



## **Computer Communications and Networks**

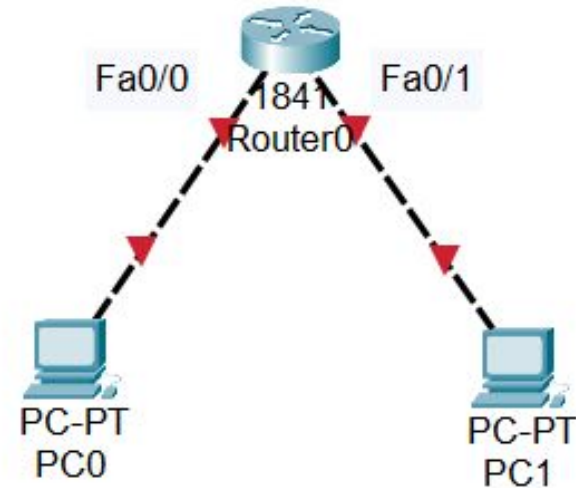
# DYNAMIC HOST CONFIGURATION PROTOCOL (DHCP)

This week, we will learn about Dynamic Host Configuration Protocol (DHCP).

- Based on our experience in previous labs, it seems we are facing challenges in understanding communication through routers.
- Today, we will begin by covering some fundamental concepts related to using routers for connecting different networks.

- Consider this simple scenario:

- Two PCs are connected to the router.
- We always refer to devices as being connected to router interfaces or ports. In this case, the relevant ports are **Fa0/0** and **Fa0/1**.
- Port numbers are critical information**—always make sure to note them.



- Enabling router ports for communication:**

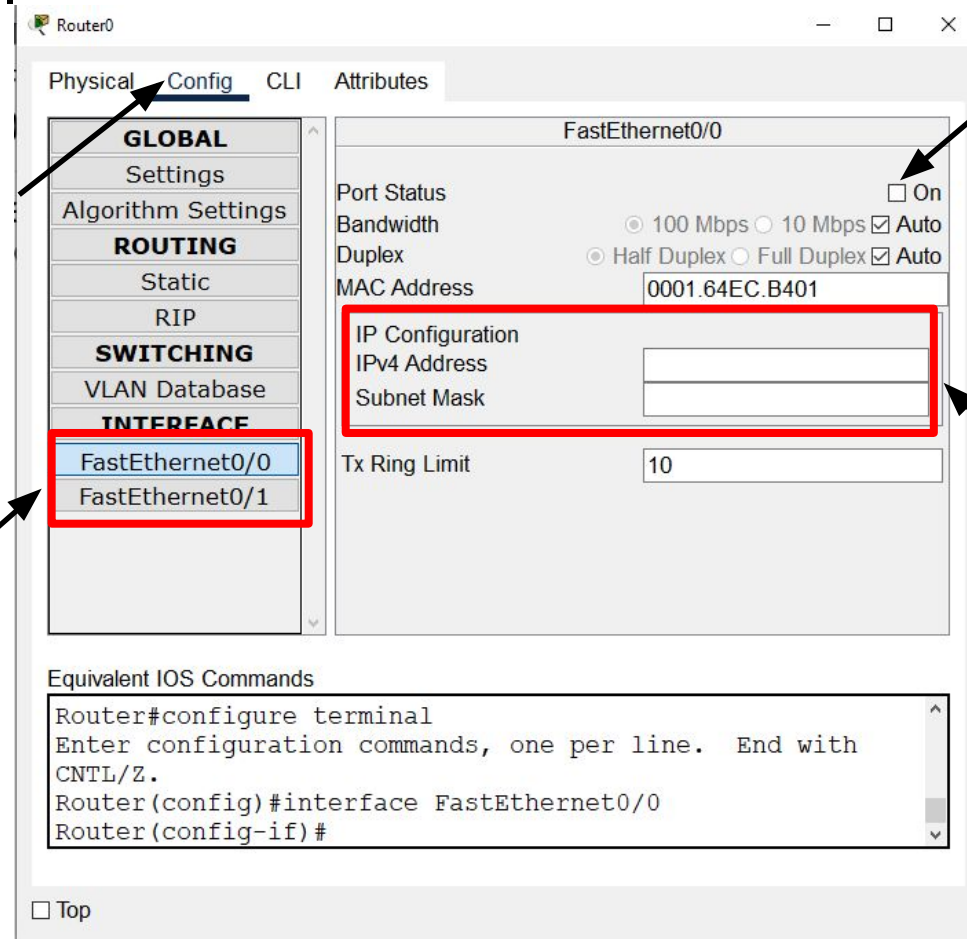
- To enable a router port for communication, the following steps are required.
  - Assign an IP address to the port.**
    - It was not needed for a layer 2 switch.
  - Activate** (Turn ON) the port.

How can we accomplish this?



# Router port: configuration

- Router ports can be configured either manually through the configuration tab or using the CLI.



The screenshot shows the configuration interface for Router0. The 'Config' tab is selected, and the 'FastEthernet0/0' interface is chosen from the left sidebar. The main configuration area shows various settings for the port, including Port Status, Bandwidth, Duplex, MAC Address, and IP Configuration. The IP Configuration section is highlighted with a red box, indicating where to enter the IP address and subnet mask. The 'Port Status' checkbox is also highlighted with a red box, indicating where to turn on the port. The 'Equivalent IOS Commands' section at the bottom shows the commands to configure the interface.

1. Click on the Config tab.

2. These are the ports (**Fa0/0** and **Fa0/1**). Click on the port you wish to configure.

4. Tick this box to turn on the port.

3. Enter the appropriate IP address and subnet mask in the designated fields.

In Cisco Packet Tracer, you can configure the router ports using the Command Line Interface (CLI) with the following steps:

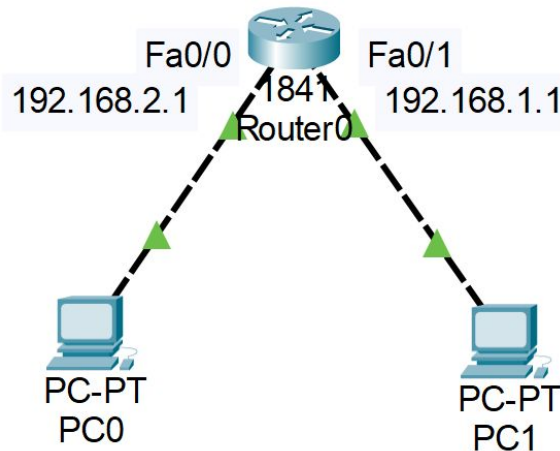
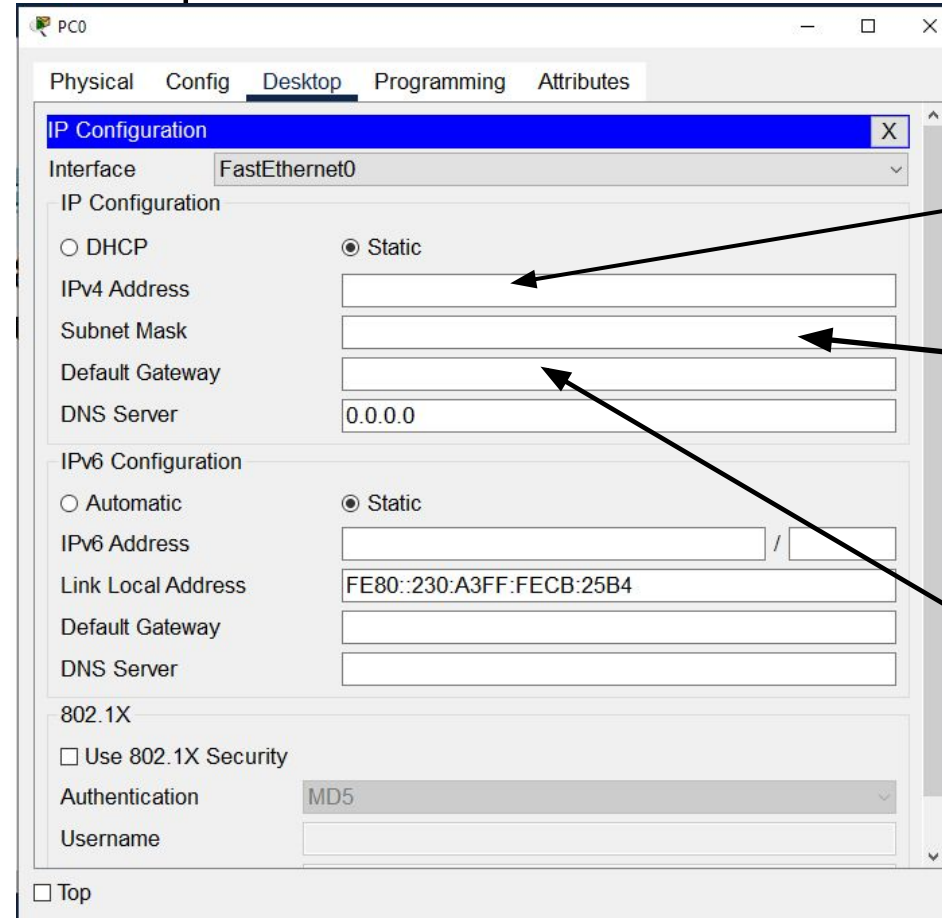
```
Router>enable
Router#configure terminal
Router(config)#interface fa0/1
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown
```

```
Router(config-if)#exit
```

```
Router(config)#interface fa0/0
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#
```

# Router: PC configuration

- Once the router ports are configured, we need to set the **default gateways** on the PCs connected to these ports.

PC0

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address

Subnet Mask

Default Gateway

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address

Link Local Address FE80::230:A3FF:FECEB:25B4

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

Username

☐ Top

1. IP address of the PC.

2. Subnet mask for the IP address.

3. The IP address of the default gateway is the IP address of the router port to which the PC is connected.



- Download the Packet Tracer file from Canvas under Week 4 and open it. The network should look like this.
- Now,
  1. Configure the router ports as per the earlier instructions.
  2. Assign IP addresses and default gateways to the PCs.
  3. Test connectivity by checking if PCs on the left side of the router can communicate with those on the right side, and vice versa.

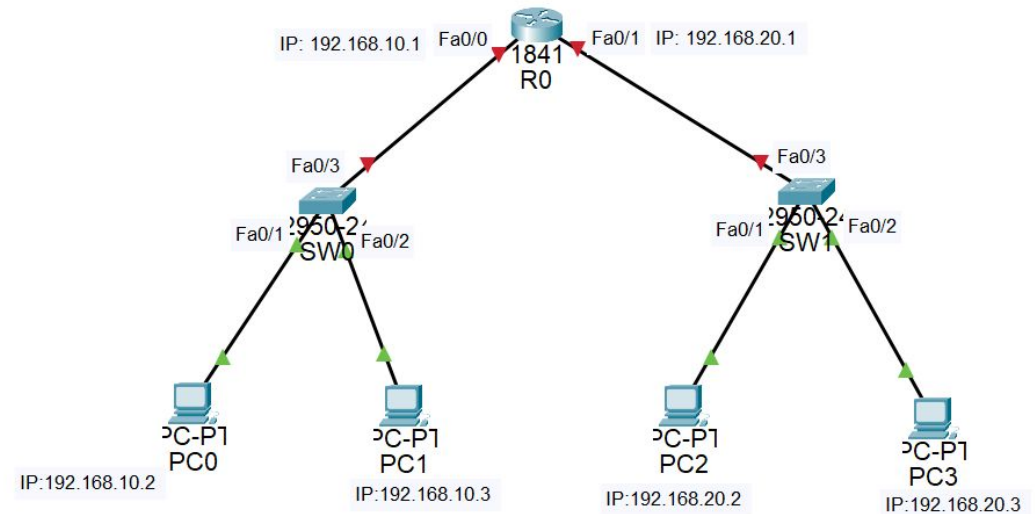


Image source: ipcisco.com



- **DHCP (Dynamic Host Configuration Protocol)** automatically assigns IP addresses to devices on a network.
- It eliminates the need for manual IP configuration, simplifying network setup.
- DHCP assigns IP addresses from a predefined pool of available addresses.
- It can also provide additional network information, such as the default gateway and DNS servers.
- DHCP works in a client-server model, with the router or dedicated server acting as the DHCP server.

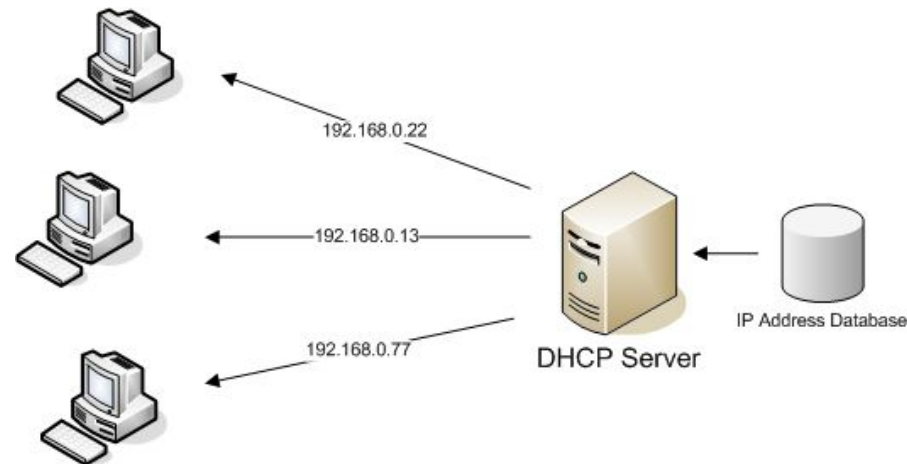


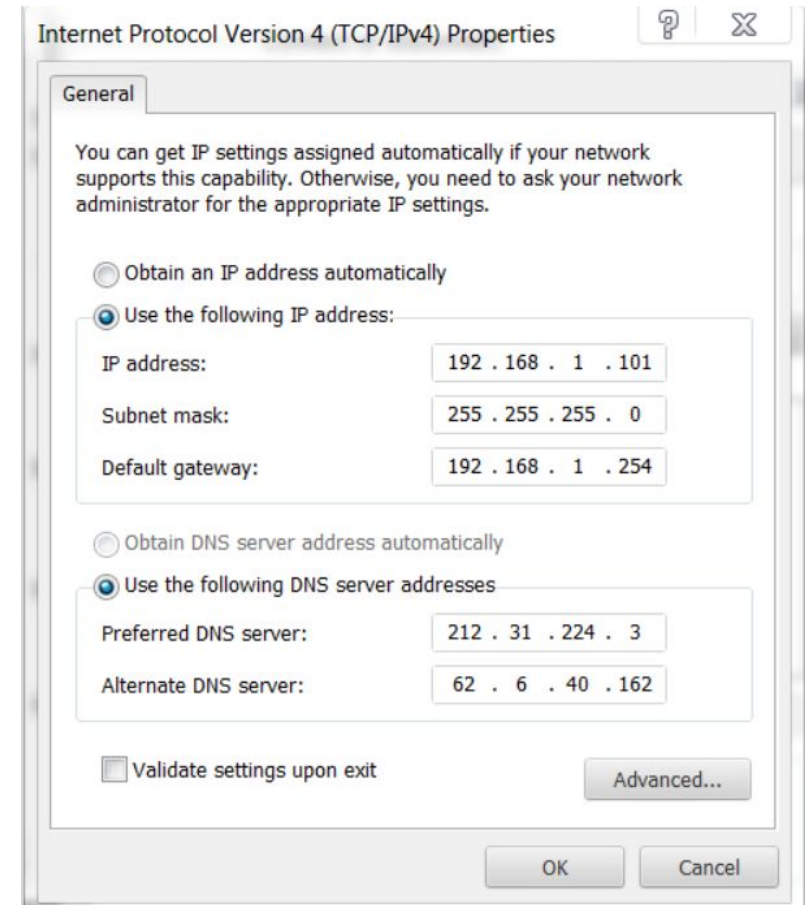
Image source: <https://www.andysowards.com/>



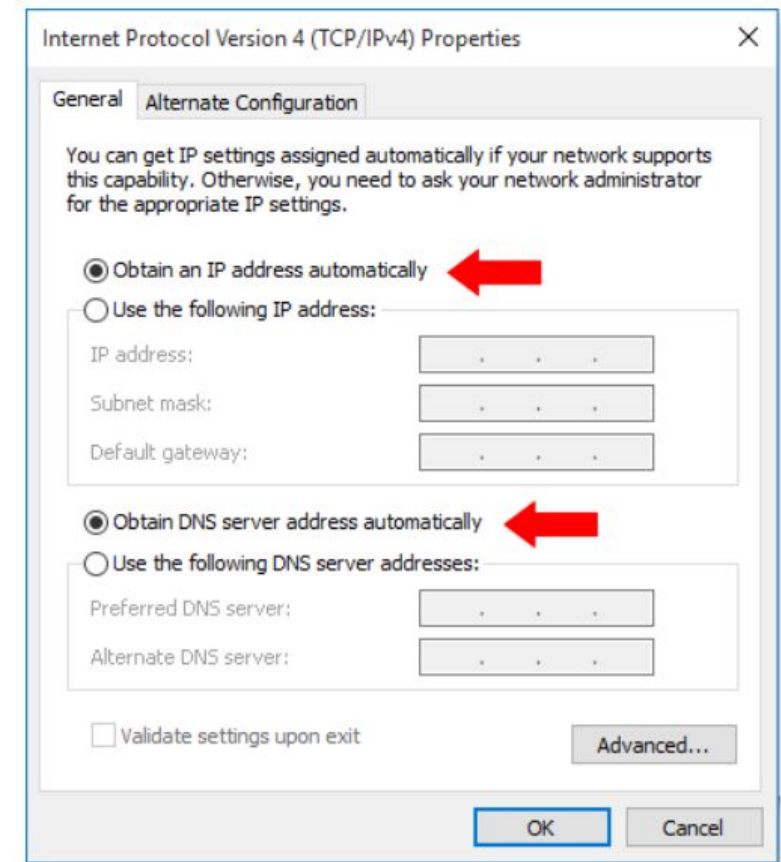


- Configuration parameters for network hosts
  - IP address
  - Router
  - Subnet Mask
  - Others..
- DHCP is used to assign IP addresses to hosts or workstations on the network
- Two types of IP addresses
  - **Static:** Is a number that is assigned to a host by an Internet service provider (ISP) to be its permanent address on the Internet
  - **Dynamic:** The temporary IP address is called a dynamic IP address

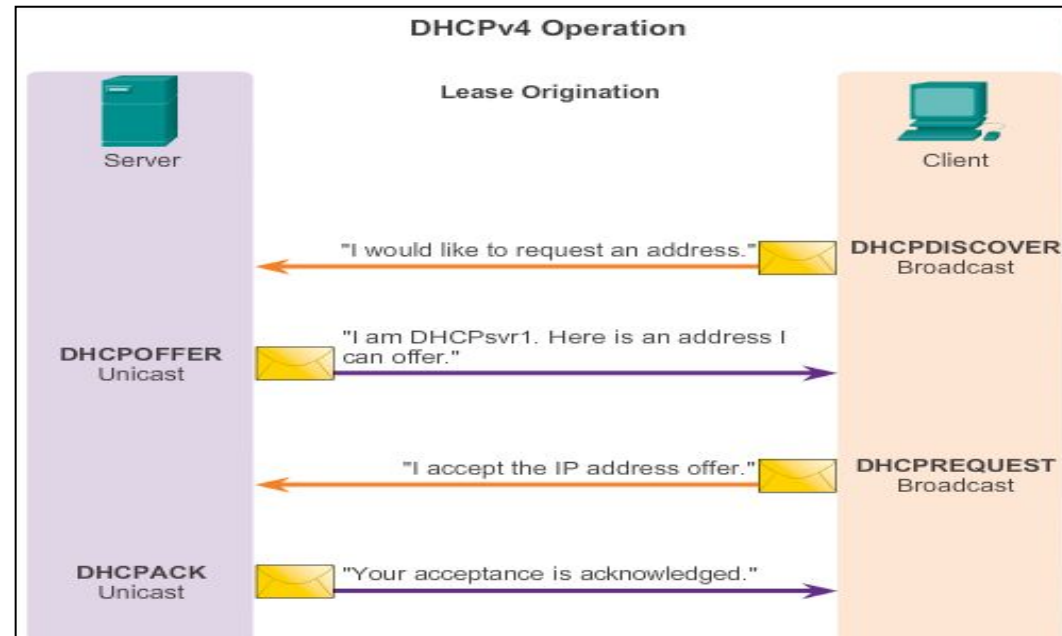
- Manually configured by the network administrator
- Advantages
  - useful for printers, servers, etc.
  - increased control of resources (security)
- Disadvantages
  - time consuming



- Automatic assignment of IP addresses
- Useful if frequent change in users (wireless hotspot)
- Uses DHCP server
  - IP addresses leased for a period of time
    - if host is removed from the network (turned off), the IP address goes back into the pool of IP address
  - Preferred method for large networks
    - reduces the burden of network support



- If host is configured as DHCP client, it will not have a
  - IP address
  - Subnet Mask
  - Default Gateway
- **Clients send a DHCP Discover Message**
  - The message comes from a client seeking an IP address
  - The destination IP address of the message is 255.255.255.255.
  - All hosts receive the message, but only a DHCP server replies



## **Advantages of DHCP**

- DHCP eliminates the need for manual IP address configuration, reducing human error and administrative workload
- It helps efficiently manage a pool of IP addresses, preventing conflicts and optimising address allocation
- DHCP allows devices to join the network without needing manual configuration, which is especially useful for large networks
- IP addresses, subnet masks, and other configurations can be centrally managed from the DHCP server

## **Disadvantages of DHCP**

- If the DHCP server fails, devices may not be able to obtain an IP address, disrupting network connectivity
- A limited pool of IP addresses may cause issues in very large networks if not managed properly
- DHCP can be vulnerable to attacks, such as DHCP spoofing, where malicious servers could assign incorrect network configurations to devices
- Since DHCP leases IP addresses for a limited time, devices may receive different IP addresses over time, making static configurations difficult

# Configuring a DHCP Server on a Router

A Cisco router running the Cisco IOS software can be configured to act as a DHCPv4 server. To set up DHCP on **Router**

## 1. Enter Global Configuration Mode:

```
Router> enable
Router# configure terminal
```

## 2. Define the DHCP Address Pool:

```
Router(config)# ip dhcp pool NetworkIT
Router(dhcp-config)# network 192.168.1.0 255.255.255.0
```

Name of the pool, you can choose your own name

Network address, IP addresses will be assigned from this network

Subnet mask of the network

## 3. Set the Default Gateway:

Define the default gateway that the router will assign to clients (usually the router's own IP in the network)

```
Router(dhcp-config)# default-router 192.168.1.1
```

## 4. Specify the DNS Server (Optional):

Optionally, you can set a DNS server for the clients:

```
Router(dhcp-config)# dns-server 8.8.8.8
```

## 5. Set the Lease Time (Optional):

You can define how long the IP addresses assigned by DHCP will be valid:

```
Router(dhcp-config)# lease 1 0 0
```

Days      Hours      Minutes

## 6. Exclude IP Addresses (Optional):

If you have certain IP addresses that should not be assigned by DHCP (e.g., for servers or printers), you can exclude them

```
Router(config)# ip dhcp excluded-address 192.168.1.1 192.168.1.10
```

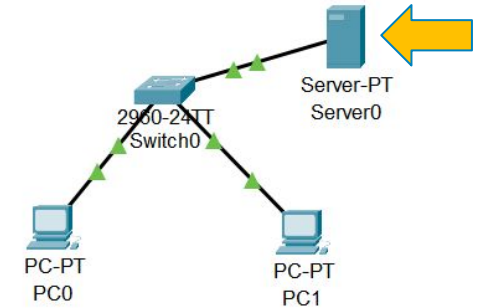
This command ensures that the IP addresses in the range from **192.168.1.1** to **192.168.1.10** will be excluded from being assigned to DHCP clients.

To verify DHCP Configuration, use : **Router# show ip dhcp pool**



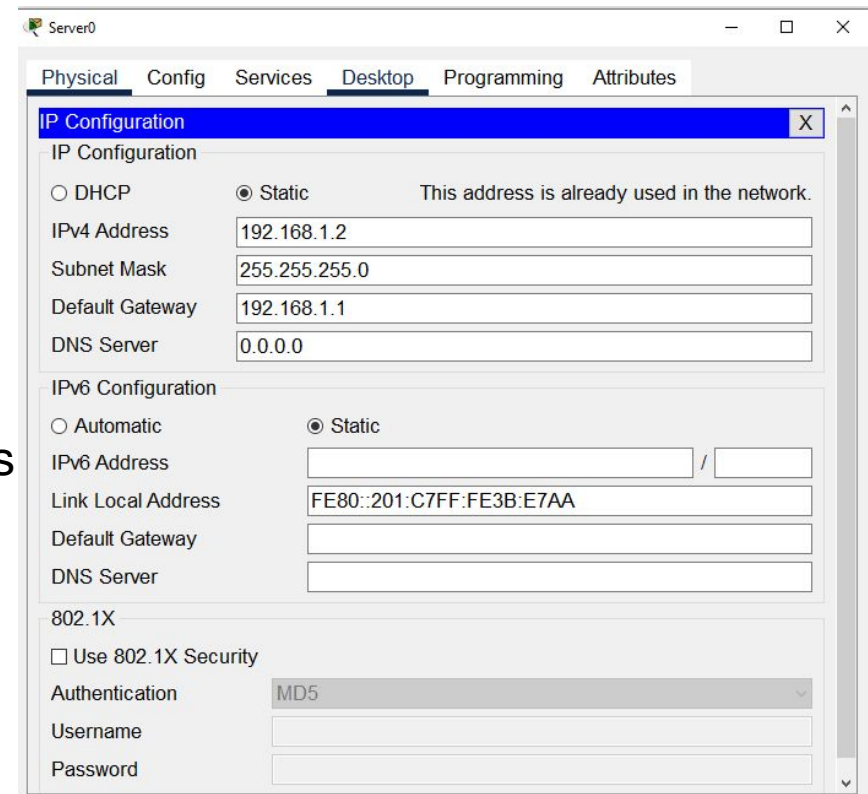
## Step 1: Add a Server to the Network

- Drag and drop a Server-PT from the device list onto the workspace.
- Connect the server to a switch or router using an Ethernet cable.



## Step 2: Assign a Static IP to the Server

- Click on the **Server-PT** and navigate to the **Desktop** tab.
- Open the **IP Configuration** window.
- Select **Static** and set:
  - **IP Address:** e.g., 192.168.1.2
  - **Subnet Mask:** e.g., 255.255.255.0
  - **Default Gateway:** e.g., 192.168.1.1 (Router's IP)



## Step 3: Enable DHCP Service

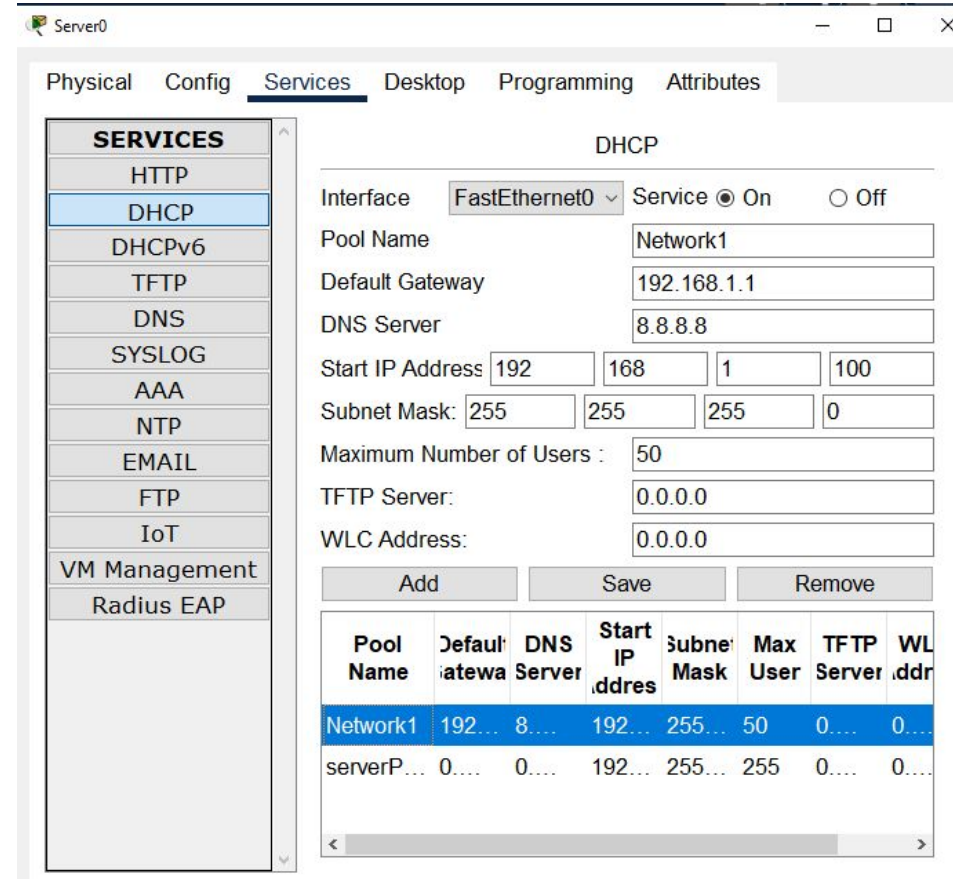
- Go to the **Services** tab.
- Click on **DHCP** from the left panel.
- Ensure that the **DHCP Service** is turned **ON**.

## Step 4: Configure the DHCP Pool

- Under the **DHCP Service** section, enter the required details:
  - Pool Name:** e.g., Network1
  - Default Gateway:** e.g., 192.168.1.1
  - DNS Server:** e.g., 8.8.8.8
  - Starting IP Address:** e.g., 192.168.1.100
  - Subnet Mask:** e.g., 255.255.255.0
  - Maximum Number of Users:** e.g., 50
- Click **Add** to save the configuration.

## Step 5: Verify DHCP Allocation

- Connect a PC to the network and configure it to obtain an IP address automatically (via DHCP).
- Check the IP Configuration of the PC to confirm that it receives an IP from the DHCP server.



The screenshot shows the 'Server0' configuration window with the 'Services' tab selected. On the left, the 'SERVICES' list has 'DHCP' highlighted. On the right, the 'DHCP' configuration section is active, showing the 'FastEthernet0' interface with the service turned 'On'. The configuration details for the 'Network1' pool are as follows:

Interface	Service
FastEthernet0	On

Configuration details for Network1:

- Pool Name: Network1
- Default Gateway: 192.168.1.1
- DNS Server: 8.8.8.8
- Start IP Address: 192.168.1.100
- Subnet Mask: 255.255.255.0
- Maximum Number of Users: 50
- TFTP Server: 0.0.0.0
- WLC Address: 0.0.0.0

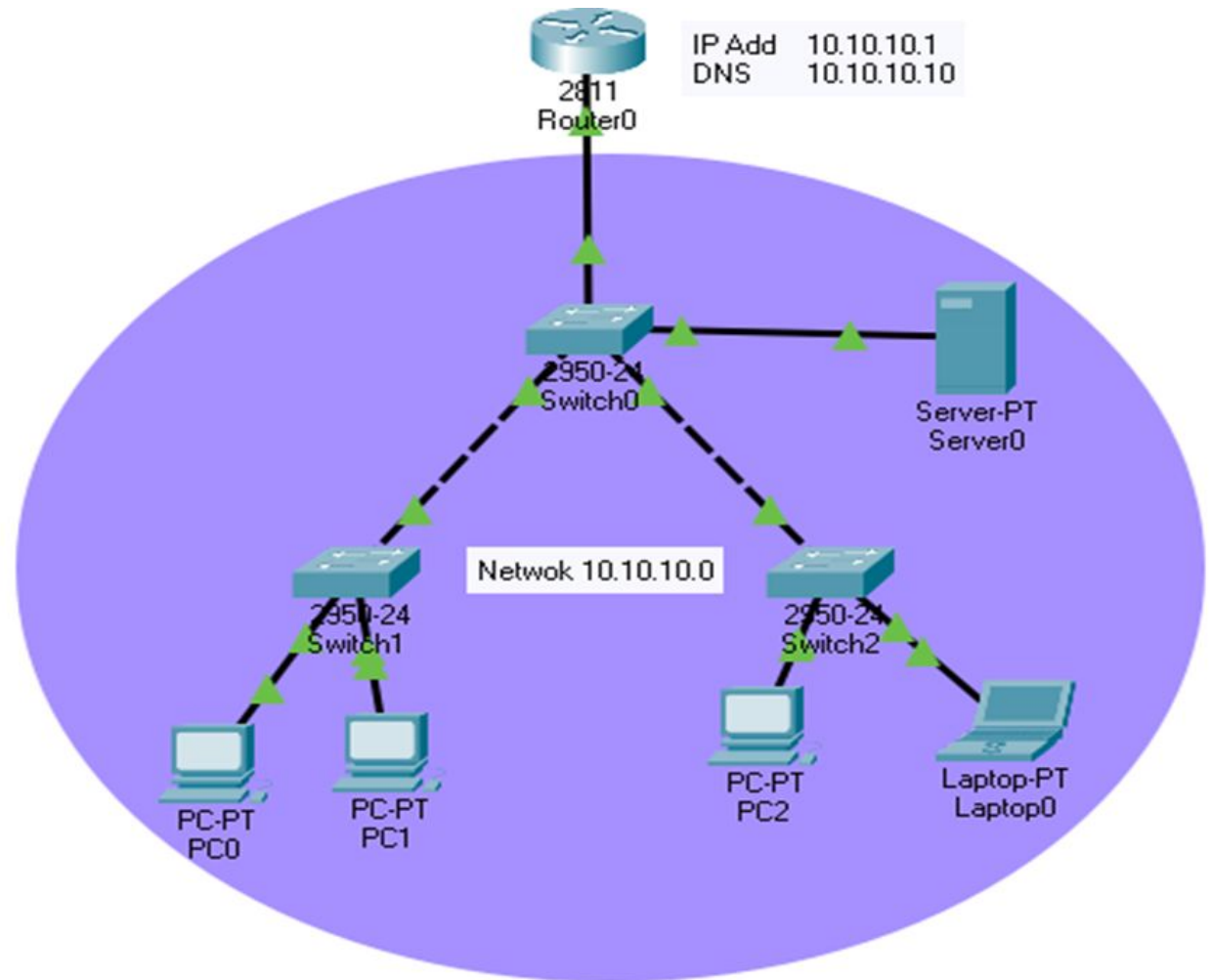
At the bottom, there are 'Add', 'Save', and 'Remove' buttons. Below these is a table showing the configured pools:

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Network1	192.168.1.1	8.8.8.8	192.168.1.100	255.255.255.0	50	0.0.0.0	0.0.0.0
serverP...	0.0.0.0	0.0.0.0	192.168.1.100	255.255.255.0	255	0.0.0.0	0.0.0.0

## Exercise 1

Use DHCP configuration on the router to generate DHCP IP addresses for all end devices

- Test if end devices obtain IP addresses automatically (via DHCP).





## Exercise 2

Use DHCP configuration on the router to generate DHCP IP addresses for all end devices

```
ip dhcp pool Network1
network 192.168.1.0 255.255.255.0
default-router 192.168.1.1
dns-server 8.8.8.8
```

```
ip dhcp pool Network2
network 10.10.10.0 255.255.255.0
default-router 10.10.10.1
dns-server 8.8.8.8
```

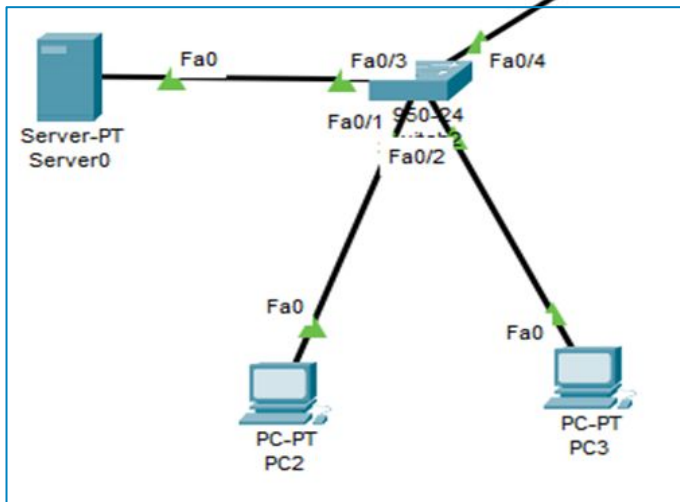
```
interface fa0/1
no shutdown
ip address 192.168.1.1 255.255.255.0
exit
```

```
interface fa0/0
no shutdown
ip address 10.10.10.1 255.255.255.0
exit
```

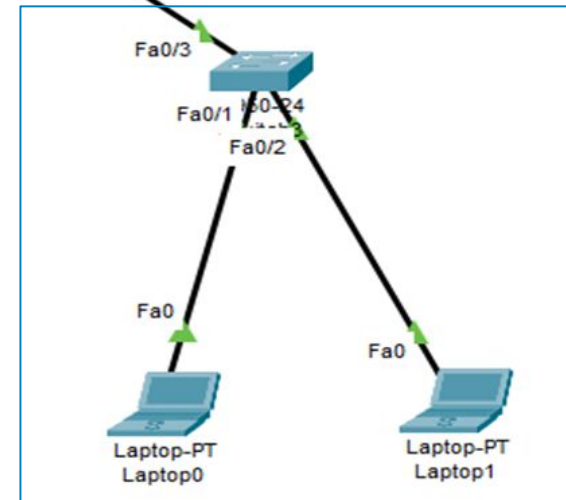
Step 1

Step 2

Network2: 10.10.10.0



Network1: 192.168.1.0





## Exercise 3

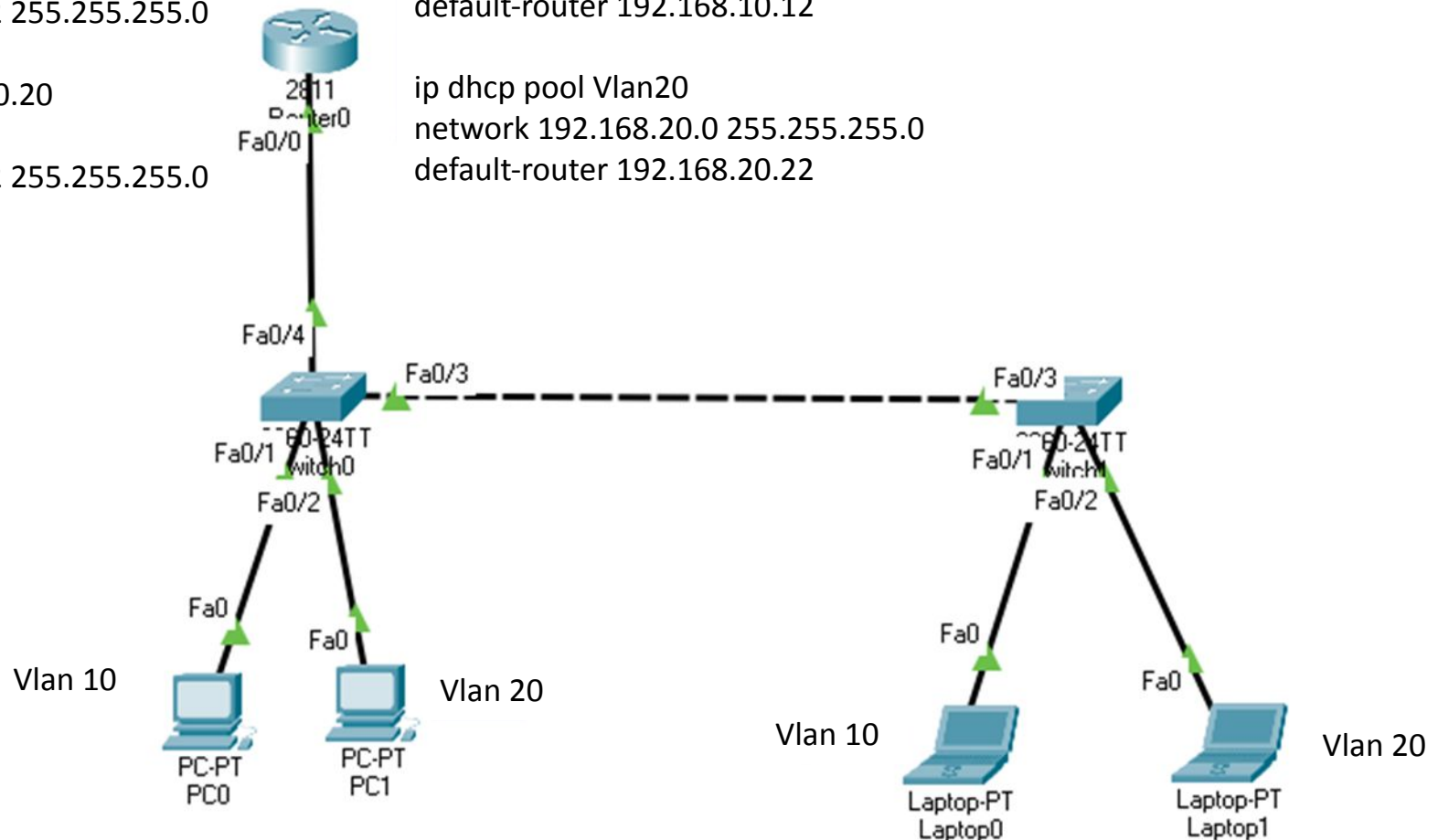
**Use DHCP configuration on the router to generate DHCP IP addresses for all end devices in two VLANs**

```
interface FastEthernet0/0.10
encapsulation dot1Q 10
ip address 192.168.10.12 255.255.255.0
```

```
interface FastEthernet0/0.20
encapsulation dot1Q 20
ip address 192.168.20.22 255.255.255.0
```

```
ip dhcp pool Vlan10
network 192.168.10.0 255.255.255.0
default-router 192.168.10.12
```

```
ip dhcp pool Vlan20
network 192.168.20.0 255.255.255.0
default-router 192.168.20.22
```



## Exercise 4

### Use DHCP configuration on the Server-PT to generate DHCP IP addresses for all end devices

DHCP Server  
\*\*\*\*\*

IP address 192.168.1.2  
Subnet 255.255.255.0  
Default Gateway 192.168.1.1

Service Tab  
\*\*\*\*\*

Select **DHCP** from the menu. Click on Service radio button.

1. Create pool name networkOne  
Gateway: 192.168.1.1  
DNS server: 192.168.1.2  
Change start IP to 192.168.1.5  
Change max user to 50  
Click Add

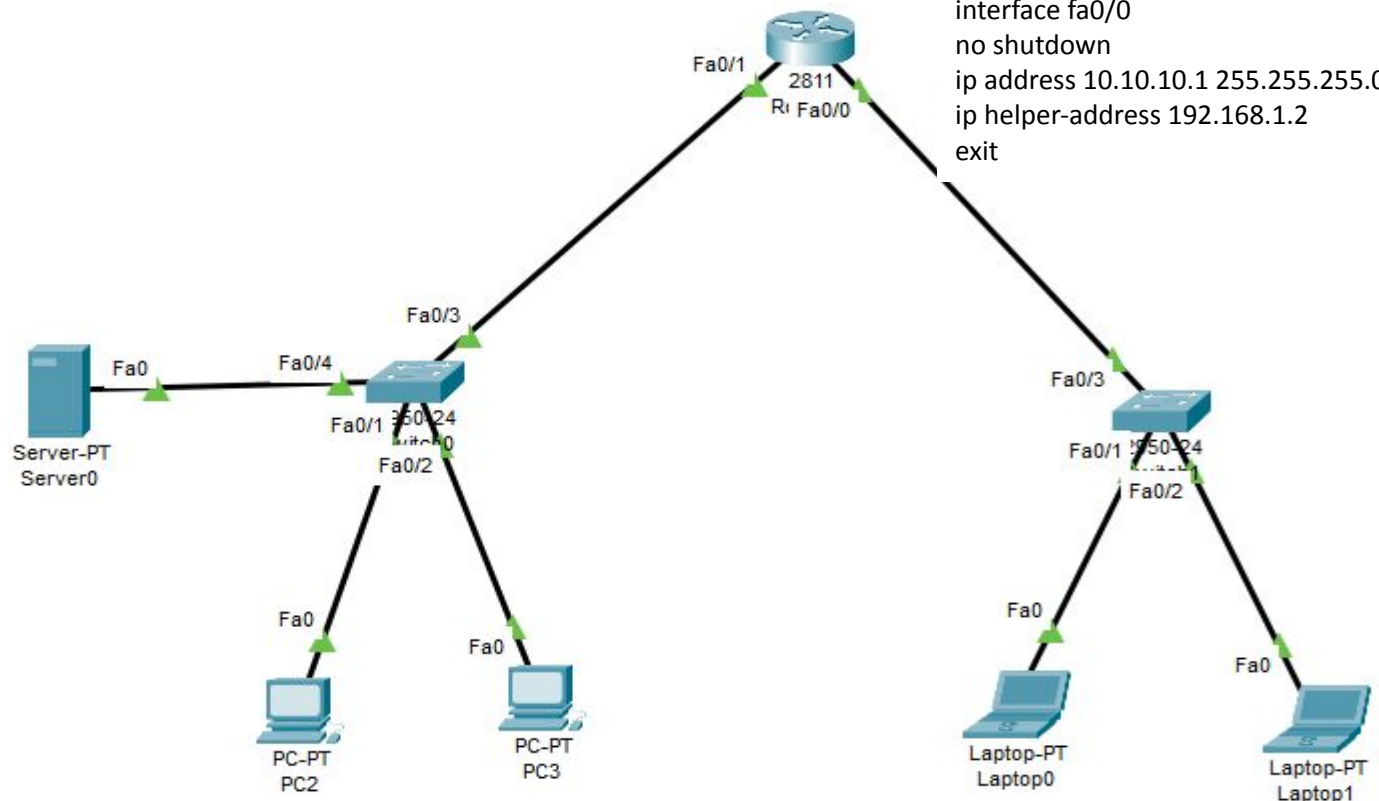
2. Create pool name networkTwo  
Gateway: 10.10.10.1  
DNS server: 192.168.1.2  
Change start IP to 10.10.10.5  
Change max user to 50  
Click Add

Select DNS option from left menu.  
Click **on** DNS Service radio button.  
Set Name to www.myweb.com.  
Set the address to 192.168.1.2.  
Click Save button.

No VLANS

interface fa0/1  
no shutdown  
ip address 192.168.1.1 255.255.255.0  
ip helper-address 192.168.1.2  
exit

interface fa0/0  
no shutdown  
ip address 10.10.10.1 255.255.255.0  
ip helper-address 192.168.1.2  
exit







## Exercise 5

Use DHCP configuration on the router to generate DHCP IP addresses for all end devices

