



Computer Networks

Lab Manual: DHCP and VLSM Implementation

Objective:

The objective of this lab is to implement DHCP on a network that is designed using Variable Length Subnet Masking (VLSM). By the end of this lab, you should be able to configure DHCP on a server, define DHCP scopes for different subnets, and implement VLSM to efficiently allocate IP addresses.

DHCP

Dynamic Host Configuration Protocol (DHCP) is a network protocol that automates the process of configuring devices on a network with IP addresses and other parameters. It simplifies the administration of IP address assignment by centralizing the management of IP addresses and related configuration details. Here's an overview of DHCP:

Key Concepts:

1. **Dynamic IP Address Assignment:**
 - DHCP allows devices to obtain IP addresses dynamically when they join a network, eliminating the need for manual IP configuration.
2. **Components:**
 - **DHCP Server:** Manages and allocates IP addresses and configuration parameters to clients.
 - **DHCP Client:** The device (e.g., computer, smartphone) that requests and receives IP configuration from the DHCP server.
3. **IP Address Pool:**
 - DHCP servers maintain a pool of available IP addresses that can be assigned to clients.
4. **Lease Duration:**
 - When a client receives an IP address from a DHCP server, it is leased for a specific duration. After this period, the client may renew the lease.
5. **DHCP Discover-Offer-Request-Acknowledge (DORA) Process:**
 - **Discover:** The client broadcasts a DHCP discover message to find available DHCP servers on the network.

- **Offer:** DHCP servers respond with a DHCP offer, providing an IP address and configuration details.
- **Request:** The client chooses an offer and requests the IP address from the selected DHCP server.
- **Acknowledge:** The DHCP server acknowledges the request and assigns the IP address to the client.

DHCP Configuration:

1. DHCP Server Configuration:

- Install and configure DHCP server software on a server or network device.
- Define the IP address range (pool) that the DHCP server will manage.
- Set lease durations, subnet masks, default gateways, DNS servers, and other configuration options.

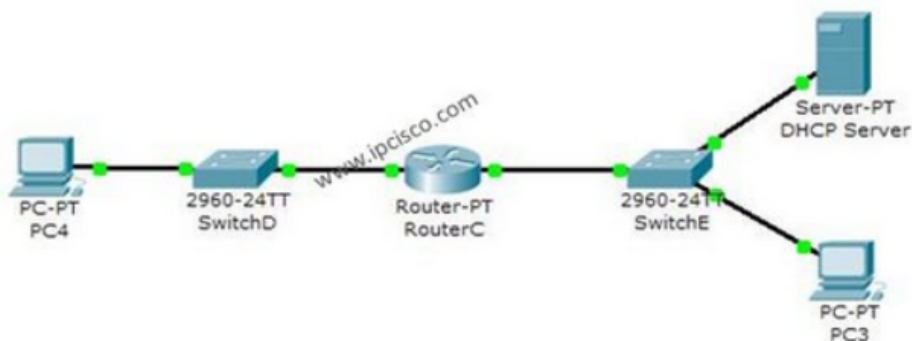
2. DHCP Client Configuration:

- Most devices are DHCP clients by default.
- Configure client devices to obtain IP addresses automatically (DHCP-enabled).

3. DHCP Relay Agent:

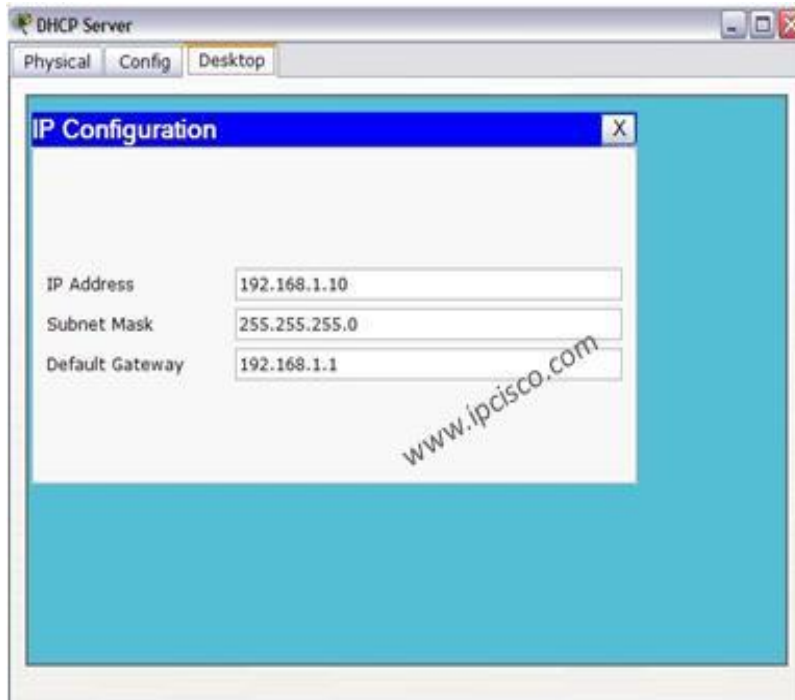
- In larger networks with multiple subnets, DHCP relay agents can be used to forward DHCP requests from clients to DHCP servers in different subnets.

Packet Tracer DHCP Config For Multiple Broadcast Domains



DHCP Example Topology (Multiple Broadcast Domains)

In the first place we will configure the **DHCP Server** for its **DHCP pools** and its ip configuration. The ip address is 192.168.1.10 and the default gateway will be the routers interface's ip address that is face to DHCP server.



For the subnets 192.168.1.0 and 10.10.0.0 there must be two **DHCP pool**. The below screenshot is showing how these assignments will be done in **DHCP Server**.

DHCP Server

Physical Config Desktop

GLOBAL

Settings

Algorithm Settings

SERVICES

HTTP

DHCP

TFTP

DNS

SYSLOG

AAA

NTP

INTERFACE

FastEthernet

DHCP

Service ☒ On ☐ Off

Pool Name: DHCP192

Default Gateway: 192.168.1.1

DNS Server: 192.168.1.10

Start IP Address : 192 168 1 11

Subnet Mask: 255 255 255 0

Maximum number of Users : 50

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Maximum number of Users
DHCP192	192.168.1.1	192.168.1.10	192.168.1.11	255.255.255.0	50
serverPool	10.10.0.1	192.168.1.10	10.10.0.11	255.255.255.0	50

DHCP Server

Physical Config Desktop

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DHCP

Service ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 10.10.0.1

DNS Server: 192.168.1.10

Start IP Address : 10 10 0 11

Subnet Mask: 255 255 255 0

Maximum number of Users : 50

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Maximum number of Users
DHCP192	192.168.1.1	192.168.1.10	192.168.1.11	255.255.255.0	50
serverPool	10.10.0.1	192.168.1.10	10.10.0.11	255.255.255.0	50

In the Packet Tracer router the following configuration will be done for two different subnet **DHCP** achivement:

RouterC # **config terminal**

RouterC(config)# **interface fa0/0**

RouterC(config-if)# **ip address 10.10.0.1 255.255.255.0**

RouterC(config-if)# **ip helper-address 192.168.1.10**

RouterC(config-if)# **no shutdown**

RouterC(config-if)# **exit**

RouterC(config)# **interface fa1/0**

RouterC(config-if)# **ip address 192.168.1.1 255.255.255.0**

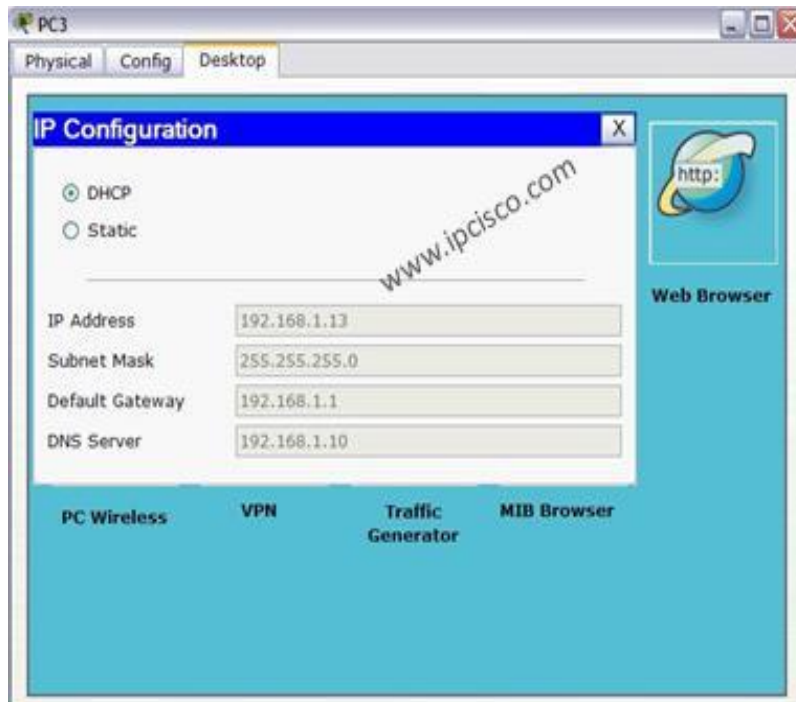
RouterC(config-if)# **ip helper-address 192.168.1.10**

RouterC(config-if)# **no shutdown**

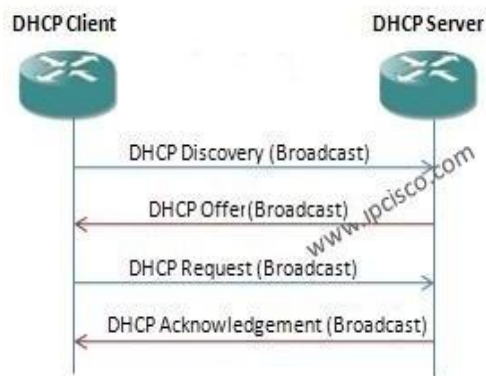
RouterC(config-if)# **end**

RouterC# **copy run start**

After this configuration, we can try **dynamic ip assignment** on PC by selecting the **dynamic option** on ip configuration screen like below.



As you can see, our PCs get their IP configuration from **DHCP Server**. The IP assignment is done automatically.



Common Issues and Troubleshooting:

- 1. IP Address Conflicts:**
 - Monitor for conflicts where two devices have been assigned the same IP address.
- 2. DHCP Lease Renewal Issues:**
 - Ensure that DHCP lease durations are appropriately configured to prevent frequent lease renewals.
- 3. DHCP Server Availability:**
 - Verify the availability of the DHCP server, as clients won't be able to obtain IP addresses if the server is down.
- 4. Network Segmentation:**
 - DHCP may need to be configured differently if your network is segmented into different subnets.

Security Considerations:

- 1. Unauthorized DHCP Servers:**
 - Protect against rogue DHCP servers that may cause network issues.
- 2. IP Address Management (IPAM):**
 - Implement IP Address Management solutions to track and manage IP address allocations.

Conclusion:

DHCP is a critical component of modern networks, making it easier to manage and scale IP address assignments. Proper DHCP configuration and management are essential for maintaining a stable and efficient network environment. Regular monitoring and troubleshooting can help address potential issues promptly.

Tasks:

Task 1: VLSM Setup

1. Design an IP addressing scheme using VLSM for the given network topology.
2. Assign IP addresses to router interfaces based on the VLSM design.

Task 2: DHCP Server Configuration

3. Configure the DHCP server with a pool of IP addresses for each subnet.
4. Define DHCP scopes for each subnet on the DHCP server.
5. Configure DHCP options such as DNS servers, default gateways, etc.

Task 3: Router Configuration

6. Configure the router interfaces with IP addresses from the VLSM design.
7. Enable routing on the router and ensure it can reach all subnets.

Task 4: DHCP Testing

8. Connect PC1 to Subnet 1 and ensure it receives a dynamically assigned IP address from the DHCP server.
9. Connect PC2 to Subnet 2 and verify DHCP functionality for this subnet.

Task 5: VLSM and DHCP Integration

10. Test DHCP functionality across different subnets, ensuring that devices receive IP addresses from the correct DHCP scopes.
11. Monitor DHCP server logs for any issues and troubleshoot if necessary.

Notes:

- Document all IP addresses, subnet masks, and configurations used in each step.
- Pay attention to DHCP lease durations, ensuring they align with network requirements.
- Experiment with modifying the VLSM design and DHCP configurations to observe the impact on IP address allocation.

Conclusion:

This lab provides hands-on experience in implementing DHCP on a network designed with VLSM. Understanding how these technologies work together is crucial for efficient IP address management in real-world networking scenarios.