DHCP & NAT Network Simulation

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Abstract

This project demonstrates how Dynamic Host Configuration Protocol (DHCP) and Network Address Translation (NAT) work together within a local area network (LAN) environment. The network topology, designed and simulated in Cisco Packet Tracer, automates IP address assignment and enables Internet access for internal hosts through NAT.

Objectives

- Configure DHCP on a Cisco router to automatically assign IP addresses to clients.
- Implement NAT to allow internal devices with private IP addresses to access external networks.
- Understand and verify the operation of DHCP and NAT services using Cisco Packet Tracer.

Network Topology Overview

The topology includes a single router serving as both the DHCP server and NAT gateway, a switch connecting the LAN clients, multiple PCs receiving IP configurations dynamically, and an ISP router representing the Internet. This setup emulates a typical small office or campus network.

IP Addressing Table

Device	Interface	IP Address	Subnet Mask	Remarks
Router	GigabitEthernet0/0	10.0.0.1	255.0.0.0	LAN Gateway
Router	Serial0/0/0	172.168.1.2	255.255.255.252	Link to ISP
PCs	NIC	DHCP Assigned	255.255.255.0	Dynamic IPs from Router
ISP Router	Serial0/0/0	172.168.2.1	255.255.255.252	External Network

DHCP Configuration

```
Router(config)# ip dhcp pool LAN_POOL
Router(dhcp-config)# network 10.0.0.0 255.0.0.0
Router(dhcp-config)# default-router 10.0.0.1
Router(dhcp-config)# dns-server 8.8.8.8
Router(config)# ip dhcp excluded-address 10.0.0.20 10.0.0.30
```

NAT Configuration

```
Router(config)# access-list 1 permit 172.168.1.2 0.0.255.255
Router(config)# interface g0/0
Router(config-if)# ip nat inside
Router(config)# interface s0/0/0
Router(config-if)# ip nat outside
Router(config)# ip nat inside source list 1 interface s0/0/0 overload
```

Testing & Verification

Once configuration is complete, the following tests are conducted:
1. Verify DHCP leases on client PCs using `ipconfig /all`.
2. Ping the default gateway and external IPs to confirm connectivity.
3. Use `show ip nat translations` on the router to observe NAT activity.
4. Ensure all clients have valid IP configurations and Internet reachability.

Conclusion

This simulation effectively demonstrates the integration of DHCP and NAT in a networked environment. By automating IP distribution and enabling Internet access through address translation, the setup mirrors real-world enterprise and small-office networking practices.

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Date: October 2025