DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ISLAMIC UNIVERSITY OF TECHNOLOGY

A SUBSIDIARY ORGAN OF OIC

LAB REPORT 3

CSE 4512: COMPUTER NETWORKING LAB

Name: Nayeemul Hasan Prince

Student ID: 220041125

Section: 1A

Semester: 5th

Date of Submission: 05.12.2025

1. Lab Task

The objective of this laboratory assignment was to design a scalable network infrastructure for the "MAGA Headquarters" expansion. The design required supporting five distinct departments (Engineering, Marketing, Sales, Administration, and Management) using efficient **Variable Length Subnet Masking (VLSM)**.

Key Objectives:

1. **Topology Design:** Implement a multi-subnet topology with a central router and dedicated switches for each department.
2. **DHCP Configuration:** * Deploy a **Dedicated DHCP Server** for Engineering, Marketing, and Sales.
    - Configure the **Router as a DHCP Server** for Administration and Management.
3. **NAT/PAT Implementation:** Configure Network Address Translation to map internal private IP addresses to a limited pool of 7 Global IPs for internet access.

Calculations for Student ID: 25

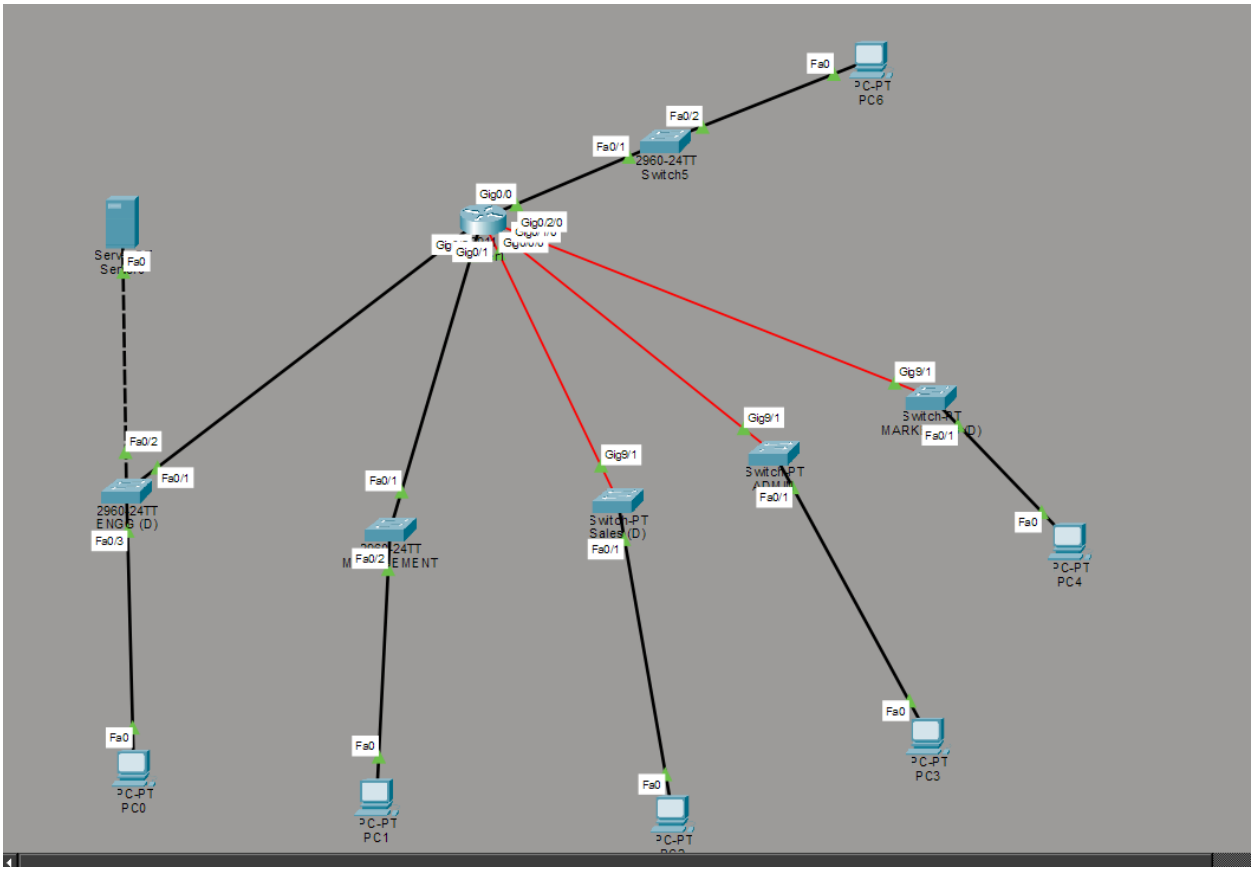
- **Network Prefix Formula:** `192.i.((i+3) % 10).0`
- **i (Last two digits):** 25
- **Third Octet:** `(25 + 3) % 10 = 28 % 10 = 8`

- **Base Network:** `192.25.8.0`

Host Requirements & VLSM Calculation:

Department	Hosts Required	Block Size	CIDR	Subnet Mask	Network Address	Gateway (Router IP)
Engineering	33	64	/26	255.255.255.192	192.25.8.0	192.25.8.1
Management	30	64	/26	255.255.255.192	192.25.8.64	192.25.8.65
Sales	14	32	/27	255.255.255.224	192.25.8.128	192.25.8.129
Admin	12	16	/28	255.255.255.240	192.25.8.160	192.25.8.161
Marketing	7	16	/28	255.255.255.240	192.25.8.176	192.25.8.177

2. Final Network Topology



3. Procedure

The implementation was divided into three primary phases: Topology Setup, DHCP Configuration, and NAT/PAT Configuration.

3.1 Topology & Interface Configuration

1. **Module Expansion:** A GigabitEthernet module (HWIC-1GE-SFP) was added to the central router to support 5 distinct LAN interfaces.
2. **Interface Configuration:** Each router interface was assigned the first usable IP of its respective subnet (The Gateway).

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3. **Global IP Network:** The interface connecting to the Internet Router was configured with an IP from the `110.25.26.0/24` block.

3.2 DHCP Implementation

Part A: Dedicated DHCP Server (Engineering, Sales, Marketing)

1. A Server-PT device was placed in the Engineering subnet with the static IP **192.25.8.2**.

2. Three DHCP pools were configured on the server with the specific VLSM masks calculated in Section 1.
3. **IP Helper:** The `ip helper-address 192.25.8.2` command was applied to the Router's Engineering, Sales, and Marketing interfaces to relay broadcast requests to the server.

Part B: Router-Based DHCP (Admin, Management)

1. Two DHCP pools (`ADMIN` and `MANAGEMENT`) were created directly on the Router via CLI.
2. The `default-router` command was used to push the specific gateway IP for each subnet.
3. Gateway IPs were explicitly excluded using `ip dhcp excluded-address` to prevent IP conflicts.

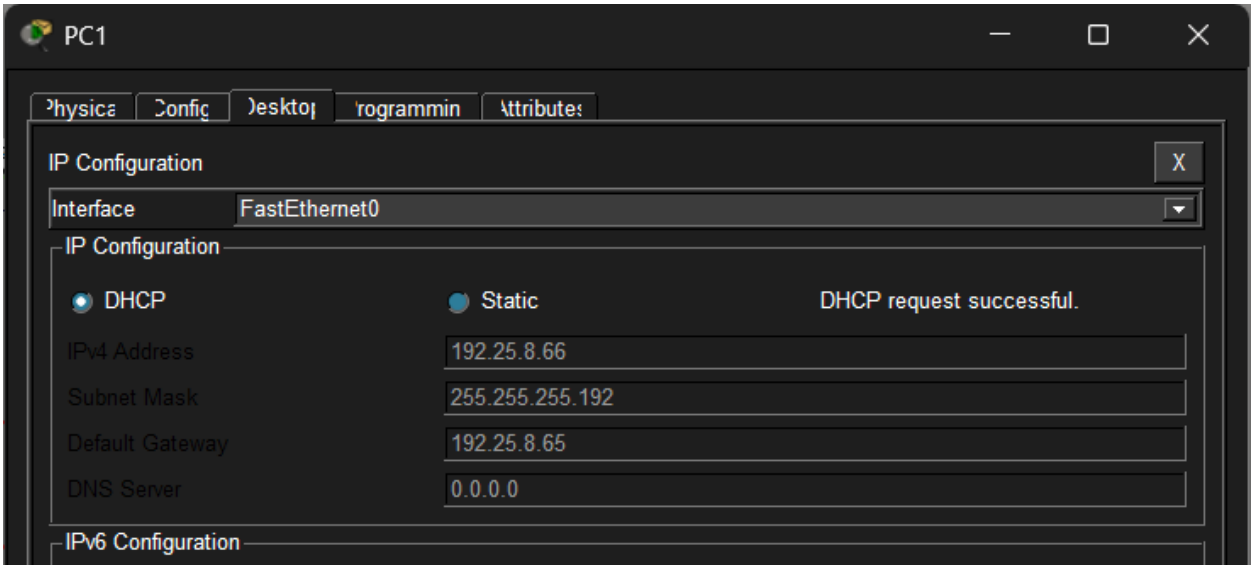
3.3 NAT & PAT Configuration

1. **Interface Definition:** Internal LAN interfaces were marked as `ip nat inside`, and the WAN interface facing the Internet Router was marked as `ip nat outside`.
2. **Address Pool:** A NAT pool named `GLOBAL_POOL` was created using the 6 available public IPs: `110.25.26.2` to `110.25.26.7`.
3. **Static NAT:** A static translation was configured for the user PC (`192.25.8.3`) to map exclusively to `110.25.26.1`.
4. **Dynamic PAT:** An access list (ACL 1) was created to permit traffic from `192.25.8.0/24`. This list was mapped to the `GLOBAL_POOL` with the `overload` keyword, enabling Port Address Translation for all other devices.

4. Observations & Results

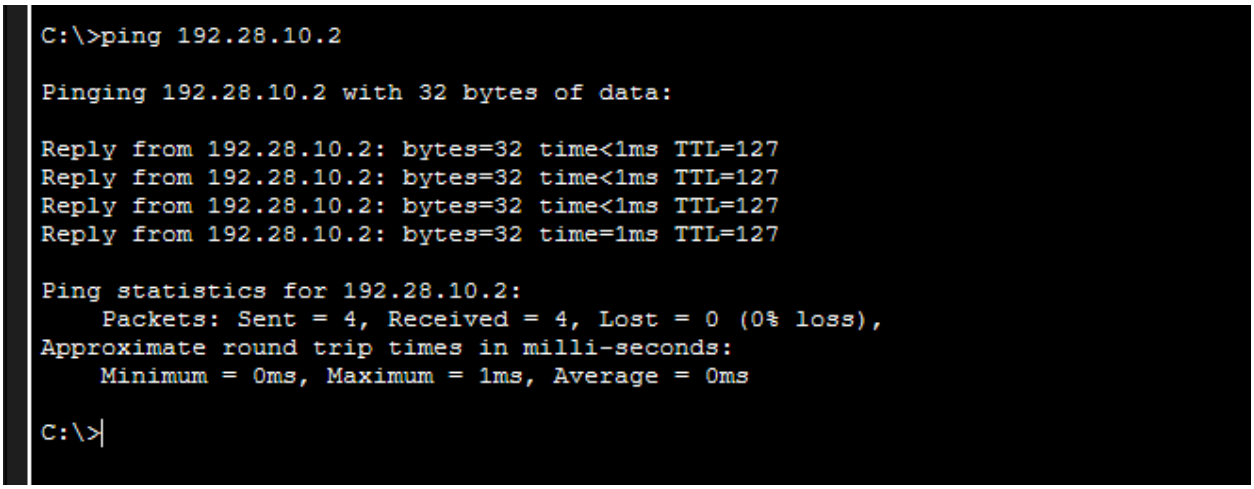
4.1 DHCP Verification

The following screenshot demonstrates a PC successfully receiving an IP address, Subnet Mask, and Gateway from the DHCP server.



4.2 Connectivity Test (Ping)

Successful communication between different departments (Routing Verification) and to the external PC6 (NAT Verification).



4.3 NAT Translation Table

The router's NAT table showing the Static entry for the main PC and Dynamic PAT entries for other hosts.

```
Router>enable
Router#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside global
icmp 110.25.26.2:10    192.25.8.66:10     192.28.10.2:10     192.28.10.2:10
icmp 110.25.26.2:11    192.25.8.66:11     192.28.10.2:11     192.28.10.2:11
icmp 110.25.26.2:12    192.25.8.66:12     192.28.10.2:12     192.28.10.2:12
icmp 110.25.26.2:13    192.25.8.66:13     192.28.10.2:13     192.28.10.2:13
icmp 110.25.26.2:14    192.25.8.66:14     192.28.10.2:14     192.28.10.2:14
icmp 110.25.26.2:15    192.25.8.66:15     192.28.10.2:15     192.28.10.2:15
icmp 110.25.26.2:16    192.25.8.66:16     192.28.10.2:16     192.28.10.2:16
icmp 110.25.26.2:17    192.25.8.66:17     192.28.10.2:17     192.28.10.2:17
icmp 110.25.26.2:18    192.25.8.66:18     192.28.10.2:18     192.28.10.2:18
icmp 110.25.26.2:19    192.25.8.66:19     192.28.10.2:19     192.28.10.2:19
icmp 110.25.26.2:20    192.25.8.66:20     192.28.10.2:20     192.28.10.2:20
icmp 110.25.26.2:21    192.25.8.66:21     192.28.10.2:21     192.28.10.2:21
icmp 110.25.26.2:22    192.25.8.66:22     192.28.10.2:22     192.28.10.2:22
icmp 110.25.26.2:23    192.25.8.66:23     192.28.10.2:23     192.28.10.2:23
icmp 110.25.26.2:24    192.25.8.66:24     192.28.10.2:24     192.28.10.2:24
icmp 110.25.26.2:25    192.25.8.66:25     192.28.10.2:25     192.28.10.2:25
icmp 110.25.26.2:26    192.25.8.66:26     192.28.10.2:26     192.28.10.2:26
icmp 110.25.26.2:27    192.25.8.66:27     192.28.10.2:27     192.28.10.2:27
icmp 110.25.26.2:28    192.25.8.66:28     192.28.10.2:28     192.28.10.2:28
icmp 110.25.26.2:29    192.25.8.66:29     192.28.10.2:29     192.28.10.2:29
icmp 110.25.26.2:30    192.25.8.66:30     192.28.10.2:30     192.28.10.2:30
 --More--
```

5. Challenges Faced

1. **Router Module Configuration:** The FastEthernet interfaces added to the router initially failed to accept IP addresses because they defaulted to Layer 2 switch ports. This was resolved by entering the `no switchport` command to convert them into Layer 3 routed interfaces.
2. **DHCP Subnet Mask Errors:** Initially, PCs received APIPA addresses (169.254.x.x) or incorrect gateways because the DHCP Server pools were configured with the default `/24` mask. The issue was resolved by manually updating the DHCP pools to match the specific VLSM masks (`/26`, `/27`, `/28`) calculated for each department.
3. **Service Persistence:** Connectivity was temporarily lost after a device restart because the DHCP Server service settings were not saved to NVRAM. This was corrected by ensuring the DHCP service was toggled ON and the configuration was explicitly saved on the server device.