFORMANCE INVESTIGATION OF EIGRP, OSPF, AND RIP ROUTING PROTOCOL FOR CAMPUS AREA NETWORK USING CISCO PACKET TRACERAND OPNET MODELER

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ABSTRACT

A routing methodology is needed to incorporate in a whole computer system with greater network facility. Routing protocols play a crucial role in modern communication networks. They facilitate the network topology information among nearby routers. Network managers have to analyze the effectiveness of various routing protocols using different criteria. The efficient functioning of a Campus Area Network (CAN) heavily relies on the selection of an appropriate routing protocol. This study conducts a comparative performance investigation of three popular routing protocols, namely Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), and Routing Information Protocol (RIP), using two simulation tools, Cisco Packet Tracer and OPNET Modeler. The objective of this investigation is to evaluate and compare the key performance metrics of these routing protocols in a CAN environment, including convergence time, routing table size, network stability, and overall throughput. The simulations are conducted under various scenarios and network configurations, simulating real-world situations that a campus network might encounter. Through the comprehensive analysis of the obtained simulation results, this study aims to identify the strengths and weaknesses of each routing protocol, enabling network administrators and engineers to make informed decisions when choosing the most suitable routing protocol for their specific CAN requirements. The findings of this investigation contribute to the existing body of knowledge in the field of computer networks and routing protocols, providing valuable insights for network designers, administrators, and researchers. Furthermore, the comparison of simulation results from two different tools, Cisco Packet Tracer and OPNET Modeler, offers an additional perspective on the consistency and accuracy of the outcomes. The outcomes of this research serve as a reference for future network design and optimization endeavors, aiding in the enhancement of the overall performance and reliability of campus area networks.

KEYWORDS

Routing Protocol, EIGRP, OSPF, RIP, Packet Tracer, OPNET & Cisco Packet Tracer

1. INTRODUCTION

The utilization of computers is experiencing substantial growth. We are currently living in the era of the internet. The advent of data transmission and networking has brought about significant changes in both business practices and personal communication methods. The process of communication has the capacity to create divisions within the global community as a result of the specific methods employed for transmitting information. Communication serves as a means through which information is exchanged.

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Within the domain of contemporary networking, the strategic development and careful choice of routing protocols assume a pivotal position in ascertaining the effectiveness, expansiveness, and dependability of a network infrastructure. The growing dependence of organizations on interconnected systems for data exchange has given rise to the significance of Campus Area Networks (CANs) as essential elements that offer connectivity within a limited geographical region, such as a university campus or a corporate headquarters. The selection of topology for these networks can have a substantial impact on their performance and resilience. Therefore, it is crucial to thoroughly examine and assess various routing protocols within the relevant context.

Routing protocols play a crucial role in the determination of data paths within a network. The protocols determine the manner in which routers establish and sustain communication with one another in order to construct and manage routing tables, thereby facilitating the efficient forwarding of data. In the realm of ring topologies, wherein devices are interconnected in a circular fashion, the choice of an appropriate routing protocol assumes heightened significance owing to potential obstacles such as the occurrence of loops and the imperative for swift convergence.

The objective of this research is to conduct a thorough analysis of the performance of three widely used routing protocols, namely Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), and Routing Information Protocol (RIP). The investigation will focus on their comparative performance within the specific topology of a ring-based Campus Area Network (CAN). In order to expedite this inquiry, two commonly utilized network simulation tools, namely Cisco Packet Tracer and OPNET Modeler, will be utilized. These tools facilitate the creation of a controlled environment that mimics real-world network scenarios, enabling the evaluation of the behavior and performance metrics of each routing protocol. Certain network performance factors, such as latency, bandwidth and congestion, may not be faithfully replicated within a simulated environment such as Packet Tracer. OPNET is a versatile tool that facilitates the examination of various aspects of network operations, including network performance evaluation, capacity planning, and resource allocation, among other areas of investigation. [1, 2, 3]

Both Cisco Packet Tracer and OPNET Modeler offer a controlled environment for the analysis of routing protocols such as EIGRP, OSPF, and RIP in diverse network topologies, including the ring topology investigated in our study. These tools provide fundamental insights into the functioning and interaction of routing protocols, allowing us to assess their effectiveness and appropriateness for particular network designs and situations. The subsequent sections of this study will employ the functionalities of these simulation platforms to conduct a comparative examination of routing protocols within the framework of a ring topology Campus Area Network. The primary objective of this study is to make a scholarly contribution to the existing body of knowledge pertaining to the selection of routing protocols within campus area networks, specifically focusing on ring topologies. Through the utilization of simulation-based experimentation, network administrators and engineers can acquire valuable insights into the performance characteristics of EIGRP, OSPF, and RIP. This empirical analysis enables them to make well-informed decisions pertaining to the design and optimization of network infrastructures, ultimately leading to improved efficiency and reliability.

1.1. Related Work

Numerous scholarly articles have been dedicated to the analysis of the efficacy of routing protocols. The researchers performed an analysis and comparison of various routing protocols, such as RIP, EIGRP, IS-IS, and OSPF. The evaluation was conducted by employing various simulation tools, including Cisco Packet Tracer, OPNET, and GNS (Graphical Network

Simulator). Different parameters were utilized to test various aspects of these protocols, resulting in conclusions that are well-founded. The findings of the research indicated that EIGRP exhibited superior performance compared to other protocols, specifically RIP and OSPF, with respect to key performance indicators. The indicators examined in this study included convergence time, CPU utilization, throughput, end-to-end delay, data transfer rate, and bandwidth management.

In a previous study cited as [4], [5], [6], [7], [8], [9], [12], [13], [14], researchers conducted a comprehensive analysis and comparison of the operational efficiency of three different routing protocols: Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), and Routing Information Protocol (RIP). The primary objective of their investigation was to assess the performance of these protocols in network topologies that were identical. However, the research conducted in references [15] and [6] lacks comprehensive evaluation of network topology and other performance metrics.

The preceding dialogue underscores the limited consideration given in previous studies to the comprehensive set of metrics relevant to the overall service quality of routing protocols. Typically, their focus is either exclusively on the OPNET Simulator or on employing a limited range of parameters. In their study, the authors[11], [12], [13], [14] and [15] examine the use of Cisco Packet Tracer and OPNET as simulation tools. However, it is worth noting that only two metrics were utilized in one of the papers.

In the study conducted by the authors [6], both Cisco Packet Tracer and OPNET Simulator were utilized. However, the researchers encountered difficulties in accurately representing their network topology using these tools. The evaluation criteria employed in their analysis are limited to two metrics, namely convergence time and routing traffic.
In the aforementioned study [15], the utilization of a Simple Mesh topology is exclusively employed within the office network. However, it is imperative to explore alternative network topologies such as star, ring, and hybrid configurations in order to conduct a comprehensive investigation into their respective performance capabilities. Only three performance metrics are considered using the OPNET simulator.

This paper aims to explore various network design scenarios and examine the key metric parameters that are essential for evaluating the efficacy of RIP, OSPF, and EIGRP routing protocols. This research endeavor conducts a comprehensive examination of the relative efficacy of EIGRP, OSPF, and RIP protocols within a Campus Area Network that is structured as a ring topology.

The routing methodologies are discussed in Section 2. Section 3 of the document delineates the Cisco Packet Tracer models pertaining to routing protocols. In a similar vein, section 4 expounds upon the OPNET models associated with routing protocols. Furthermore, section 5 furnishes a comprehensive overview of the simulation scenarios. The outcomes of the simulation are discussed in Section 6. Ultimately, we have acquired Section 7.

2. Overview of Routing Protocols and Performance Metrics

Routing protocols can be categorized into two main types: interior gateway protocols (IGPs) and exterior gateway protocols (EGPs). IGPs are designed to function within a single autonomous system, while EGPs are responsible for managing routing between multiple autonomous systems. OSPF and EIGRP serve as instances of Interior Gateway Protocols (IGPs), which are utilized for routing within autonomous systems. Conversely, BGP, a widely recognized Exterior Gateway

Protocol (EGP), is employed for routing between autonomous systems. [16] In this study, we conduct a comparative analysis of three routing protocols within the broader context of dynamic routing protocols.

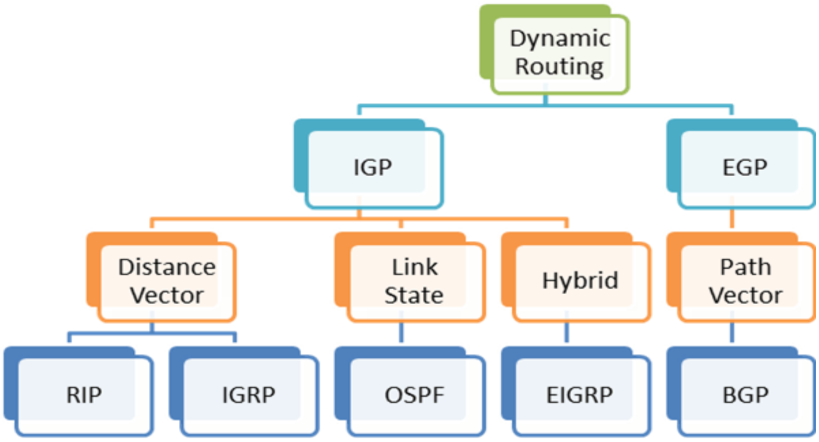

Figure 1. Dynamic routing protocol [13]

2.1. Rip Routing Protocol

The Routing Information Protocol (RIP) is a routing protocol that employs a distance-vector algorithm, utilizing hop count as its metric for evaluating and selecting the most optimal route to a given destination. In networking, it is customary for routers to maintain a routing table that contains information regarding the available destinations and the corresponding number of hops needed to reach them. Routers that employ the Routing Information Protocol (RIP) periodically transmit their complete routing tables to adjacent routers. The aforementioned procedure is commonly referred to as "routing table updates." When a router receives an update, it performs a comparison between the received information and its own routing table. If the new information presents a shorter path, the router proceeds to update its routing table accordingly. [17]

Maintenance and Discovery of Routes: Routers in the Rest in Peace (RIP) protocol periodically refresh their routing tables every 30 seconds through the process of broadcasting their complete routing tables to adjacent routers. When a router fails to receive an update from a neighboring router within a specified timeframe, usually set at 180 seconds, it deems the corresponding route as inaccessible and proceeds to eliminate it from its routing table. Nevertheless, the Routing Information Protocol (RIP) exhibits sluggish convergence as a result of its inflexible update intervals and inadequate adaptation to alterations in network topology.

2.2. Ospf Routing Protocol

OSPF is a network protocol classified as a link-state routing protocol, which primarily emphasizes the dissemination of comprehensive data pertaining to the network's topology. OSPF routers engage in the generation and dissemination of link-state advertisements (LSAs), which serve the purpose of conveying information about their own operational state as well as the operational state of their adjacent routers. The provided data is utilized for constructing a comprehensive representation of the network's topology. Subsequently, routers employ Dijkstra's algorithm to determine the most efficient routes to reach desired destinations. [18]

Maintenance and Discovery of Routes: OSPF routers consistently observe their links and interfaces for any modifications. When a change in the link state occurs, a router initiates the generation of a Link State Advertisement (LSA) and disseminates it to all other routers within the Open Shortest Path First (OSPF) area. Routers employ the received Link-State Advertisements (LSAs) to update their link-state databases and subsequently recalculate the shortest paths. The prompt reaction to modifications, coupled with the capacity to condense pathways, enhances the expeditious attainment of stability in OSPF networks.

2.3. Eigrp Routing Protocol

The Enhanced Interior Gateway Routing Protocol (EIGRP) is a networking protocol that exhibits characteristics of both distance-vector and link-state protocols. EIGRP routers are responsible for the maintenance of neighbor tables, topology tables, and routing tables. EIGRP disseminates routing updates to its neighboring routers; however, in contrast to conventional distance-vector protocols, EIGRP exclusively transmits updates when there is a modification in the network.

The establishment and maintenance of neighbor relationships among EIGRP routers is facilitated through the exchange of hello packets. In the event of a change, update messages are exclusively transmitted by routers that are directly impacted. The aforementioned updates encompass pertinent details regarding the alteration, thereby enabling the receiving routers to update their topology tables and perform route recalculations. The Diffusing Update Algorithm (DUAL) is employed to guarantee the absence of loops in paths and expedite the process of convergence. This is achieved by enabling routers to focus solely on the modifications that directly impact their own routing tables. [19]

Each of the aforementioned routing protocols possesses distinct advantages and disadvantages, rendering them appropriate for diverse network environments and specific requirements. When making a decision on which routing protocol to choose, it is important to take into account various factors such as the size of the network, its topology, the time it takes for convergence, its scalability, and the level of support provided by vendors.

2.4. Performance Metrics

2.4.1. Convergence

Duration pertains to the temporal interval necessary for a collection of routers to attain convergence through the construction of their routing tables. Following the process of convergence, individual routers are provided with a comprehensive representation of the network's topology, which they utilize to determine the most suitable routes for the transmission of packets. Fast convergence times are of utmost importance for routing protocols. The rate of convergence per unit of time is employed in the computation of this duration. [20]

Mathematically, convergence time can be expressed as follows:

$$Convergence\ Time = Detection\ Time + Propagation\ Time + Computation\ Time$$

Where:

- Detection Time: The detection time refers to the duration it takes for a router to identify a modification in the network topology. It encompasses the duration required for the identification of a failed link or router as being inaccessible.
- Propagation Time: Once a change is detected, routers are required to disseminate this

information to their adjacent routers. Propagation time encompasses the duration required for the transmission of routing update messages to adjacent routers.

- Computation Time: After receiving updated information regarding a change in the network's topology, routers are required to compute new routes based on the revised information. The computation time encompasses the duration required for the recalculation of the routing tables.

2.4.2. Throughput

n the context of computer networks, throughput pertains to the mean quantity of messages or data packets that are effectively transmitted within a given timeframe, typically quantified in terms of bits per second or data packets per second. [21]

Mathematically, throughput can be represented using the following equation:
Throughput = Data Transmitted / Time Taken
Where:

- Data Transmitted: The amount of data sent or received over the network within the measured time period.
- Time Taken: The duration of the measurement period during which data is being transmitted.

2.4.3. Queuing Delay

The term queuing delay or latency pertains to the duration that time frames or cells remain in a device's queue prior to transmission, and this delay frequently constitutes a significant factor in the overall latency experienced. [22]

Mathematically, queuing delay can be calculated using Little's Law:

$$Queuing\ Delay\ (Dq) = (Average\ Number\ of\ Packets\ in\ Queue) / (Network\ Arrival\ Rate) * (Transmission\ Time\ per\ Packet)$$

Where:

- Average Number of Packets in Queue: This is the average number of packets waiting in the queue to be transmitted. It represents the traffic load on the network.
- Network Arrival Rate: The rate at which packets arrive at the queue for transmission.
- Transmission Time per Packet: The time it takes to transmit a single packet.

2.4.4. Cpu Utilization

CPU utilization refers to the percentage of a computer's central processing unit (CPU) capacity that is actively being used at a given time. [23]

Mathematically, CPU utilization can be calculated using the following equation:

$$CPU\ Utilization\ (\%) = (Time\ CPU\ Spent\ on\ Processing\ Tasks) / (Total\ Time) * 100$$

Where:

- Time CPU Spent on Processing Tasks: The amount of time the CPU is actively executing instructions and performing tasks.

- Total Time: The total time over which the measurement is taken.

2.4.5. Bandwidth Utilization

Bandwidth utilization pertains to the proportion of the network's available capacity that is presently occupied by data traffic. The metric quantifies the efficiency with which the network's capacity for data transmission is being utilized. [24]

Mathematically, bandwidth utilization can be calculated using the following equation:

$$Bandwidth\,Utilization\,(\%) = (Actual\ Data\ Rate) / (Link\ Capacity) * 100$$

Where:

- Actual Data Rate: The rate at which data is being transmitted over the network link. This can be measured in bits per second (bps), kilobits per second (Kbps), megabits per second (Mbps), etc.
- Link Capacity: The maximum data rate that the network link can handle. This is usually the specified or negotiated capacity of the link.

3. Design Network Topology in Packet Tracer

This simulation will involve the utilization of Packet Tracer to design and execute the implementation of three distinct routing protocols within a network that follows a ring topology. The network infrastructure will comprise of a total of four routers, six switches, and 18 personal computers (PCs) allocated for each of the three routing protocols, namely Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF), and Routing Information Protocol (RIP). The objective is to systematically observe and analyze the behavior of each protocol within the context of a ring topology configuration. [25, 26] In this study, distinct logical topologies will be established for each routing protocol, and their respective performance will be evaluated within the network.

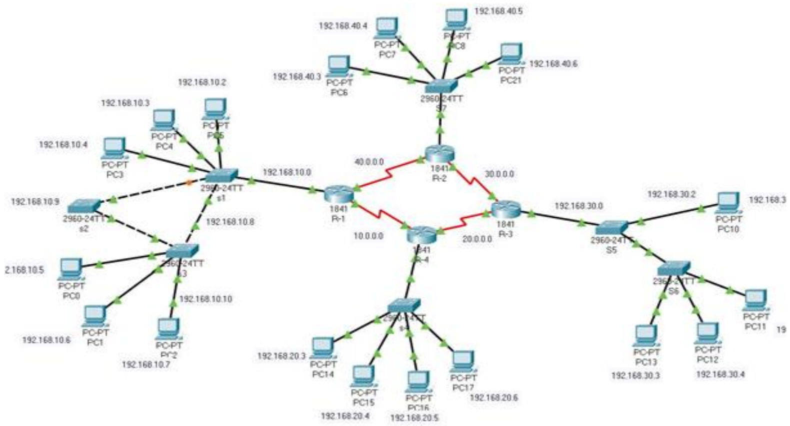

Figure 2. Schematic representation of a network

4. Design Network Topology in OPNET

In order to accurately replicate each network within OPNET, a sequence of actions must be executed. The OPNET simulation environment is known for its tranquil and user-friendly nature.

[27, 28, 29] The subsequent procedures delineate the necessary actions involved in the design process on a simulator while implementing a genuine OPNET model of the system.

- Generating network models
- Choose statistics
- Simulation running
- Result analysis

Figure 3. Designing steps

In OPNET, the network arrangement is illustrated in Figure 4. For our study, we created three different scenarios, each consisting of 18 interconnected subnets.

The routers within each subnet were configured using the EIGRP, OSPF, and RIP routing protocols. The network topology encompasses a range of network devices and setup utilities, which are as follows: The network infrastructure consists of various components, including CS_7200 Cisco routers, an Ethernet server, a switch, a PPP_DS3 duplex link, an Ethernet 100 Base T duplex link, an Ethernet workstation, and a total of 18 subnets. The routers are interconnected via a Point-to-Point Protocol (PPP) DS3 duplex link. The switches are connected to the routers using a shared duplex link, while the Ethernet workstations are connected to the switch using 10 Base T duplex links.

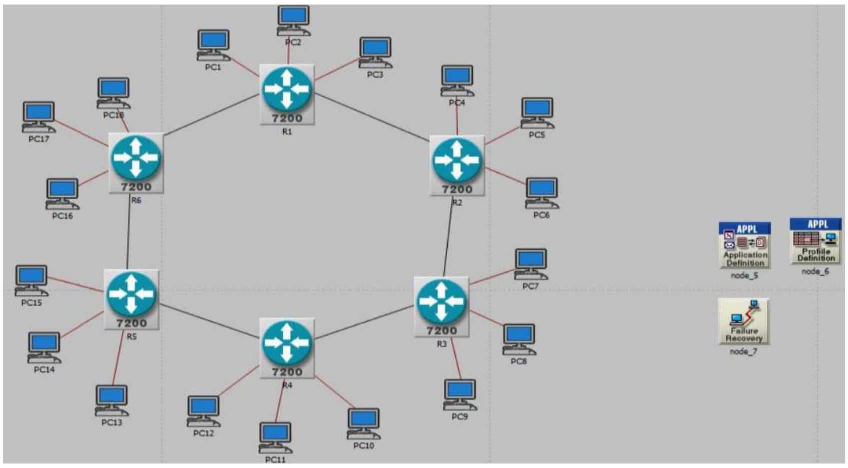

Figure 4. Ring topology in OPNET

5. SIMULATION SETUP

The network illustrated in Figure 4 is equipped with three distinct routing protocols, namely RIP, OSPF, and EIGRP. Every network router has the routing protocol enabled, and discrete event simulation (DES) statistics are chosen to evaluate the performance metrics and behavior of each protocol. The duration of the simulation for each of the three scenarios is established as 15 minutes. The network topology employed for all three routing protocols is identical.

In the simulation's Application Definition layout, the Application Definition Object is introduced into the workspace by selecting it from the object palette. This artifact facilitates the configuration of diverse types of application traffic.[30, 31] In our real-time application project, we have opted to utilize the Video conferencing option within the Application Definition Object in order to facilitate the transmission of video conferencing traffic.

In the subsequent step of configuring the Profile Definition simulation, the Profile Configuration is incorporated into the workspace by selecting it from the object palette. The Profile Configuration Object is responsible for defining profiles within the Application Definition Object, which are used to manage and control various types of application traffic. [32] In this configuration, a unified profile is established, encompassing the essential features required for video conferencing applications.

Within the OPNET simulation environment, the concepts of failure and recovery layouts pertain to the manner in which network failures are modeled and the subsequent mechanisms employed to restore functionality. The comprehension of network behavior in different failure scenarios and the assessment of recovery strategies' efficacy are of utmost importance. In the Failure/Recovery Configuration of the simulation setup, the failure link scenarios are configured. The presence of these instances of failure leads to disruptions in the structure of the routing topology, resulting in the emergence of additional periods of convergence activity.

Specifically, we set the link between routers R2 and R3 to experience failure & recovery according to the time shown in Table1.

Table 1. Failure/Recovery time.

Status	**Time(s)**
Fail	240
Recover	480
Fail	720
Recover	960
Fail	1200
Recover	1440

6. STUDYING AND ANALYZING SIMULATION

This section will undertake an analysis of the results derived from the simulation of the scenario outlined in the article. The objective of this study is to conduct a comparative analysis of simulation outcomes for various scenarios and subsequently identify the scenarios that are most suitable for the relevant applications. Furthermore, a range of topologies were employed to establish multiple protocols and simulation parameters in this particular section. The subsequent phase entails the presentation of simulation outcomes, wherein the comparative effectiveness of three distinct routing protocols, namely RIP, OSPF, and EIGRP, is examined. The aforementioned comparison is depicted in Figure 4.

The network convergence graph visually represents the durations of convergence for various routing protocols. The horizontal axis of the graph represents time measured in minutes, while the vertical axis represents the percentage of completion of the convergence process. A higher percentage value signifies a higher level of convergence, suggesting that the routing tables among the network devices are more stable and uniform. As depicted in figures 5 and 6, each line graphically represents the rate at which the routing protocols adapt to variations in the network topology. The Enhanced Interior Gateway Routing Protocol (EIGRP) and the Open Shortest Path First (OSPF) protocols exhibit contrasting network convergence times, with EIGRP demonstrating the fastest convergence time and OSPF exhibiting the slowest.

The queuing delay refers to the duration during which a packet remains in a queue, awaiting transmission. The metric in question pertains to the level of congestion and the overall performance of a network. The graph depicts a temporal dimension on the x-axis, representing time in minutes, while the y-axis represents queuing delay, typically measured in milliseconds (ms). In contrast to OSPF, EIGRP exhibits a reduced queuing delay as shown as in Figure 7.

CPU utilization is a metric that quantifies the extent to which a computer's central processing unit (CPU) is being utilized at a specific moment. When a routing protocol induces elevated CPU utilization, it can result in a decline in performance, heightened latency, and the possibility of network instability. Minimizing CPU utilization is imperative in routing protocols to optimize network operations, mitigate latency, and uphold consistent network performance. In the following scenario, we will be conducting a comparative analysis of CPU utilization among the routing protocols RIP, OSPF, and EIGRP. The x-axis denotes time intervals measured in minutes, while the y-axis represents the percentage of CPU utilization. During the duration of the observation, it is apparent that EIGRP consistently exhibits elevated levels of CPU utilization in comparison to OSPF.

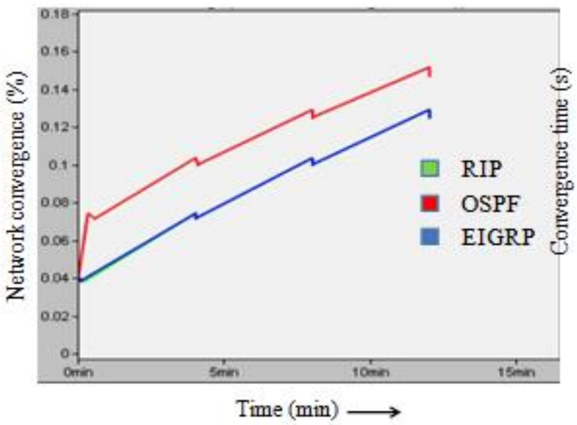

Figure 5. Network convergence activity

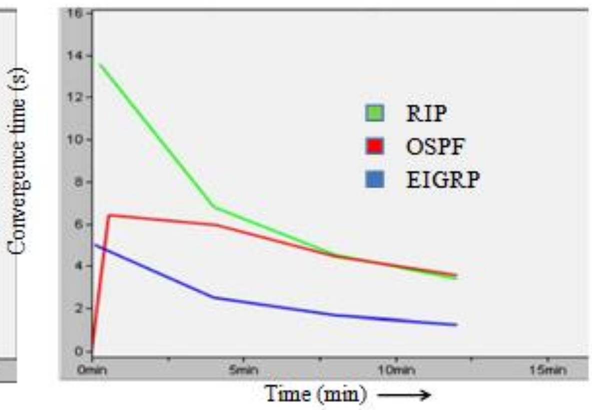

Figure 6. Network convergence duration(s)

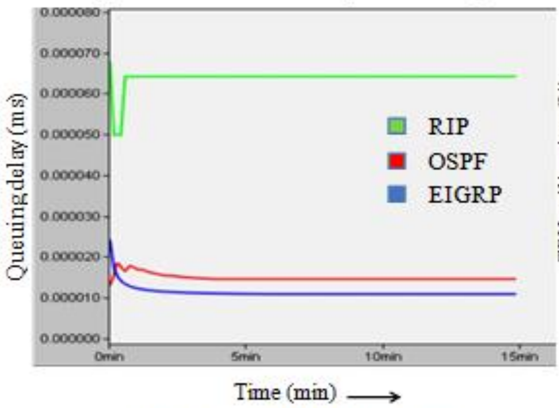

Figure 7. Queuing delay (sec)

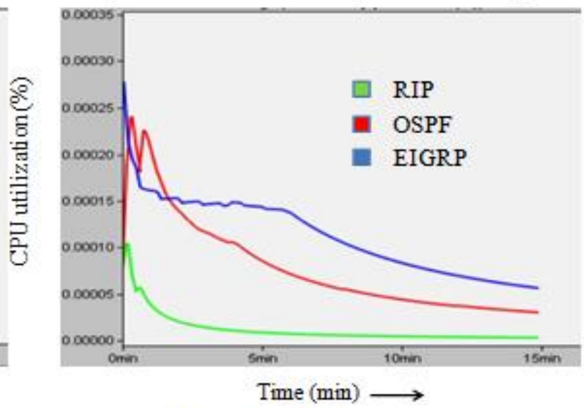

Figure 8. CPU Utilization

In the context of network topology, Ethernet delay pertains to the temporal duration required for a data packet to traverse from the originating node to the target node via Ethernet connections. The latency can be influenced by multiple factors, such as the bandwidth of the connection, the distance between the communicating entities, the level of congestion in the network, and the routing decisions implemented by the routing protocol. A decreased Ethernet delay is typically more advantageous in routing protocols due to its indication of diminished latency and expedited packet transmission. As depicted in Figure 9, it can be observed that EIGRP exhibits the shortest delay, while RIP demonstrates the longest delay.

The efficiency of a network in managing data traffic is a critical performance metric. A higher throughput typically signifies superior network performance in relation to the capacity for data transmission. Upon meticulous observation and thorough comparison, it has been observed that the Enhanced Interior Gateway Routing Protocol (EIGRP) demonstrates superior throughput in comparison to the Routing Information Protocol (RIP). However, it is noteworthy that the Open Shortest Path First (OSPF) protocol surpasses both EIGRP and RIP in terms of throughput across all stages, as illustrated in Figure 10. Bandwidth utilization pertains to the proportion of the network's available capacity that is presently being utilized. The metric denotes the extent to which the overall data-carrying capacity of a network link or channel is currently being utilized. Excessive utilization of bandwidth can result in congestion and impede the efficiency of data transmission, whereas insufficient utilization may suggest that the available resources are not being fully utilized. In contrast to the Enhanced Interior Gateway Routing Protocol (EIGRP), the Open Shortest Path First (OSPF) protocol makes use of a greater amount of network bandwidth.

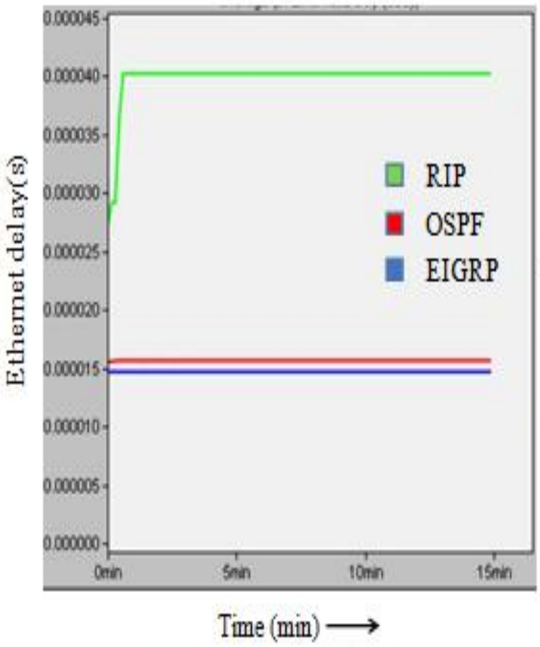

Figure 9. Ethernet delay(s)

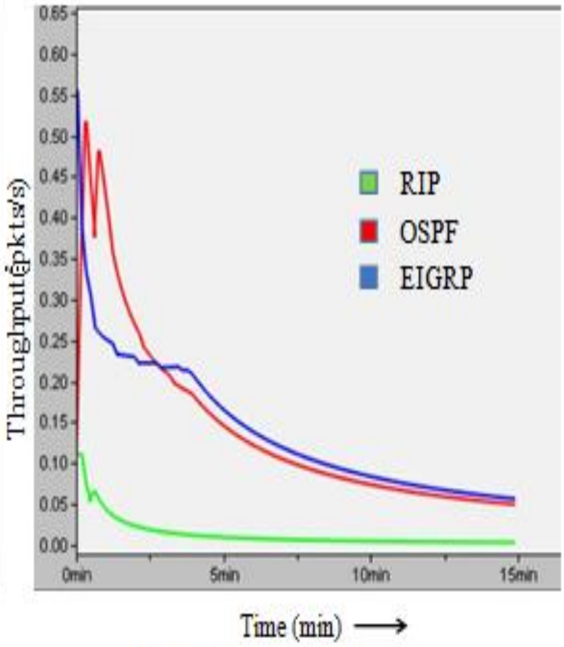

Figure 10. Throughput (pkts/s)

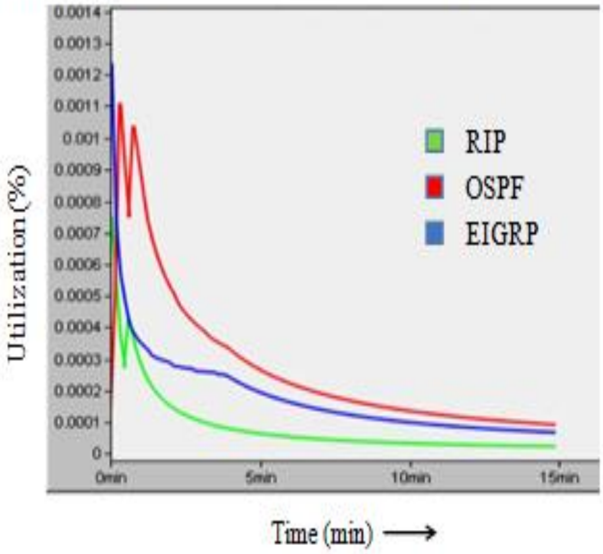

Figure 11. Bandwidth utilization

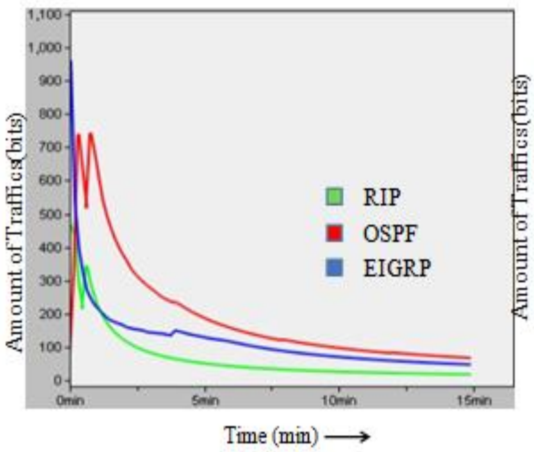

Figure 12. Traffic received (bits/s)

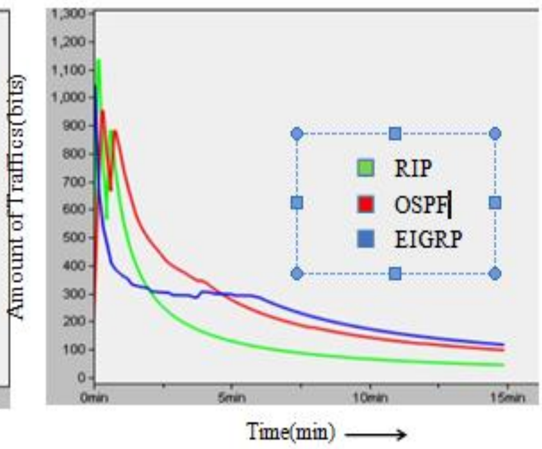

Figure 13. Traffic sent (bits/s)

When compared to EIGRP, the OSPF protocol handles more traffic, as depicts in figures 12 & 13. Simulation results indicate that the Routing Information Protocol (RIP) outperforms other routing protocols in terms of voice packet latency due to its simplicity and utilization of distance vector methods. In the context of this project's simulation, it was observed that RIP generates comparatively lower levels of protocol traffic in medium scale networks, when compared to EIGRP and OSPF. The vulnerability of the Routing Information Protocol (RIP) lies in its slower convergence time when operating in larger networks. This vulnerability has the potential to result in incongruous routing entries and, in rare instances, routing loops or metrics that approach infinity. RIP is the preferred routing protocol in networks with a hop count of fewer than 15.

OSPF imposes significant protocol overhead during the process of updating routing tables. However, in scenarios where there are no observable modifications in the network, it consumes minimal bandwidth. The protocol is an open standard that is well-suited for managing extensive networks. In contrast to RIP and EIGRP, OSPF utilizes a more intricate algorithm, resulting in a longer convergence time, heightened duration for routing table generation, and elevated protocol traffic. The Open Shortest Path First (OSPF) routing protocol requires increased computational resources, memory capacity, and network bandwidth when encountering the initial occurrence of link-state packet overflow in a moderately large simulated network.

EIGRP demonstrates superior performance in the areas of traffic routing, network convergence, and Ethernet delay. In contrast to the RIP and OSPF protocols, EIGRP exhibits a fusion of attributes from both distance vector and link state protocols. This amalgamation yields enhanced network convergence, diminished routing protocol traffic, and decreased utilization of CPU and RAM resources. In its typical operational state, the Enhanced Interior Gateway Routing Protocol (EIGRP) effectively utilizes network resources by primarily transmitting hello packets. EIGRP demonstrates enhanced convergence speed and reduced bandwidth consumption in response to alterations in the routing table. Due to its proprietary nature, the Enhanced Interior Gateway Routing Protocol (EIGRP) is limited to Cisco devices and is incompatible with non-Cisco routers within a network.

7. CONCLUSIONS

In this research, the findings of the study indicated that EIGRP exhibited superior performance compared to the other protocols in terms of initialization, failure, and recovery times and demonstrating the shortest duration for convergence. Additionally, our research revealed that the initialization process of OSPF was comparatively sluggish as a result of the requirement for all routers to establish connections with one another. Through the examination of the transmitted traffic volume measured in bits per second, it was observed that OSPF and EIGRP effectively made use of available bandwidth, whereas RIP inundated the network with comprehensive information, resulting in the inefficient utilization of bandwidth resources. Based on the results obtained from the simulation, it is evident that EIGRP can be confidently advocated as the optimal choice for networks of varying sizes, including both small and large networks due to its rapid convergence and efficient utilization of bandwidth.

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