School Of Computer Science and IT

# School of Computer Science and Information Technology

## Department of Computer Science and Information Technology

## 2024 - 2025

**Semester: IV**
**Specialization: Internet of Things**
**Section: E**

## 23BCA4VC02 : Network Administration

## Activity 2

### ENTERPRISE BRANCH ROUTING AND NETWORKING

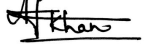
## (Simulation on Cisco Packet Tracer)

**Date of Submission:** 22 April 2025

**SUBMITTED BY:**

**NAME:** Afreen Khan

**USN:** 23BCAR0308

**SIGNATURE:** 

**Name of Faculty In-Charge:**
Mr. Sahabzada Betab Badar

School Of Computer Science and IT

# CERTIFICATE

This is to certify that Afreen Khan has satisfactorily completed activity prescribed by JAIN (Deemed to be University) for the fourth semester degree course in the year 2024-2025.

| Sl.No | CRITERIA | MARKS | MARKS OBTAINED |
|---|---|---|---|
| 1 | On-time Submission | 10 | |
| 2 | Demonstration Skills | 15 | |
| 3 | Clarity of Explanation | 15 | |
| 4 | Viva | 10 | |
| | Total | 50 | |
| | Convert | 15 | |

| MARKS | |
|---|---|
| MAX | OBTAINED |
| 15 | |

Signature of the Student:

Date of Submission: 22 April 2025

Signature of the Faculty

# INDEX

# 1. KEY TERMS AND CONCEPTS

- **LAN (Local Area Network):**
  A network setup that connects devices within a specific location, such as an office or building, to facilitate data exchange.

- **VLAN (Virtual Local Area Network):**
  A virtual division of a network that groups devices logically, improving security and traffic management without physical separation.

- **DHCP (Dynamic Host Configuration Protocol):**
  An automated system that distributes IP addresses to devices, reducing manual setup efforts.

- **DNS (Domain Name System):**
  A service that translates website names into IP addresses, making online access intuitive for users.

- **OSPF (Open Shortest Path First):**
  A routing protocol that calculates the best data paths across a network using a sophisticated path-finding method.

- **IP Address:**
  A unique identifier for each device on a network, enabling precise communication.

- **Subnet Mask:**
  A configuration that splits an IP address into network and device portions, aiding in address organization.

- **Router:**
  A device that directs data traffic between different networks, operating at the network layer.

# 2. PROJECT OVERVIEW AND SCENARIO

## 2.1 Project Background:

A trading floor support center, employing 600 staff members, is transitioning to a new three-story building due to business growth. The absence of an existing network infrastructure necessitates a complete redesign to support the company's operations. The new building will be organized as follows:

- First Floor:
  Sales & Marketing: 120 users
  Human Resources & Logistics: 120 users
- Second Floor:
  Finance & Accounts: 120 users
  Administration & Public Relations: 120 users
- Third Floor:
  Information & Communication Technology (ICT): 120 users
  Server Room: 12 devices (including servers and admin systems)

As a vital member of the networking team, the responsibility falls on designing a reliable network using Cisco Packet Tracer. The solution must feature a hierarchical layout with redundancy, employing two routers and two multilayer switches. Connectivity to two ISPs is required for failover support, using public IP ranges 195.136.17.0/30, 195.136.17.4/30, 195.136.17.8/30, and 195.136.17.12/30. Each department needs wireless access, with VLANs and subnets isolating them. The base network 172.16.1.0 will be subnetted accordingly. The network will use DHCP for dynamic IP allocation from the server room, enable inter-department communication via multilayer switches, implement OSPF for routing, secure access with SSH, apply port-security to the Finance department, and use PAT for internet sharing. Extensive testing will confirm operational success.

## 2.2 Project Goals

1. Design and simulate a network topology in Cisco Packet Tracer using a hierarchical model with built-in redundancy.
2. Deploy one router and one multilayer switch per floor, configure OSPF, provide wireless coverage, and automate IP assignment with DHCP.
3. Integrate email and DNS servers to support business functions.
4. Set up essential device configurations including device names, passwords, welcome messages, and disable IP lookup.
5. Create separate VLANs and subnets for each department using 172.16.1.0 as the base.
6. Develop an IP addressing plan with subnetting to accommodate 120 users per department and 12 static IPs for the server room.
7. Configure end devices with calculated IP addresses.
8. Implement port-security on Finance department ports to restrict access to one device with sticky MAC and shutdown on violation.
9. Conduct thorough testing to validate network performance.
10. Produce a detailed report documenting the design and execution.

### 2.3 Essential Technologies

1. Network topology creation in Cisco Packet Tracer.
2. Hierarchical design with redundancy features.
3. Accurate cabling for device interconnections.
4. Basic device setup and security.
5. VLAN establishment and port mapping.
6. IP subnetting and addressing.
7. Inter-VLAN routing on multilayer switches.
8. DHCP server setup for dynamic IPs.
9. SSH configuration for remote management.
10. OSPF routing protocol implementation.
11. Port-security configuration on switches.
12. Wireless network deployment with access points.
13. Device configuration for hosts.
14. ISP router setup.
15. Network testing and validation.

## 3. EQUIPMENT INVENTORY

### 3.1 Device List:

- Routers (Cisco 2911) x 2
  CORE-R1
  CORE-R2

- Layer 3 Switches x 2
  Multilayer1
  Multilayer2

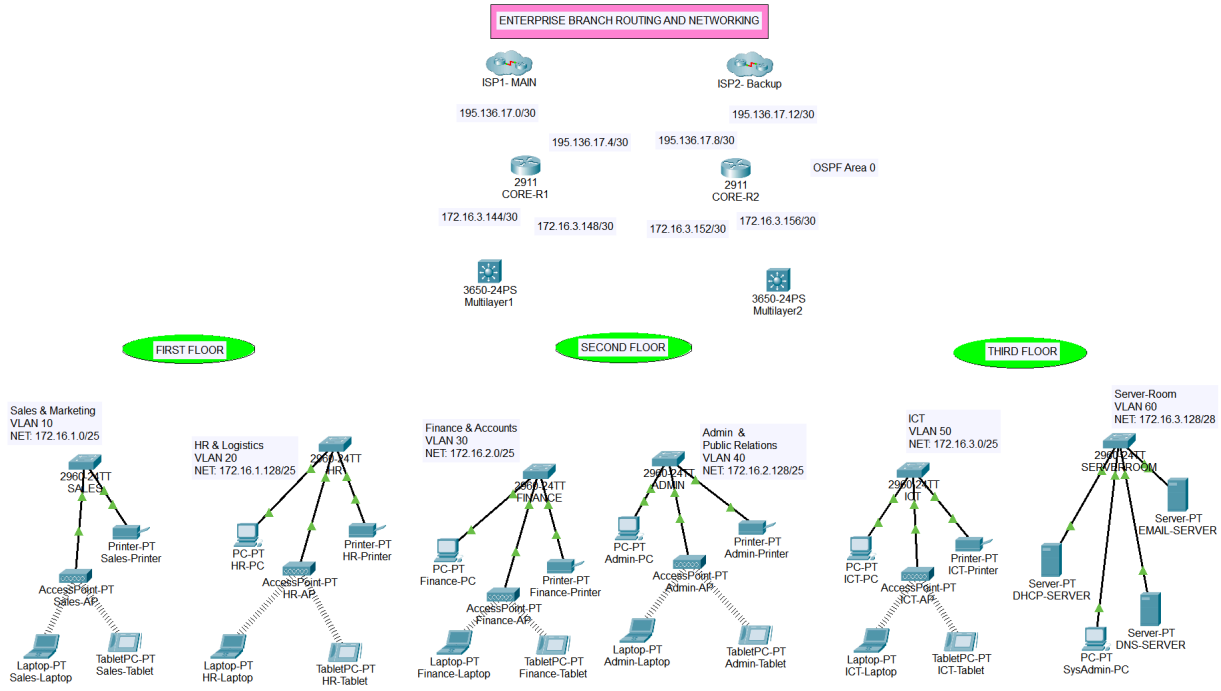
- Layer 2 Switches (2960-24TT or 2960-24PT) x 6
  SALES-SW
  HR-SW
  FINANCE-SW
  ADMIN-SW
  ICT-SW
  SERVERROOM-SW

- End Devices (PCs, Laptops, Tablets)
  Various units for Sales, HR, Finance, Admin, ICT, and Server Room.

- Printers
  Sales-Printer, HR-Printer, Finance-Printer, Admin-Printer, ICT-Printer.

- Access Points
  Sales-AP, HR-AP, Finance-AP, Admin-AP, ICT-AP.

- Servers
  - DHCP-SERVER
  - EMAIL-SERVER
  - DNS-SERVER




## 3.2 Topology Visualization

The network is illustrated in Cisco Packet Tracer as a hierarchical structure, featuring two core routers (CORE-R1, CORE-R2) linked to two multilayer switches (Multilayer1, Multilayer2). These switches connect to Layer 2 switches on each floor, which in turn support end devices, printers, and access points. Dual ISP links ensure redundancy, with VLANs defined for each department and a dedicated server room on the third floor.

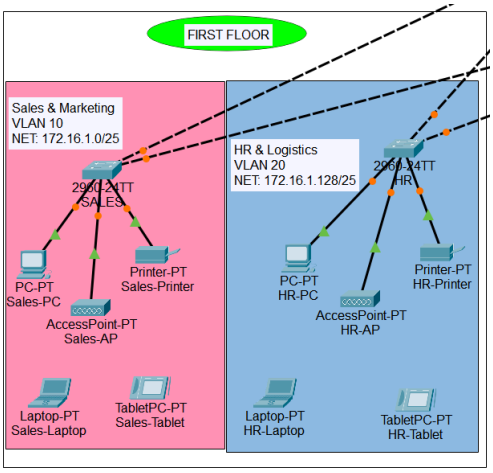
# 4. NETWORK ADDRESS ALLOCATION

## 4.1 IP Assignment Plan

Base Network: 172.16.1.0

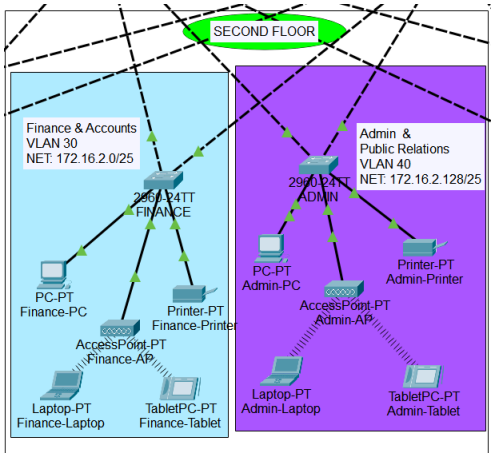
- **First Floor**

| Department | Network | Subnet Mask | Usable IP Range | Broadcast |
|---|---|---|---|---|
| Sales & Marketing | 172.16.1.0 | 255.255.255.0 /24 | 172.16.1.1 - 172.16.1.254 | 172.16.1.255 |
| HR & Logistics | 172.16.2.0 | 255.255.255.0 /24 | 172.16.2.1 - 172.16.2.254 | 172.16.2.255 |



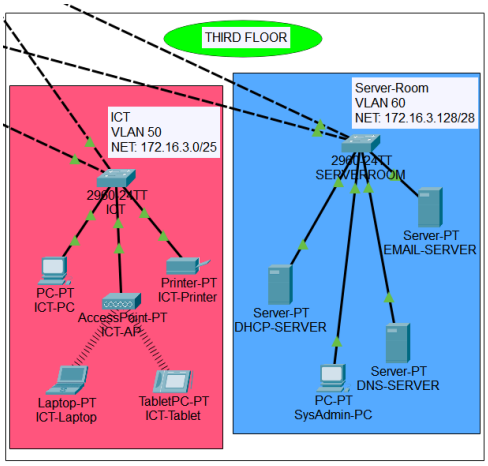

- **Second Floor**

| Department | Network | Subnet Mask | Usable IP Range | Broadcast |
|---|---|---|---|---|
| Finance & Accounts | 172.16.3.0 | 255.255.255.0 /24 | 172.16.3.1 - 172.16.3.254 | 172.16.3.255 |
| Admin & PR | 172.16.4.0 | 255.255.255.0 /24 | 172.16.4.1 - 172.16.4.254 | 172.16.4.255 |



- **Third Floor**

| Department | Network | Subnet Mask | Usable IP Range | Broadcast |
|---|---|---|---|---|
| ICT | 172.16.5.0 | 255.255.255.0 /24 | 172.16.5.1 - 172.16.5.254 | 172.16.5.255 |
| Server Room | 172.16.6.0 | 255.255.255.240 /28 | 172.16.6.1 - 172.16.6.14 | 172.16.6.15 |




## 4.2 Inter-Device Links

Base Network: 10.0.0.0

| Link | Network | Subnet Mask | IP Range | Broadcast |
|---|---|---|---|---|
| R1-M1 | 10.0.0.0 | 255.255.255.252 /30 | 10.0.0.1 - 10.0.0.2 | 10.0.0.3 |
| R1-M2 | 10.0.0.4 | 255.255.255.252 /30 | 10.0.0.5 - 10.0.0.6 | 10.0.0.7 |
| R2-M1 | 10.0.0.8 | 255.255.255.252 /30 | 10.0.0.9 - 10.0.0.10 | 10.0.0.11 |
| R2-M2 | 10.0.0.12 | 255.255.255.252 /30 | 10.0.0.13 - 10.0.0.14 | 10.0.0.15 |

## 4.3 ISP Connectivity

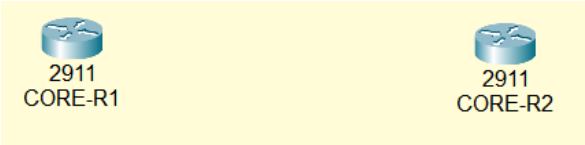
- ISP1 Main: 195.136.17.1
- ISP1 Backup: 195.136.17.5
- ISP2 Main: 195.136.17.9
- ISP2 Backup: 195.136.17.13

# 5. DETAILED IMPLEMENTATION GUIDE

## 5.1 Initial Network Layout

Step 1: Core Router Placement

- Position CORE-R1 and CORE-R2 centrally in Packet Tracer, linking them with a serial connection for backbone communication.

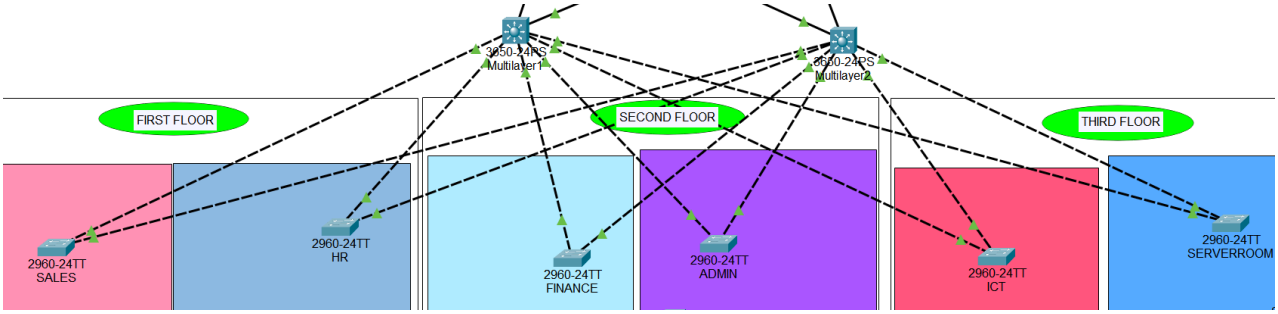



Step 2: Multilayer Switch Integration

- Place Multilayer1 and Multilayer2 adjacent to the routers, connecting each router to both switches with Ethernet for redundancy.

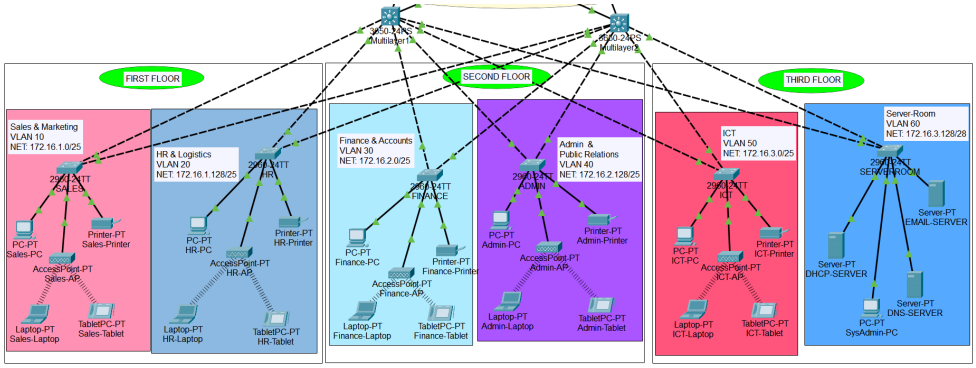

Step 3: Layer 2 Switch Deployment

- First Floor: Add SALES-SW and HR-SW, linking to Multilayer1.
- Second Floor: Add FINANCE-SW and ADMIN-SW, linking to Multilayer2.
- Third Floor: Add ICT-SW and SERVERROOM-SW, linking to Multilayer2.



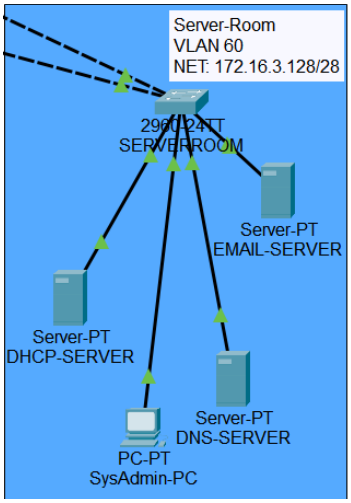

Step 4: Device Connection

- Connect PCs, printers, and access points to respective Layer 2 switches (e.g., SALES-SW to Sales-PC, Sales-Printer, Sales-AP).



Step 5: Server Room Setup

- Attach DHCP-SERVER, EMAIL-SERVER, and DNS-SERVER to SERVERROOM-SW.




## 5.2 Device Initialization

Step 1: Layer 2 Switch Setup

- Assign hostname (e.g., hostname SALES-SW).
- Set banner (banner motd #Restricted Access#).
- Configure console (line console 0, password secure, login).
- Configure VTY (line vty 0 15, password secure, login).
- Disable lookup (no ip domain-lookup).
- Set enable password (enable password secure).
- Encrypt passwords (service password-encryption).
- Save (write memory).

Step 2: Layer 3 and Router Configuration

- Assign hostname (e.g., hostname Multilayer1).
- Set banner (banner motd #Enterprise Network#).
- Configure console (line console 0, password secure, login).
- Enable SSH (ip domain-name branch.local, username admin password secure, crypto key generate rsa, 1024, line vty 0 15, login local, transport input ssh).
- Disable lookup (no ip domain-lookup).
- Set enable password (enable password secure).
- Encrypt passwords (service password-encryption).
- Save (write memory).

## 5.3 VLAN and Port Management

Step 1: Define VLANs

- VLAN 10: Sales & Marketing (172.16.1.0/24)
- VLAN 20: HR & Logistics (172.16.2.0/24)
- VLAN 30: Finance & Accounts (172.16.3.0/24)
- VLAN 40: Admin & PR (172.16.4.0/24)
- VLAN 50: ICT (172.16.5.0/24)
- VLAN 60: Server Room (172.16.6.0/28)

Step 2: Port Settings

- Set access ports (e.g., interface range fa0/1-24, switchport mode access, switchport access vlan 10 on SALES-SW).
- Set trunk ports (e.g., interface range fa0/1-2, switchport mode trunk)

## 5.4 Port-Security Implementation

Step 1: Finance Security

- On FINANCE-SW, enter interface fa0/1, switchport port-security, switchport port-security maximum 1, switchport port-security mac-address sticky, switchport port-security violation shutdown.
- Check status with show port-security.

## 5.5 IP Configuration

Step 1: Layer 3 Switch IPs

- Assign SVIs (e.g., interface vlan 10, ip address 172.16.1.1 255.255.255.0, no shutdown).

Step 2: Router IPs

- Assign interfaces (e.g., interface gig0/0, ip address 10.0.0.1 255.255.255.252).

## 5.6 OSPF Setup

Step 1: Activate OSPF

- On Multilayer1: ip routing, router ospf 1, network 172.16.1.0 0.0.0.255 area 0, network 172.16.2.0 0.0.0.255 area 0.
- On CORE-R1: router ospf 1, network 10.0.0.0 0.0.0.3 area 0.
- Verify with show ip route.

## 5.7 DHCP Configuration

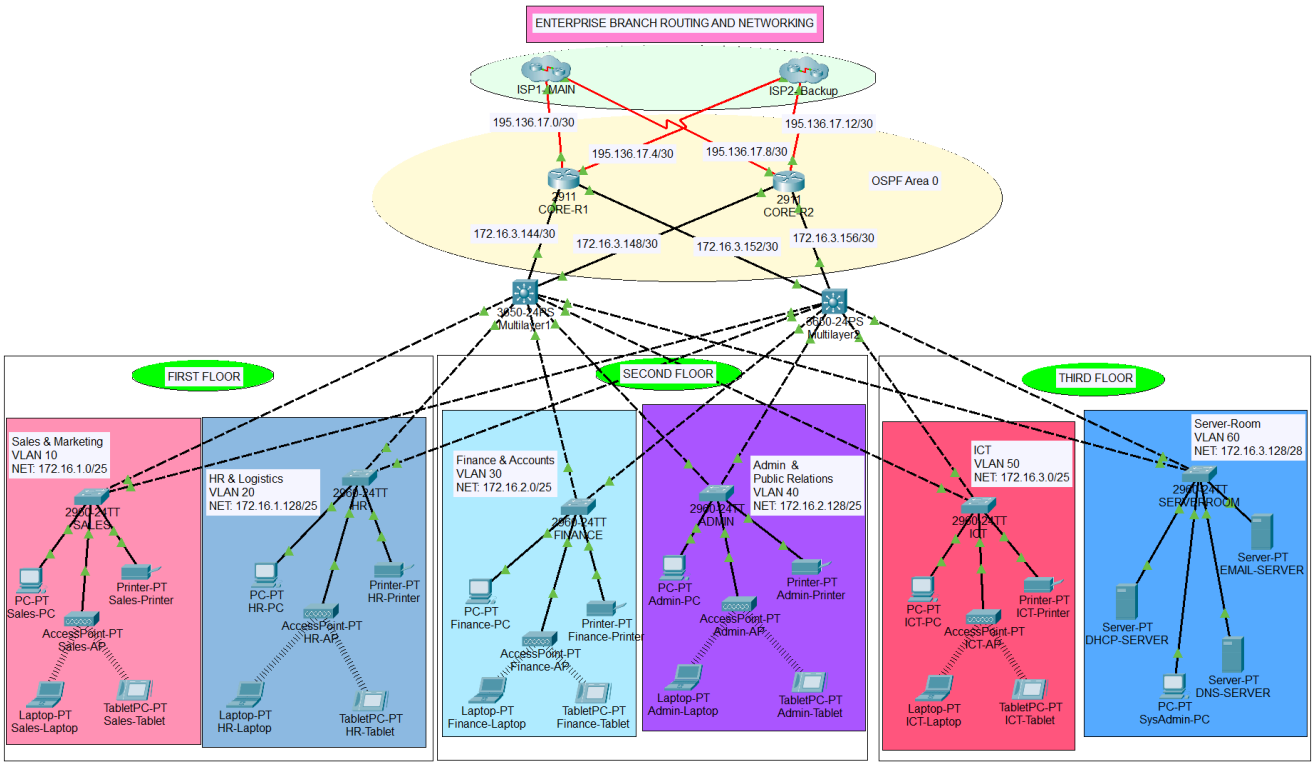
Step 1: Create Pools

- On DHCP-SERVER: ip dhcp pool SALES, network 172.16.1.0 255.255.255.0, default-router 172.16.1.1.
- Set helper (e.g., interface vlan 10, ip helper-address 172.16.6.2).

## 5.8 PAT Setup

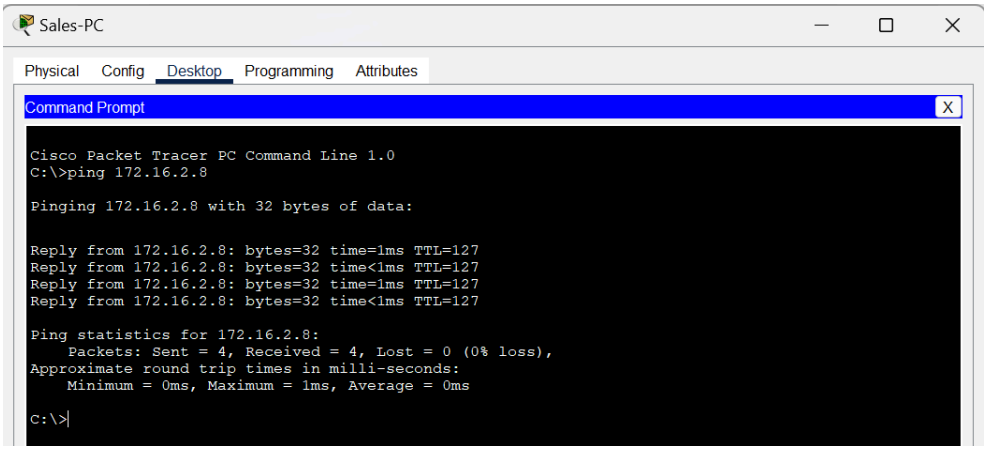
Step 1: Enable NAT

- On CORE-R1: ip nat inside source list 1 interface gig0/0 overload, access-list 1 permit 172.16.0.0 0.0.255.255.

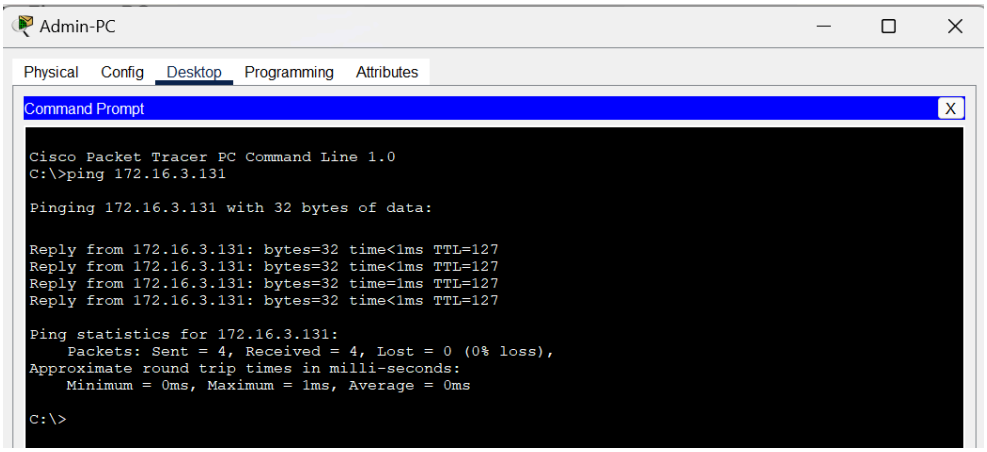



## 5.9 Validation Tests

- Ping from Sales-PC to Finance-PC.



- Access DNS-SERVER from Admin-PC.




# 6. SKILLS AND INSIGHTS GAINED

- Developed expertise in crafting a large-scale network for a 600-user trading center.
- Grasped the value of hierarchical design for growth and backup capabilities.
- Mastered VLAN setup for secure departmental separation.
- Learned inter-VLAN routing for cross-department connectivity.
- Honed subnetting skills for efficient IP distribution.
- Implemented OSPF for optimized routing.
- Configured DHCP for automated address assignment.
- Secured networks with SSH and port-security.
- Deployed wireless for user flexibility.
- Integrated servers for operational support.
- Validated network functionality through testing.

# 7. RFERENCE AND LINKS

- Reference: https://gurutechnetworks.otombenard.com/assetsProject/project6
- LinkedIn:https://www.linkedin.com/posts/afreen-khan-8870ba299_enterprisenetworking-ciscopackettracer-networksimulation-activity-7320019427733684225-aE47?utm_source=share&utm_medium=member_desktop&rcm=ACoAAEgYk2cBI99YCV0AatAGG7cOEEmz38O3a8E
- GitHub: https://github.com/Afreen-khan2605/Enterprise-Branch-Routing-and-Networking---CPT