DYNAMIC VS STATIC ROUTING EFFICIENCY

A CAPSTONE PROJECT REPORT

Submitted in the partial fulfilment for the Course of

CSA0735 – Computer Networks for communication

to the award of the degree of

BACHELOR OF ENGINEERING

IN

CSE, AIML

Submitted by

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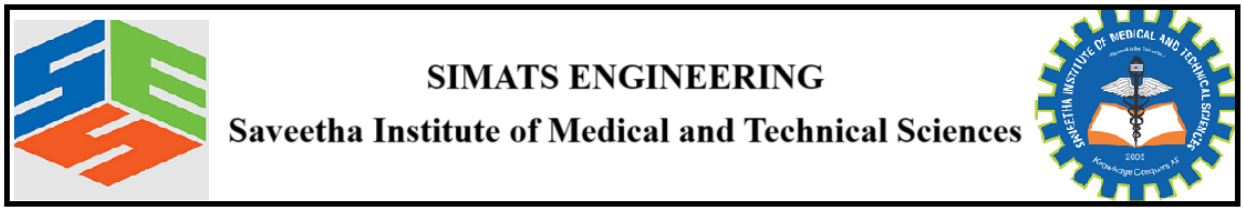

DECLARATION

We, **Mohamed Syed Thowfiq S (192511178), Rakesh (192525075), Abhinay Reddy (192525082) of the CSE, AIML,** Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, hereby declare that the Capstone Project Work entitled "**Dynamic vs Static Routing Efficiency**" is the result of our own bonafide efforts. To the best of our knowledge, the work presented here in is original, accurate, and has been carried out in accordance with principles of engineering ethics.

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BONAFIDE CERTIFICATE

This is to certify that the Capstone Project entitled "**Dynamic vs Static Routing Efficiency**" has been carried out by **Mohamed Syed Thowfiq S (192511178), Rakesh (192525075), Abhinay Reddy (192525082)** under the supervision of **Dr Hemavathi R** and is submitted in partial fulfilment of the requirements for the current semester of the **CSE, AIML (BE)** program at Saveetha Institute of Medical and Technical Sciences, Chennai.

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Submitted for the Project work Viva-Voce held on_____

INTERNAL EXAMINER **EXTERNAL EXAMINER**

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TABLE CONTENT

ABSTRACT

Routing is a key component in network communication, directing data packets from source to destination. Two primary types of routing are static and dynamic routing. Static routing involves manually configuring fixed paths in the routing table, which makes it simple and predictable. It is particularly suitable for small-scale networks where the routing paths remain constant. Since it doesn't require extra CPU or memory resources, static routing is highly efficient in stable environments with minimal changes.

Dynamic routing, on the other hand, automatically learns and updates routes using protocols like RIP, OSPF, or BGP. It is designed for larger and more complex networks that experience frequent topology changes. Dynamic routing adapts to link failures and congestion, offering better fault tolerance and scalability. However, it requires more system resources to process routing updates and may introduce some delay due to convergence time.

When comparing efficiency, the choice depends on the network size and behavior. Static routing is more efficient in simple, secure networks with minimal maintenance needs. In contrast, dynamic routing is more efficient in environments where automatic adaptation and scalability are necessary. For optimized performance, many organizations use a combination of both approaches, applying static routing for core paths and dynamic routing for flexible communication.

CHAPTER-1
INTRODUCTION

In computer networks, routing is the process of selecting the best path for data packets to travel from source to destination. Efficient routing ensures fast, reliable, and accurate data transmission across interconnected networks. Routing decisions are crucial in managing traffic flow, reducing congestion, and maintaining network performance. Two major types of routing used in networks are static routing and dynamic routing.

Static routing is a method where network administrators manually configure routing paths. These routes remain fixed unless they are manually changed. Static routing is simple, secure, and requires very little processing power, making it suitable for small networks with predictable traffic patterns. However, its inability to automatically adapt to network changes can lead to disruptions if a route becomes unavailable.

Dynamic routing, in contrast, uses routing protocols to automatically discover and maintain routing paths. Routers exchange information to update their routing tables in real time, allowing them to adapt to changes in the network, such as failures or new routes. While dynamic routing is more complex and uses more CPU and memory resources, it is highly efficient in large and frequently changing networks. This comparison between static and dynamic routing helps evaluate their efficiency in different networking scenarios.

CHAPTER-2

STATIC ROUTING

Static routing is a routing technique in which routes are manually configured by a network administrator. These routes remain fixed unless the administrator manually updates them. Each route entry in the routing table defines a specific path to a destination, ensuring that data packets follow the same route every time. Static routing is commonly used in small or simple networks where changes are rare, such as in home networks, small office setups, or point-to-point connections between routers.

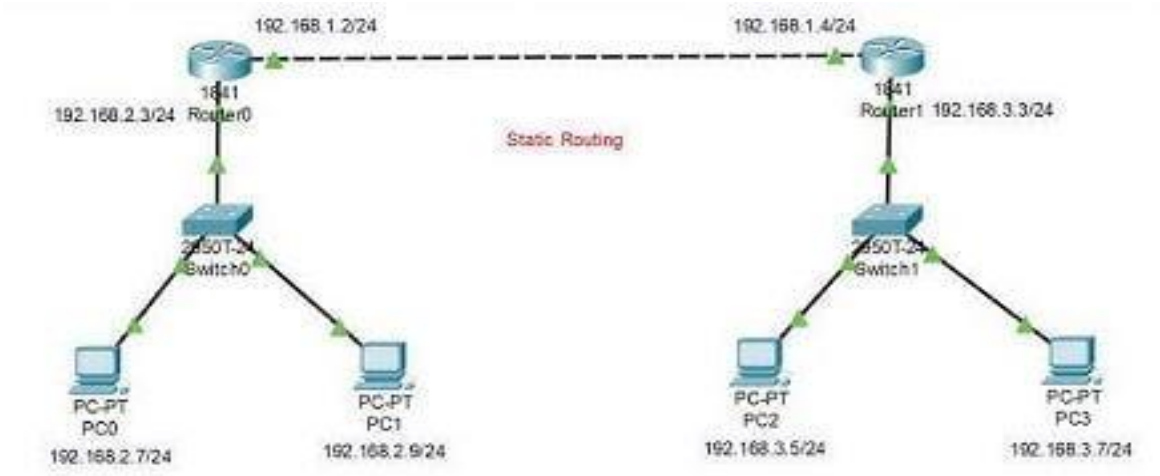

Fig1.1

The main advantages of static routing include simplicity, security, and minimal resource usage. Since it does not rely on routing protocols or route calculations, it consumes very little CPU and memory resources. This also makes it predictable and secure, as traffic flows along predefined paths. Moreover, static routing does not introduce extra network overhead due to periodic updates, which helps in improving performance in low-complexity environments.

However, static routing has several limitations. It lacks the ability to automatically adapt to network changes. If a link fails or the network topology changes, the static route becomes unusable until the administrator reconfigures it. This can result in downtime or packet loss. Additionally, managing static routes becomes increasingly difficult and time-consuming as the network grows in size. Therefore, while static routing is efficient in small and stable networks, it is not suitable for dynamic or large-scale network environments.

CHAPTER-3

DYANMIC ROUTING

Dynamic routing is a technique where routers automatically discover and maintain paths using routing protocols such as RIP (Routing Information Protocol), OSPF (Open Shortest Path First), and BGP (Border Gateway Protocol). These protocols allow routers to exchange information about network topology and update their routing tables accordingly. This makes dynamic routing highly adaptable and suitable for large or frequently changing networks.

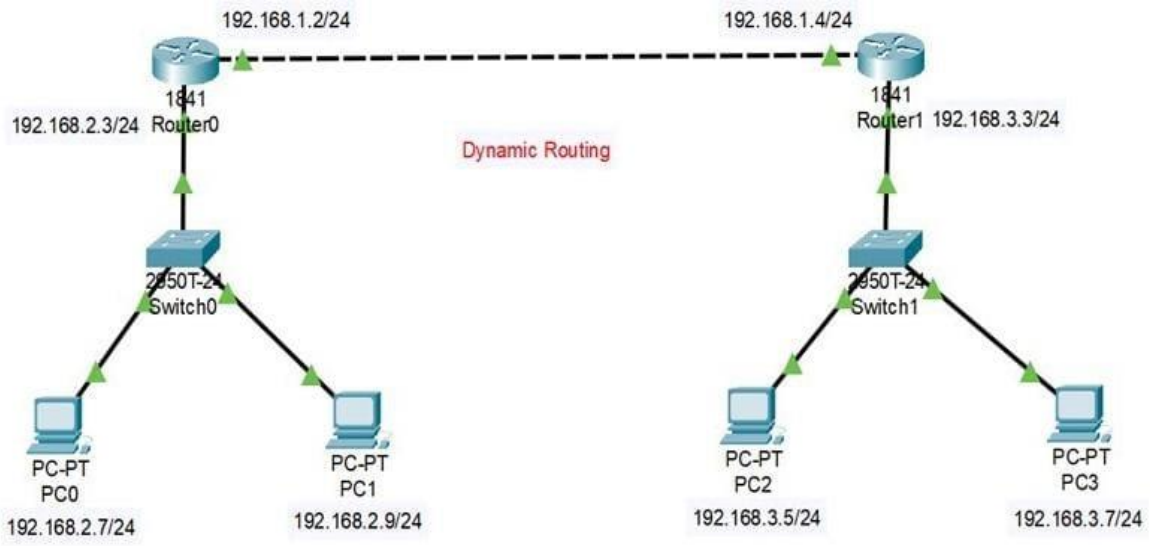

FIG 1.2

The key advantages of dynamic routing include scalability, flexibility, and automatic fault tolerance. When a network change or link failure occurs, dynamic routing protocols can automatically find alternate routes without manual intervention. This makes it ideal for enterprise networks, service providers, and data centers. Dynamic routing reduces administrative overhead since routes are updated in real-time and do not require manual configuration for each change.

Despite its benefits, dynamic routing also comes with disadvantages. It consumes more CPU, memory, and bandwidth to process routing updates and protocol

messages. The configuration of dynamic protocols can be complex and may require expertise to avoid issues such as routing loops. Additionally, convergence time—the time it takes for routers to agree on a new route after a change—can lead to temporary disruptions. Thus, while dynamic routing is more efficient in large and dynamic environments, it may be unnecessarily complex for small or static networks.

CHAPTER-4

EFFICIENCY COMPARISON

Static routing	Dynamic routing
One pre-configured route to destination	Multiple available routes to destination
Engineers must reconfigure to make route changes	Algorithms automatically update with preferred route changes
Smaller routing table with only one entry for each destination	Routers send out entire routing tables to identify route availability
Does not use protocols or algorithms for pre-configured route	Distance vector algorithms (RIP, IGRP) and link state algorithms (OSPF, IS-IS) adjust routes
Requires less computation time and bandwidth	Requires more computation and bandwidth
Better security	Less security
Used in smaller networks with fewer routers and unchanging network architecture	Used in larger networks and in networks that change frequently

FIG1.3

Efficiency in routing depends on how well a routing method manages network traffic, adapts to changes, and uses system resources. When comparing static and dynamic routing, each has specific use cases where it performs best. Static routing is more efficient in small networks where the topology rarely changes. It consumes no extra CPU or memory and adds no network overhead because there are no routing protocol updates.

In contrast, dynamic routing is more efficient in larger, complex, or frequently changing networks. It reduces administrative effort by automatically adjusting

routes in response to network changes. Although it uses more resources and takes time to converge after changes, it ensures high availability and resilience, which is essential in enterprise and multi-path environments.

Overall, the choice between static and dynamic routing depends on the size, complexity, and stability of the network. Static routing is efficient for simple, secure networks where reliability is ensured through manual control. Dynamic routing, while more resource-intensive, offers flexibility and fault tolerance that make it more efficient in large-scale or dynamic networks. Often, network administrators use a hybrid approach—static routing for core, stable paths and dynamic routing for external or frequently changing routes—to balance performance, reliability, and efficiency.

IMPLEMENTATION

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RESULT AND RECOMMENDATIONS

RESULT:

The implementation of static routing involves manually entering routing information into the router's configuration. Network administrators define specific paths for data packets by specifying destination networks and the next-hop IP addresses. This process is usually done using router command-line interfaces (CLI) such as Cisco IOS. For example, to add a static route on a Cisco router, a command like ip route 192.168.2.0 255.255.255.0 192.168.1.2 is used. Static routing is best implemented in small networks or in parts of a larger network that require high security and stability.

On the other hand, dynamic routing is implemented by enabling routing protocols like RIP, OSPF, or BGP on the routers. These protocols allow routers to exchange routing information automatically and update their routing tables in real-time. Configuration involves enabling the desired routing protocol and defining network ranges that the router will advertise and listen to. For instance, enabling OSPF on a Cisco router involves commands like router ospf 1, followed by network 192.168.1.0 0.0.0.255 area 0. Once implemented, the routers dynamically learn and maintain optimal paths, which enhances fault tolerance and scalability.

In practice, many networks use a combination of both static and dynamic routing. Static routes may be used for default gateways or backup paths, while dynamic routing manages the bulk of traffic and adapts to network changes. This hybrid implementation approach ensures efficient routing, reduces administrative workload, and maintains network stability and performance. The choice of implementation depends on network size, available resources, required flexibility, and administrative expertise.

Recommendations

1. Use Static Routing in:

Small, fixed-topology networks.Environments requiring high control and security.Networks with limited router resources (CPU/memory)

2. Use Dynamic Routing in:

Large-scale and enterprise networks. Networks where topology frequently change Scenarios requiring high availability and fault recovery

3. Adopt a Hybrid Approach where:

Static routes can be used for critical paths (e.g., default gateways or specific security zones)Dynamic routing handles general traffic and adapts to network changes automatically

4. Train network administrators to understand and configure both routing types properly to reduce misconfigurations and improve network reliability.

In conclusion, selecting the right routing method should be based on network size, required flexibility, administrative capacity, and performance goals. Combining both methods smartly can offer the best balance of efficiency, control, and scalability.

CONCLUSION

Routing plays a vital role in the performance and reliability of computer networks. This study compared the two main routing techniques—static routing and dynamic routing—with a focus on their efficiency in various network scenarios. Static routing is efficient in small, stable networks where routes do not change often, offering simplicity, predictability, and low resource usage. In contrast, dynamic routing is more suitable for large and complex networks where automatic adaptation to changes is critical.

Each routing method has its own advantages and limitations. While static routing requires manual updates and is less flexible, it provides better security and control. Dynamic routing, though more resource-intensive, offers scalability, flexibility, and resilience through automatic path adjustments and route learning. Therefore, the efficiency of routing depends heavily on network size, design, and operational needs.

In conclusion, there is no one-size-fits-all solution. The best results are often achieved by combining both static and dynamic routing methods in a hybrid approach. This allows organizations to optimize performance, minimize risk, and maintain flexibility while ensuring efficient and reliable network communication.

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