Kingdom of Saudi Arabia
Ministry of Education
Imam Abdulrahman bin Faisal University
Computer Science department

CIS 326: Design and configure dynamic routing protocols (RIP and OSPF) for an organization (business/educational/office) using Cisco Packet Tracer.

Smart Parking and Monitoring System Network Design

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1. Introduction

With the growing need for smarter urban infrastructure, especially in crowded areas like universities, malls, and office buildings, managing parking and monitoring systems efficiently has become essential. Our project aims to design and implement a **Smart Parking and Monitoring System** supported by a strong network infrastructure that connects all devices, departments, and services in real time.

To achieve this, we built two network models using **Cisco Packet Tracer** — one using **RIP (Routing Information Protocol)** and the other using **OSPF (Open Shortest Path First)**. Each model simulates how devices such as employee computers, printers, IP phones, access points, and servers can communicate smoothly across multiple floors and departments.

The network is divided into subnetworks based on department (e.g., IT, Computer, Chairman, Server Room), with proper IP addressing and routing configurations. We also included **VoIP communication**, wireless connectivity, and remote monitoring to demonstrate a real smart environment.

This network design ensures smooth data flow and efficient communication between devices, allowing the smart system to function reliably and respond quickly to real-time events.

2. Methodology

This research aims to compare the performance of two dynamic routing protocols, RIP (Routing Information Protocol) and OSPF (Open Shortest Path First), by analyzing their packet loss rates. Cisco Packet Tracer was utilized as the primary simulation tool to design and implement network topologies. The scenarios were created to simulate real-world conditions under which both routing protocols operate, allowing the evaluation of their efficiency and reliability. To measure performance, packet loss was chosen as a key metric. Packet loss occurs when data packets fail to reach their intended destination and can be caused by various factors such as network congestion, collisions, hardware errors, or buffer overflow at the receiving end. The packet loss percentage was calculated using the following formula:

$$\text{Packet Loss (\%)} = \frac{\text{Sent Packets} - \text{Received Packets}}{\text{Sent Packets}} \text{ x } 100$$

The test was conducted by sending ICMP echo requests (ping) from one device in a network to another device in a different network using both RIP and OSPF configurations. The results were recorded and analyzed to determine the performance of each protocol in terms of reliability and efficiency.

3. Proposed Model

This section presents the network topology, addressing structure, and the arrangement of devices and protocols in the system. The network topology applied in the current design is a hybrid topology, combining star topology within each floor or department and a bus topology connecting the routers across different locations. Each floor or area uses a star layout to connect end devices to central switches, while the routers are linked linearly, forming a bus topology. This setup ensures efficient internal communication within departments and a stable interconnection across the entire network infrastructure.

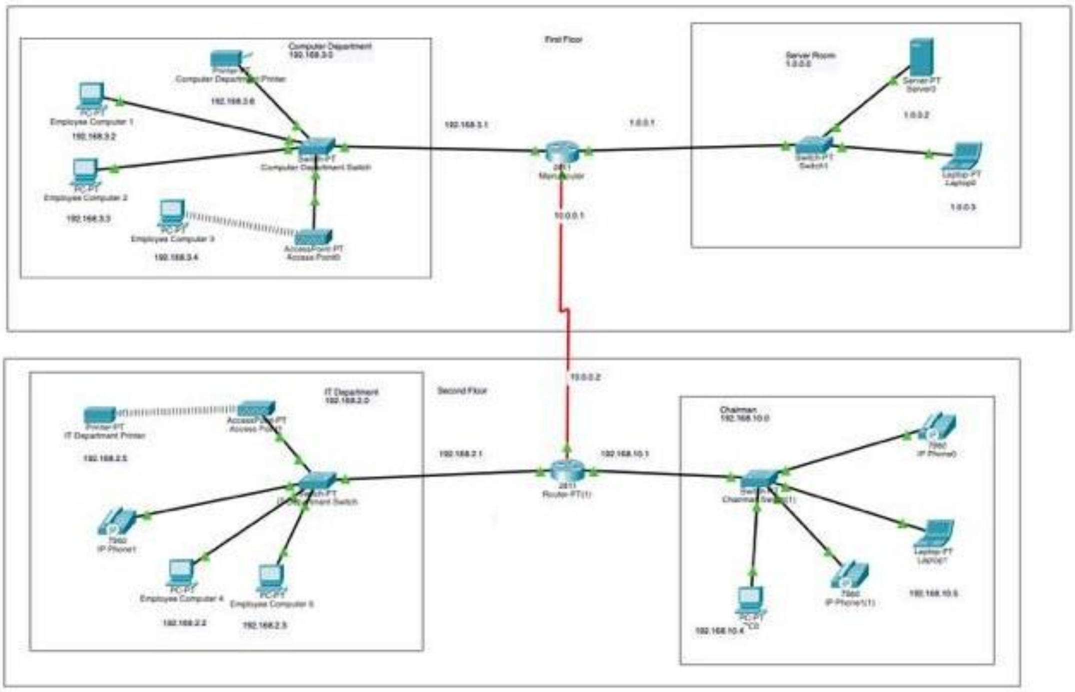

Figure 1 - Proposed Model of The Network Topology

Table 1 the addressing table for the network

Subnet Name	Network Address	Subnet Mask	Usable IP Range	Broadcast Address
Computer Department	192.168.3.0	255.255.255.0 (/24)	192.168.3.1-192.168.3.254	192.168.3.255
IT Department	192.168.2.0	255.255.255.0 (/24)	192.168.2.1-192.168.2.254	192.168.2.255
Chairman's Office	192.168.10.0	255.255.255.0 (/24)	192.168.10.1-192.168.10.254	192.168.10.255
Server Room	1.0.0.0	255.255.255.0 (/24)	1.0.0.1-1.0.0.254	1.0.0.255
Router Interconnection	10.0.0.0	255.255.255.252 (/30)	10.0.0.1-10.0.0.2	10.0.0.3

Device	Subnet	Assigned IP Address	Role
Router Interface 1	Computer Department	192.168.3.1	Gateway for Computer Department
Router Interface 2	IT Department	192.168.2.1	Gateway for IT Department
Router Interface 3	Chairman's Office	192.168.10.1	Gateway for Chairman's Office
Router Interface 4	Server Room	1.0.0.1	Gateway for Server Room
Router Interconnection	Main Router	10.0.0.1 (Main)	Connection to Second Floor Router
Router Interconnection	Second Floor Router	10.0.0.2 (Second Floor)	Connection to Main Router

4. Results

RIP is a distance-vector routing protocol that uses hop count to determine the best path for data transmission. It is simple and commonly used in smaller networks.

OSPF is a link-state routing protocol that uses a cost metric based on bandwidth to determine the best route. It is more scalable and efficient, making it ideal for larger, complex networks.

To evaluate the performance of RIP and OSPF, packet loss is quantified by executing a ping command via the Command Prompt, transmitting packets from one PC in a specific network to another PC in a distinct network.

Test Packet Loss:

To calculate Packet Loss percentage, we used the following formula:

Packet Loss (%) = $\frac{\text{Sent Packets}-\text{Received Packets}}{\text{Sent Packets}} \times 100$

Based on ping processes in RIP and OSPF between devices in the next pages below, we calculated Packet Loss percentages for each network, then organized it in a table:

In RIP configuration From a Laptop in Server Room Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

In RIP configuration From a PC in Computer Department Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

In RIP configuration From a PC in IT Department Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

In RIP configuration From a PC in Chairman Room Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

In OSPF configuration From a Laptop in Server Room Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

In OSPF configuration From a PC in Computer Department Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

In OSPF configuration From a PC in IT Department Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

In OSPF configuration From a PC in Chairman Room Network

Packet Loss (%) = $\frac{4-4}{4} \times 100$ = 0%

Some ping processes between devices in RIP configurations:

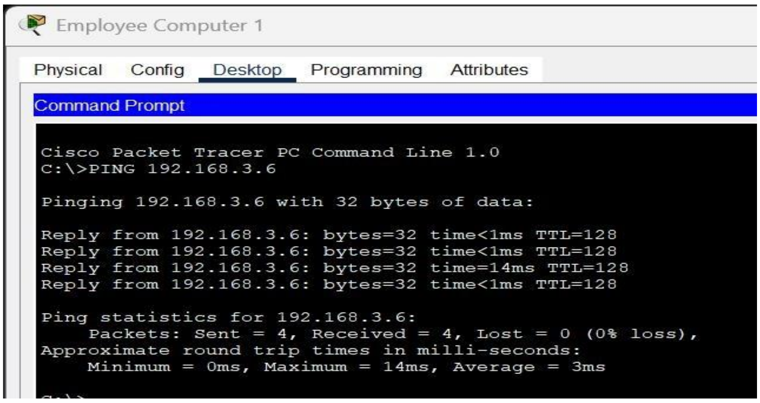

Figure 3 -RIP Checking Connectivity from Computer Department PC

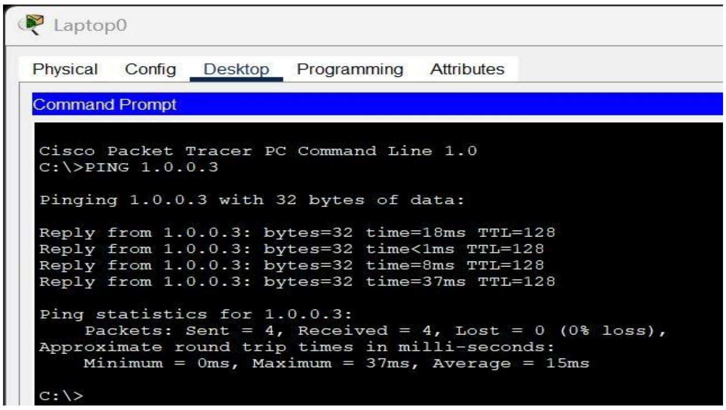

Figure 2 - RIP Checking Connectivity from server Laptop

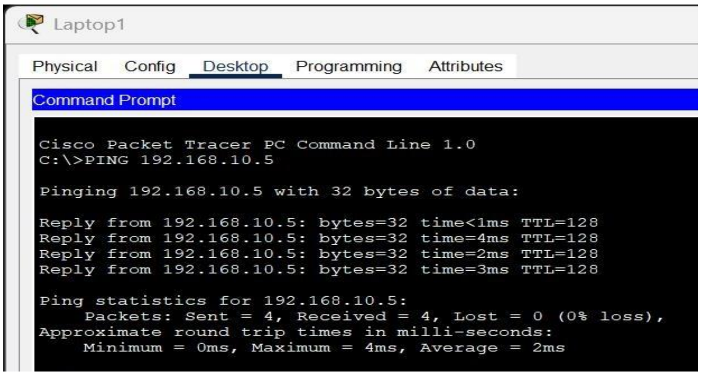

Figure 5 - RIP Checking Connectivity from chairman Room Laptop

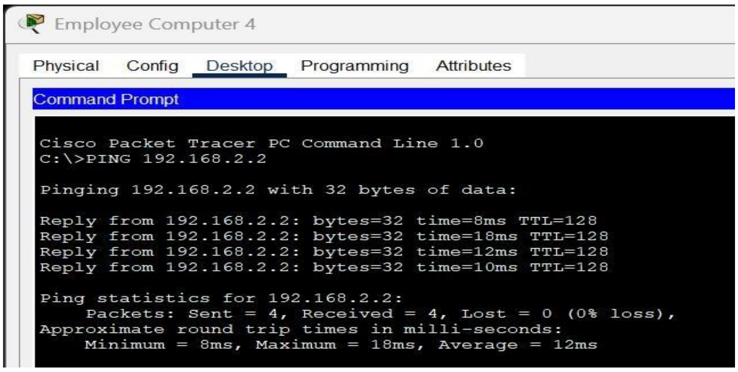

Figure 4 - RIP Checking Connectivity from IT Department PC

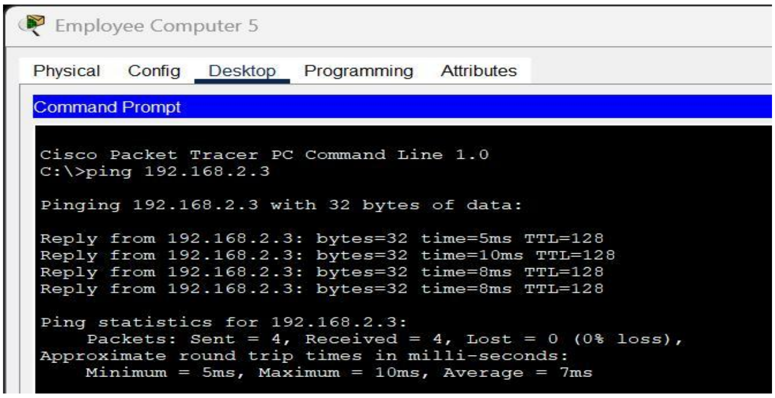

Figure 6 -RIP Checking Connectivity from another IT Department PC

Some ping processes between devices in OSPF configurations:

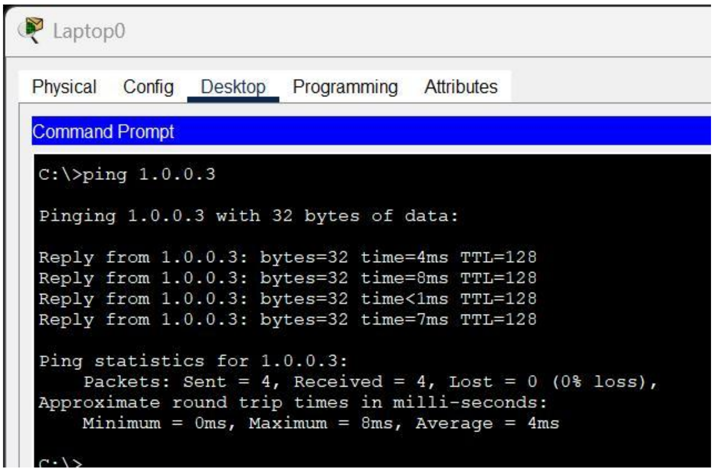

Figure 8 -OSPF Checking Connectivity from Computer Department PC

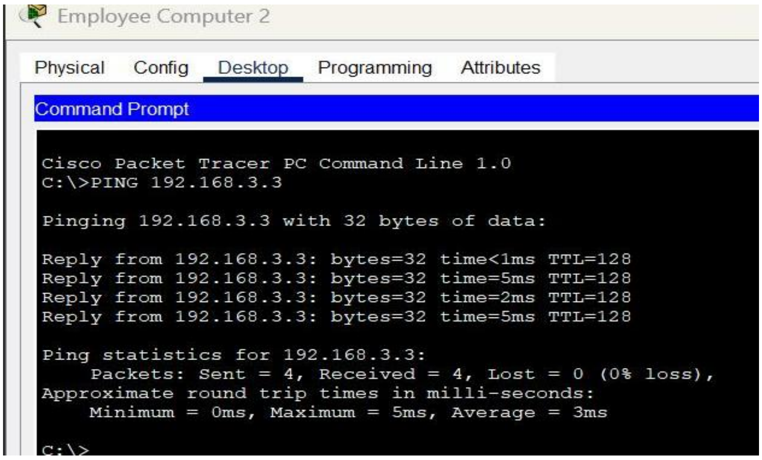

Figure 7 -OSPF Checking Connectivity from Server Room Laptop

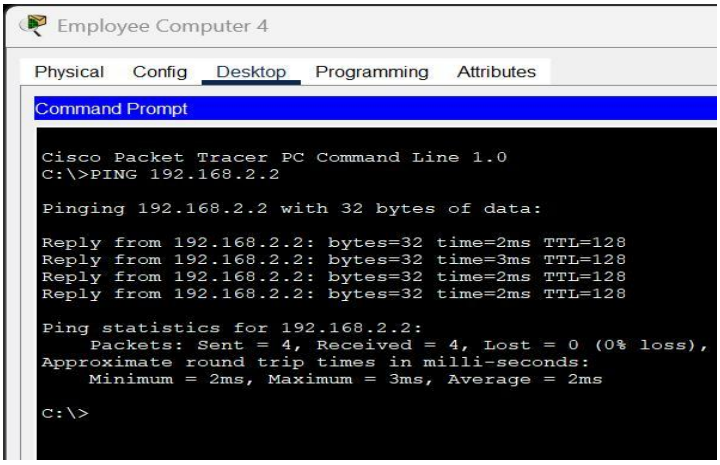

Figure 9 -OSPF Checking Connectivity from IT Department PC

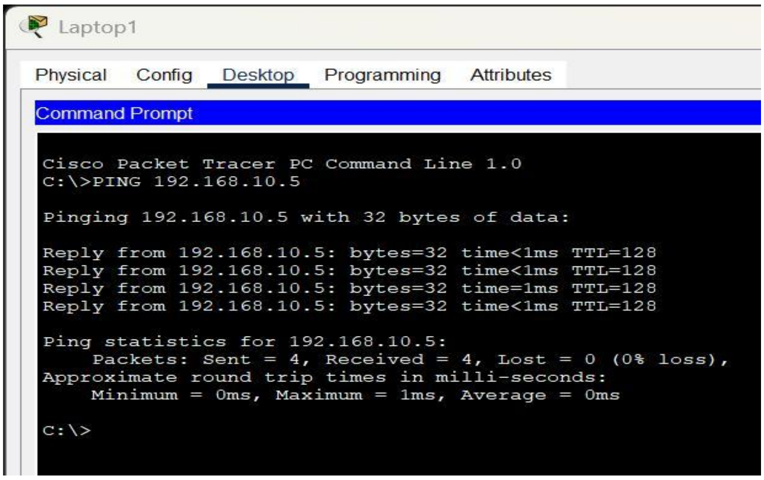

Figure 10 - OSPF Checking Connectivity from Chairman Laptop

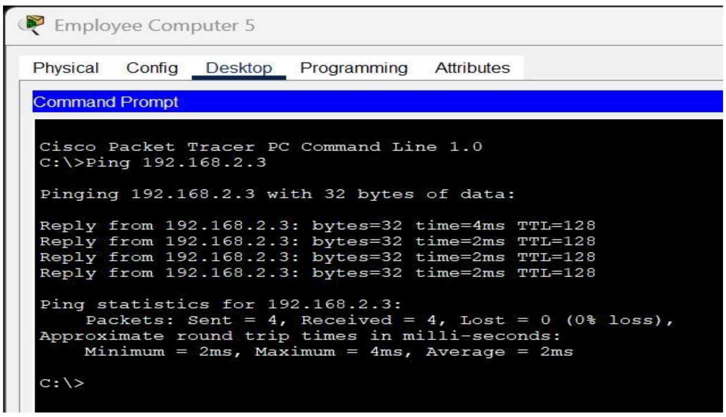

Figure 11- OSPF Checking Connectivity from another IT Department PC

Table 2 ***Packet Loss Testing for all PC's in RIP***

sender	receiver	Sent Packets	Received Packets	Packet Arrival Percentage	Packet Lost Percentage
Employee PC1	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC2	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC3	**All PC's**	**4**	**4**	**100%**	**0%**
Server Laptop	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC4	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC5	**All PC's**	**4**	**4**	**100%**	**0%**
Chairman PC0	**All PC's**	**4**	**4**	**100%**	**0%**
Chairman Laptop1	**All PC's**	**4**	**4**	**100%**	**0%**

*Table 3****Packet Loss Testing for all PC's in OSPF***

sender	receiver	Sent Packets	Received Packets	Packet Arrival Percentage	Packet Lost Percentage
Employee PC1	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC2	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC3	**All PC's**	**4**	**4**	**100%**	**0%**
Server Laptop	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC4	**All PC's**	**4**	**4**	**100%**	**0%**
Employee PC5	**All PC's**	**4**	**4**	**100%**	**0%**
Chairman PC0	**All PC's**	**4**	**4**	**100%**	**0%**
Chairman Laptop1	**All PC's**	**4**	**4**	**100%**	**0%**

5. Discussion

Comparing RIP and OSPF Protocols

Based on the results of the study, it can be concluded that the ping results for both RIP and OSPF protocols were successful and showed no packet loss. However, as you can see from the ping statistics, for the approximate round trip time OSPF demonstrated slightly better performance in terms of network responsiveness and convergence. The average response time (latency) in OSPF was lower and more stable compared to RIP, which means data was delivered slightly faster. This is expected, as OSPF uses a link-state algorithm that calculates the shortest and most efficient path. Therefore, while both protocols maintained good connectivity with 0% packet loss, OSPF showed better connectivity overall due to faster response and optimized routing.

6. Conclusion

In conclusion, this report evaluated the performance of RIP and OSPF routing protocols using network simulations. While both protocols ensured full connectivity with no packet loss, OSPF demonstrated better performance due to faster convergence and more efficient routing. Its link-state algorithm allows it to adapt quickly to network changes, making it a more suitable choice for larger and more complex networks compared to RIP.

7. References

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[3] Network Direction. (2020, May 18). *How to Configure RIP on Cisco Router using Packet Tracer* [Video]. YouTube. https://youtu.be/Cug24p-5Cq8

[4] Network Direction. (2020, May 18). *How to Configure OSPF on Cisco Router using Packet Tracer* [Video]. YouTube. Retrieved April 28, 2025, from https://youtu.be/RGk8Mdu2iXo