CSE438L: Data Communication and Network Lab

Project Report

Section: 03
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Introduction

In this project, we have successfully designed a network system for Johnson & Johnson, a fictional company consisting of five departments: Production, Research & Development, Finance, Sales & Marketing, and Human Resources. Our main objective was to create a robust and interconnected network infrastructure that enables seamless communication and data sharing between the departments.

We began by determining the subnet mask and network ID from the given IP address. This information allowed us to properly address and route data within the network, ensuring efficient connectivity. We incorporated hubs for reliable data transmission and used serial connections to connect routers between departments based on our network design requirements.

Each department was allocated its own dedicated sub-network, resulting in a total of five sub-networks. To simplify IP address allocation for all devices within the network, we implemented a DHCP (Dynamic Host Configuration Protocol) server in the Human Resources sub-network. This centralized server assigned IP addresses to all PCs in the five sub-networks, streamlining network management and addressing.

In addition to basic connectivity, we provided additional services to specific departments. Research & Development and Sales & Marketing networks were equipped with DNS (Domain Name System) and HTTP (Hypertext Transfer Protocol) services. This allowed web browsing and domain name resolution within their respective networks.

For enhanced network efficiency and reliability, we implemented all three routing protocols, which are: RIP (Routing Information Protocol), OSPF (Open Shortest Path First), and EIGRP (Enhanced Interior Gateway Routing Protocol). These protocols dynamically determined the best paths for data transmission, optimizing network performance.

This network enables efficient communication and data sharing among the company's departments.

Subnetting Procedure

As part of our project, we were given the IP address **192.183.49.0/22.** Our task was to create five subnetworks for five different departments. To begin, we needed to figure out the network address and subnet mask of the given IP.

Since the CIDR notation for the given IP address is 22, the first 22 bits of the subnet mask will be set to 1, indicating that these bits will represent the network portion. The remaining 10 bits will be set to 0, designating them as the host bits.

So the subnet mask will be:

```
11111111.11111111.11111100.00000000
```

To find the network address, we need to perform logical AND between the given ip and the subnet mask. Therefore:

```
192.183.49.0     = 11000000.10110111.00110001.00000000
Subnet Mask      = 11111111.11111111.11111100.00000000
-------------------------------------------------------
Network Address  = 11000000.10110111.00110000.00000000
                 = 192.183.48.0/22
```

In order to create five subnetworks from this network, we borrowed 3 bits from the host bits, which allows us to create $2^3 = 8$ subnetworks. Therefore, our five subnetwork addresses are as follows:

Subnet 1:

From:

192.183.00110000.00000000 | 192.183.48.0/25 [Network]

To:

192.183.00110000.01111111 | 192.183.48.127/25 [Broadcast]

Subnet 2:

From:

192.183.00110000.10000000 | 192.183.48.128/25 [Network]

To:

192.183.00110000.11111111 | 192.183.48.255/25 [Broadcast]

Subnet 3:

From:

192.183.00110001.00000000 | 192.183.49.0/25 [Network]

To:

192.183.00110001.01111111 | 192.183.49.127/25 [Broadcast]

Subnet 4:

From:

192.183.00110001.10000000 | 192.183.49.128/25 [Network]

To:

192.183.00110001.11111111 | 192.183.49.255/25 [Broadcast]

Subnet 5:

From:

192.183.00110010.00000000 | 192.183.50.0/25 [Network]

To:

192.183.00110010.01111111 | 192.183.50.127/25 [Broadcast]

Here are the network addresses for the departments that we assigned:

Department Name	Assigned Network Address
Production	192.183.48.0/25
Research & Development	192.183.48.128/25
Finance	192.183.49.0/25
Sales & Marketing	192.183.49.128/25
Human Resources	192.183.50.0/25

Network details:

- **Production:** Three PCs are in this network.
- **Research & Development:** Three PCs, an HTTP server, and a DNS server are in this network.
- **Finance:** Three PCs are in this network.
- **Sales & Marketing:** Three PCs, an HTTP server, and a DNS server are in this network.
- **Human Resources:** Three PCs and a DHCP server are in this network. All the PCs in all 5 sub-networks are assigned IP addresses using this DHCP server.

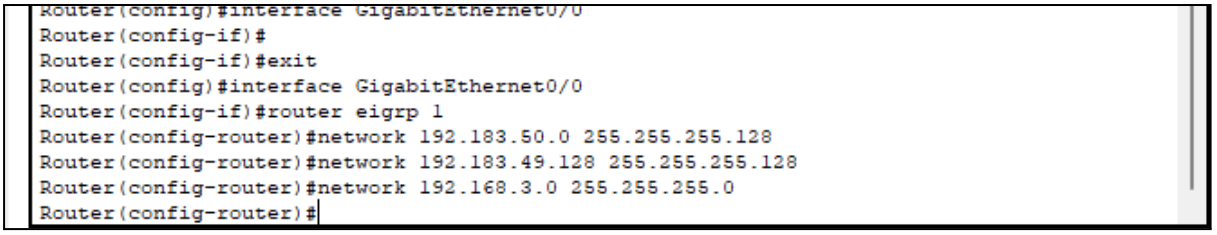
Modules and Routing Protocols

We have carefully designed our network infrastructure to incorporate three routing protocols simultaneously: RIP, OSPF, and EIGRP. To ensure seamless connectivity and efficient routing, we have used four Cisco 1941 series routers. These routers are connected using serial ports, which offer advantages in terms of long-distance data transmission with minimal signal degradation.

To establish serial connectivity, we have added the "HWIC-2T" module to our routers. This module expands the capabilities of our routers by providing two high-speed serial interfaces, allowing for simultaneous communication with other routers. With this addition, we can effectively establish point-to-point connections, enabling efficient data transfer and seamless integration of the routing protocols.

By combining RIP, OSPF, and EIGRP, we have created a resilient and adaptive routing environment. RIP efficiently exchanges routing information throughout the network. OSPF dynamically calculates the shortest path for data transmission, optimizing network performance. EIGRP combines the features of distance-vector and link-state protocols, providing enhanced scalability and flexibility.

The simultaneous utilization of these three routing protocols enables our network to leverage their strengths while mitigating their limitations. This approach ensures efficient routing, fault tolerance, and load balancing, ultimately enhancing the overall performance and reliability of our network.

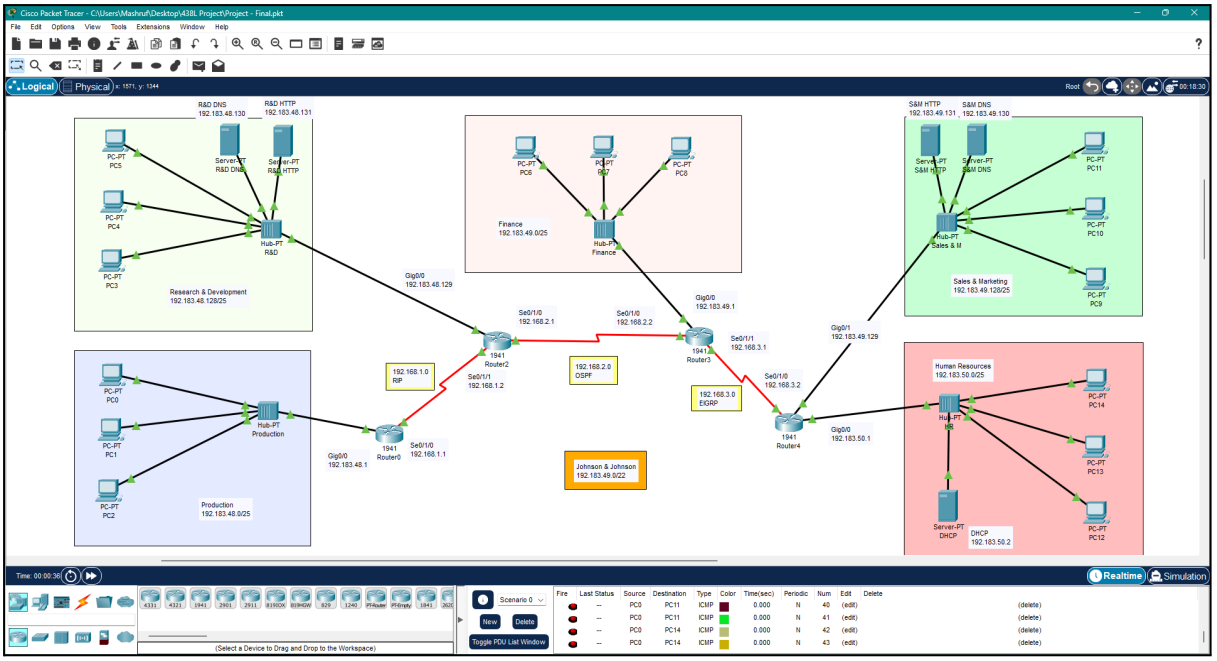


(Fig: Configuring EIGRP protocol in one of the routers)

With the deployment of our Cisco 1941 series routers, the integration of the HWIC-2T module, and the strategic implementation of RIP, OSPF, and EIGRP, we have established a highly resilient and scalable network architecture. This setup allows us to effectively meet the dynamic demands of our network, ensuring seamless communication and optimal data transmission across all connected devices.

Results and Discussion

The network system we designed for Johnson & Johnson successfully achieved our main objective of enabling efficient communication and seamless data sharing among the company's departments. Through the process of subnetting, we ensured logical separation and effective IP address management. Each department was allocated its dedicated subnetwork, facilitating secure and isolated communication within their respective domains.

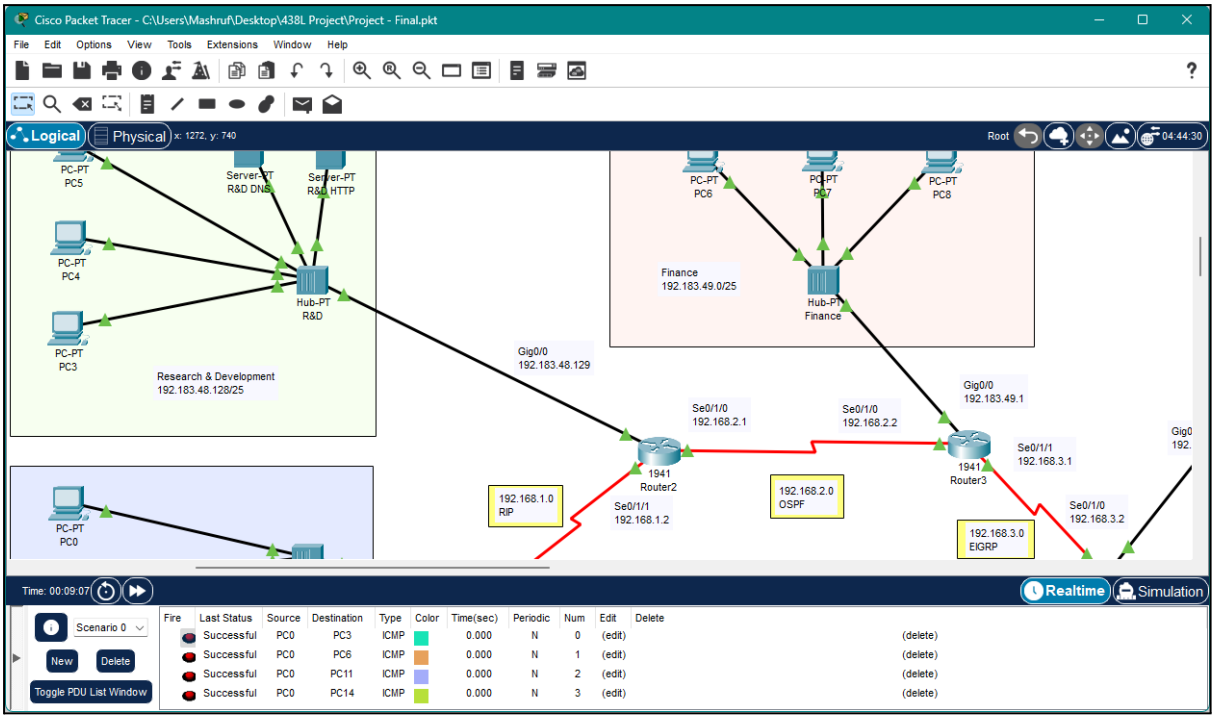


(Fig: Complete network infrastructure)

To meet the specific requirements of each department, we assigned a range of devices. These included PCs for all departments, as well as additional devices such as HTTP servers, DNS servers, and a DHCP server in the Research & Development, Sales & Marketing, and Human Resources departments, respectively.

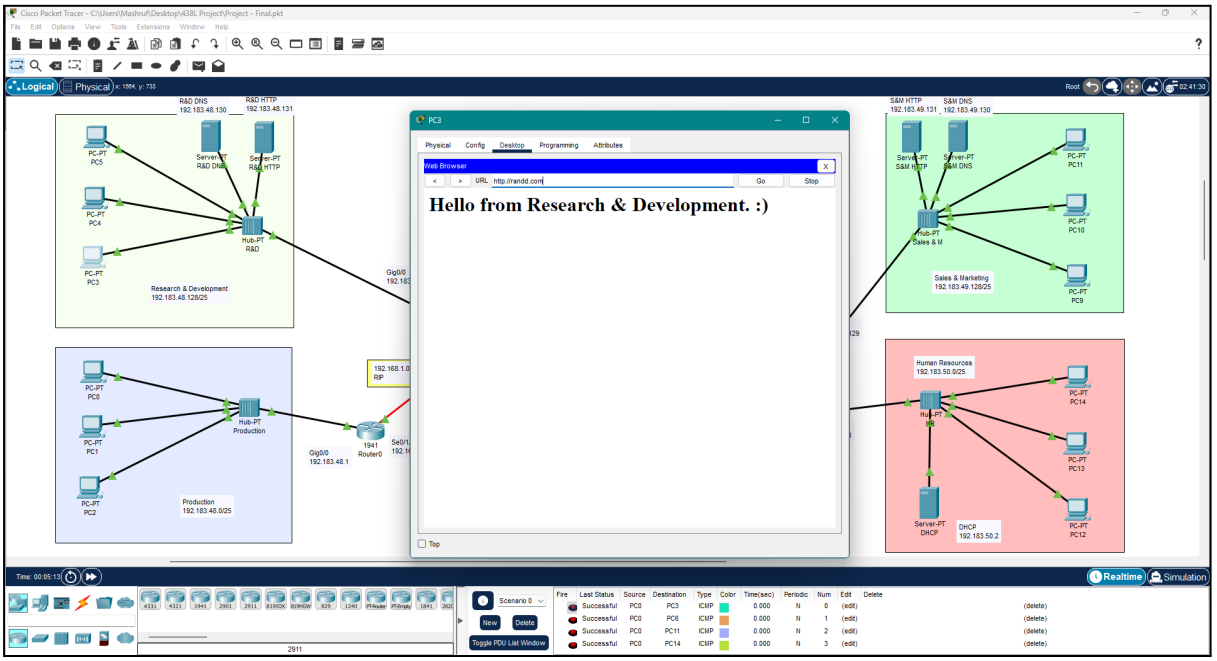
To ensure reliable connectivity and optimal data transfer, we deployed Cisco 1941 series routers equipped with HWIC-2T modules. These modules provided high-speed serial interfaces, enabling efficient point-to-point connections. The integration of three routing protocols, namely RIP, OSPF, and EIGRP, ensured efficient routing, fault tolerance, and load balancing throughout the network.

Sending PDUs to check network connectivity

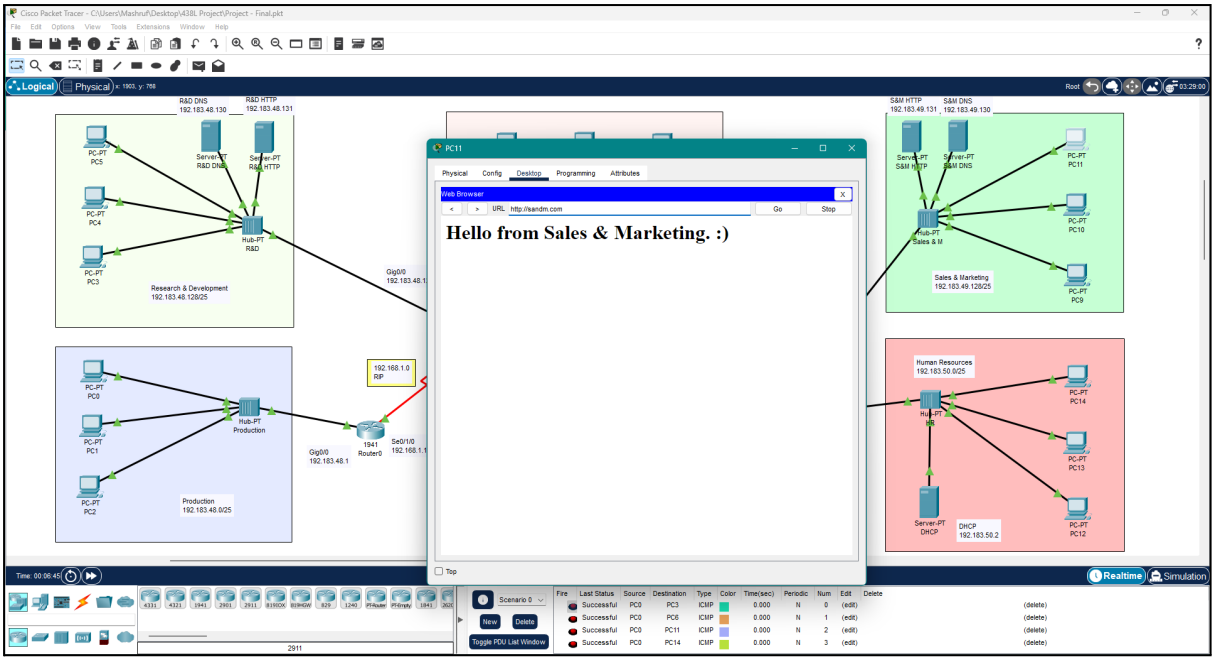


(Fig: Sending PDUs from one network to others)

DNS and HTTP server test



(Fig: DNS and HTTP service working for R&D)



(Fig: DNS and HTTP service working for S&M)

Overall, our network system demonstrated a resilient and scalable infrastructure, effectively meeting the communication needs of Johnson & Johnson's departments. It enabled seamless data transmission, reliable connectivity, and optimized performance, fostering efficient collaboration and resource sharing among the different departments. The network system provided a robust foundation for Johnson & Johnson's operations, enhancing productivity and facilitating smooth workflows across the organization.