Computer Networks-Lab 04

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CL30001 – Computer Networks-Lab

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Computer Networks Lab 04

Objective

The objective of this lab is to provide students with a comprehensive understanding of IPv4 addresses, IP addressing in network devices, and static routing. Through practical simulations using Packet Tracer, students will gain hands-on experience in configuring IP addresses, subnet masks, and static routing on network devices such as routers, switches, and laptops.

Learning Outcomes

By the end of this lab, students will be able to:

- Understand the structure and types of IPv4 addresses, including the concept of classes.
- Configure IPv4 addresses on network devices (routers, switches, and laptops) in Packet Tracer.
- Implement static routing on routers to establish network connectivity.
- Simulate various network topologies in Packet Tracer to enhance comprehension of IP addressing in network devices.
- Analyze and troubleshoot network connectivity issues using different network topologies and IP addressing configurations.

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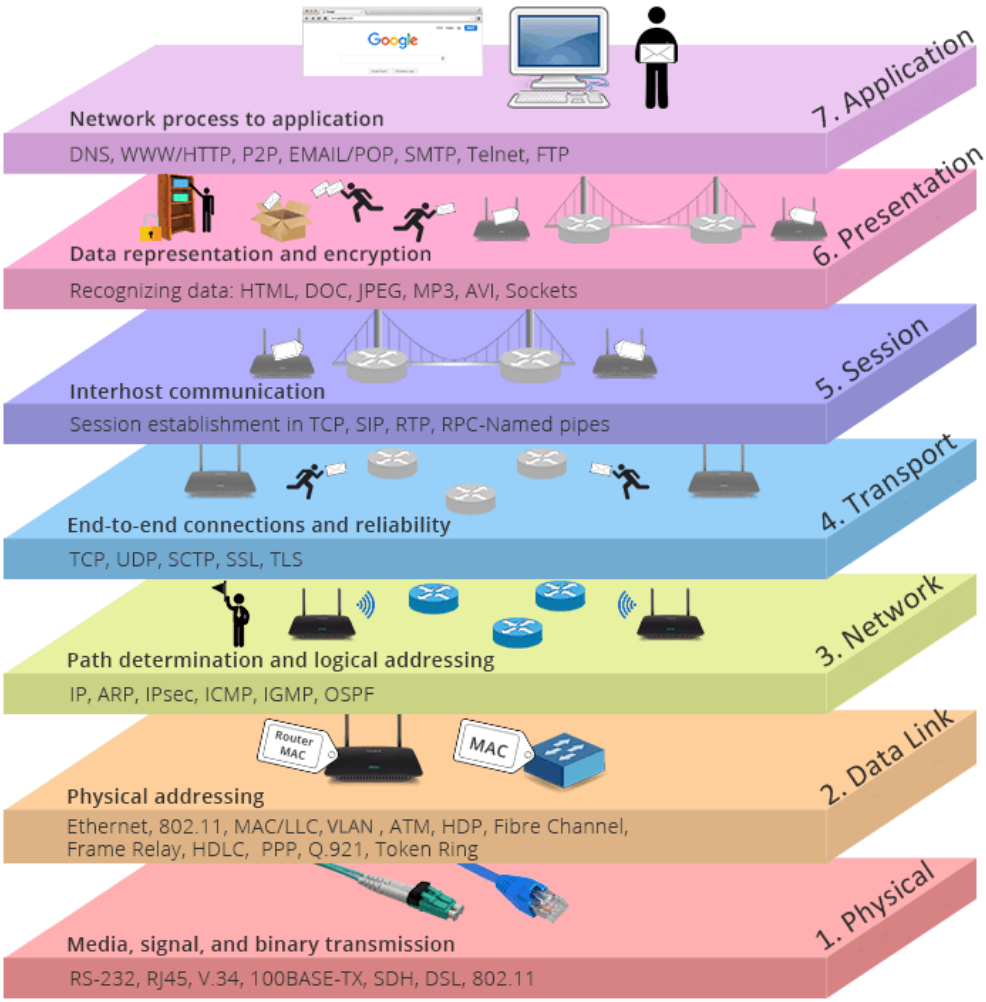
OSI Model



Protocols of Application Layer

The application layer provides several protocols which allow any software to easily send and receive information and present meaningful data to its users. The following are some of the protocols which are provided by the application layer.

TELNET: Telnet stands for Telecommunications Network. This protocol is used for managing files over the Internet. It allows the Telnet clients to access the resources of Telnet server. Telnet uses port number 23.

DNS: DNS stands for Domain Name System. The DNS service translates the domain name (selected by user) into the corresponding IP address. For example- If you choose the domain name as www.abcd.com, then DNS must translate it as 192.36.20.8 (random IP address written just for understanding purposes). DNS protocol uses the port number 53.

DHCP: DHCP stands for Dynamic Host Configuration Protocol. It provides IP addresses to hosts. Whenever a host tries to register for an IP address with the DHCP server, DHCP server provides lots of information to the corresponding host. DHCP uses port numbers 67 and 68.

FTP: FTP stands for File Transfer Protocol. This protocol helps to transfer different files from one device to another. FTP promotes sharing of files via remote computer devices with reliable, efficient data transfer. FTP uses port number 20 for data access and port number 21 for data control.

SMTP: SMTP stands for Simple Mail Transfer Protocol. It is used to transfer electronic mail from one user to another user. SMTP is used by end users to send emails with ease. SMTP uses port numbers 25 and 587.

HTTP: HTTP stands for Hyper Text Transfer Protocol. It is the foundation of the World Wide Web (WWW). HTTP works on the client server model. This protocol is used for transmitting hypermedia documents like HTML. This protocol was designed particularly for the communications between the web browsers and web servers, but this protocol can also be used for several other purposes. HTTP is a stateless protocol (network protocol in which a client sends requests to server and server responses back as per the given state), which means the server is not responsible for maintaining the previous client's requests. HTTP uses port number 80.

NFS: NFS stands for Network File System. This protocol allows remote hosts to mount files over a network and interact with those file systems as though they are mounted locally. NFS uses the port number 2049.

SNMP: SNMP stands for Simple Network Management Protocol. This protocol gathers data by polling the devices from the network to the management station at fixed or random intervals, requiring them to disclose certain information. SNMP uses port numbers 161 (TCP) and 162 (UDP).

Server

A server is a computer program or device that provides a service to another computer program and its user, also known as the client. In a data center, the physical computer that a server program runs on is also frequently referred to as a server. That machine might be a dedicated server or it might be used for other purposes.

Types of servers: Servers are often categorized in terms of their purpose. A few examples of the types of servers available are as follows:

Web server: a computer program that serves requested HTML pages or files. In this case, a web browser acts as the client.

Application server: a program in a computer in a distributed network that provides the business logic for an application program.

Proxy server: software that acts as an intermediary between an endpoint device, such as a computer, and another server from which a user or client is requesting a service.

Mail server: an application that receives incoming emails from local users -- people within the same domain -- and remote senders and forwards outgoing emails for delivery.

Virtual server: a program running on a shared server that is configured in such a way that it seems to each user that they have complete control of a server.

Blade server: a server chassis housing multiple thin, modular electronic circuit boards, known as server blades. Each blade is a server in its own right, often dedicated to a single application

File server: a computer responsible for the central storage and management of data files so that other computers on the same network can access them.

Policy server: a security component of a policy-based network that provides authorization services and facilitates tracking and control of files.

Database server: this server is responsible for hosting one or more databases. Client applications perform database queries that retrieve data from or write data to the database that is hosted on the server.

Print server: this server provides users with access to one or more network-attached printers -- or print devices as some server vendors call them. The print server acts as a queue for the print jobs that users submit. Some print servers can prioritize the jobs in the print queue based on the job type or on who submitted the print job.

Server components

Hardware

Servers are made up of several different components and subcomponents. At the hardware level, servers are typically made up of a rack mount chassis containing a power supply, a system board, one or more CPUs, memory, storage, a network interface and a power supply.

Most server hardware supports out-of-band management through a dedicated network port. Out-of-band management enables low-level management and monitoring of the server, independently of the operating system. Out-of-band management systems can be used to remotely power the server on or off, to install an operating system, and to perform health monitoring.

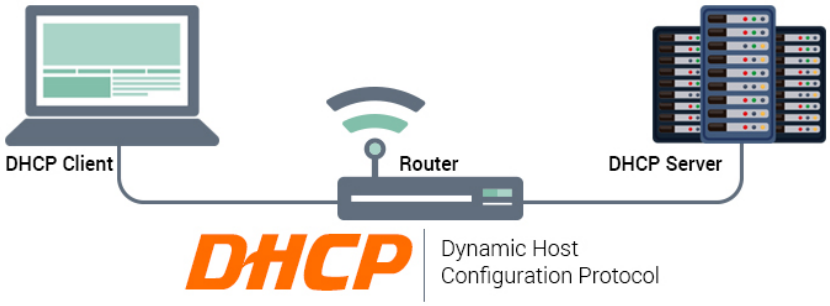
Operating systems

Another component is the server operating system. A server operating system, such as Windows Server or Linux, acts as the platform that enables applications to run. The operating system provides applications access to the hardware resources that they need and enables network connectivity.

The application is what enables the server to do its job. For example, a database server would run a database application. Likewise, an email server would need to run a mail application.

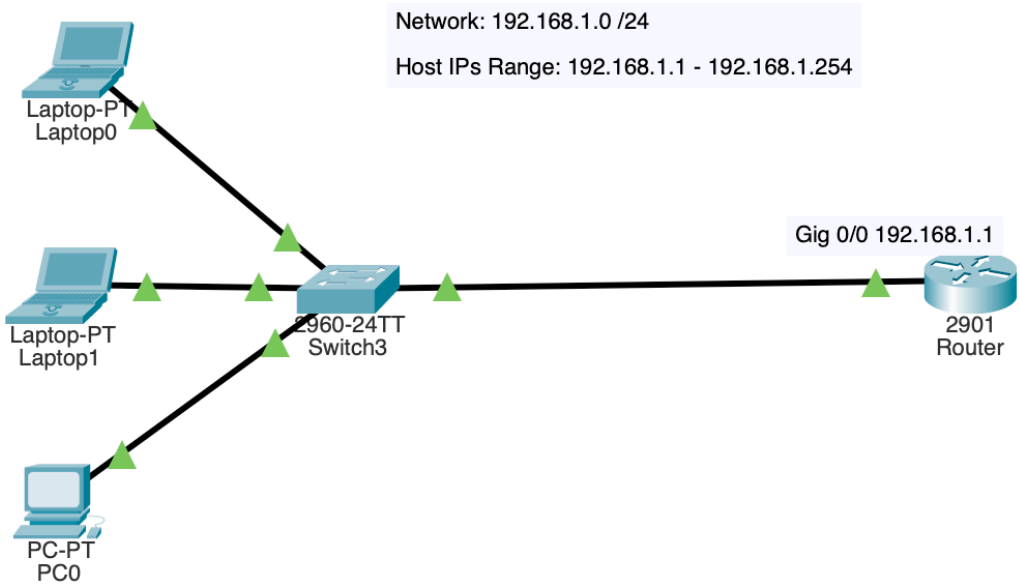
DHCP Server

DHCP **(Dynamic Host Configuration Protocol)** Server allots the IP addresses to computers, while DNS server resolves them. You need DHCP Server if you do not want to manually maintain IP Addresses or you have less IP Addresses than number of machines you have, as dynamic DHCP Server will recycle IP Addresses on machines. DHCP Features support Static and Dynamic 125 DHCP Ranges, Range Filters, Relay Agents and BOOT, Options can be specified for DHCP Ranges, Global or for Static Hosts.



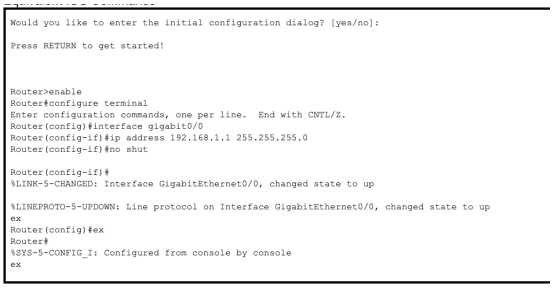
Configuring DHCP server on a Router

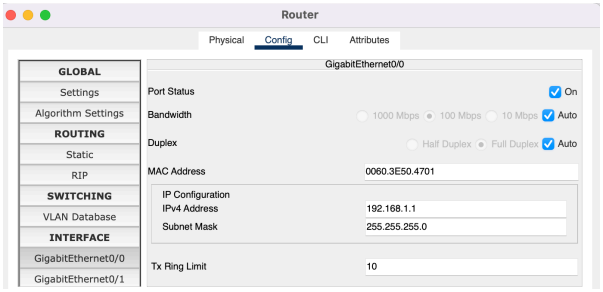
Build the network topology:



On the router, configure interface fa0/0 to act as the default gateway for our LAN.

```
Router>enable

Router# configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

Router(config)#interface GigabitEthernet0/0

Router(config-if)#ip address 192.168.1.1 255.255.255.0

Router(config-if)#no shutdown
```





Configure DHCP server on the Router. In the server we will define a DHCP pool of IP addresses to be assigned to hosts, a Default gateway for the LAN and a DNS Server.

```
Router(config-if)#ex

Router(config)#ip dhcp pool P1

Router(dhcp-config)#network 192.168.1.0 255.255.255.0

Router(dhcp-config)#default-router 192.168.1.1

Router(dhcp-config)#dns-server 192.168.1.2

Router(dhcp-config)#ex
```

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# ip dhcp pool P1
Router(dhcp-config)#network 192.168.1.0 255.255.255.0
Router(dhcp-config)#default-router 192.168.1.1
Router(dhcp-config)#dns-server 192.168.1.2
Router(dhcp-config)#exit
Router(config)#
```

We can add ip dhcp excluded-address command to our configuration so as to configure the router to exclude addresses 192.168.1.1 through 192.168.1.10 when assigning addresses to clients. The **ip dhcp excluded-address** command may be used to reserve addresses that are statically assigned to key hosts.

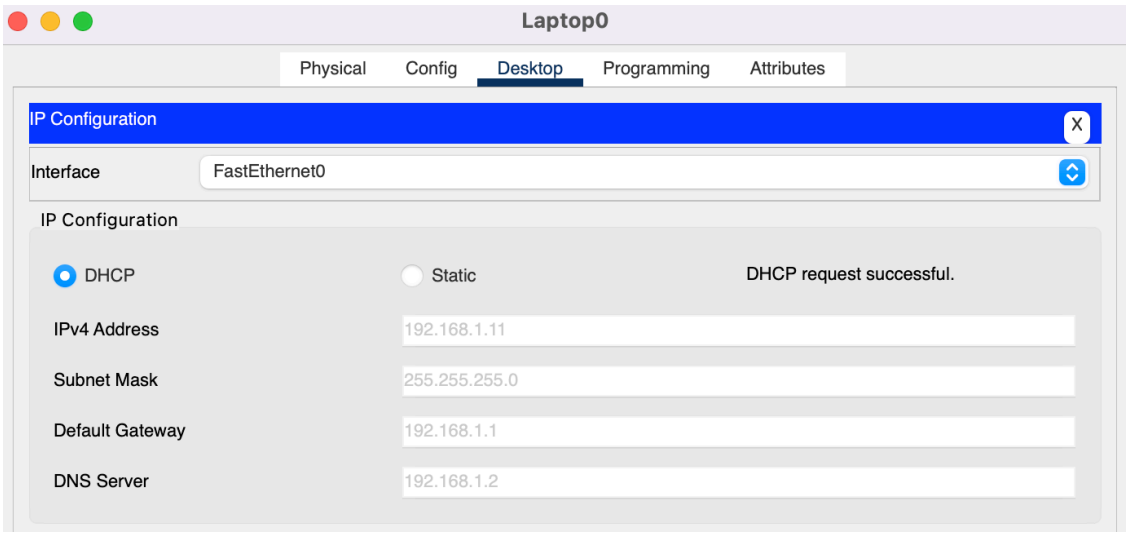
So add the above command under the **global configuration mode.**

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

Now go to every PC and on their IP configuration tabs, enable DHCP. Every PC should be able to obtain an IP address, default gateway and DNS server, as defined in step 2.

For example, to enable DHCP on PC1:

Click PC1->Desktop->IP configuration. Then enable DHCP:



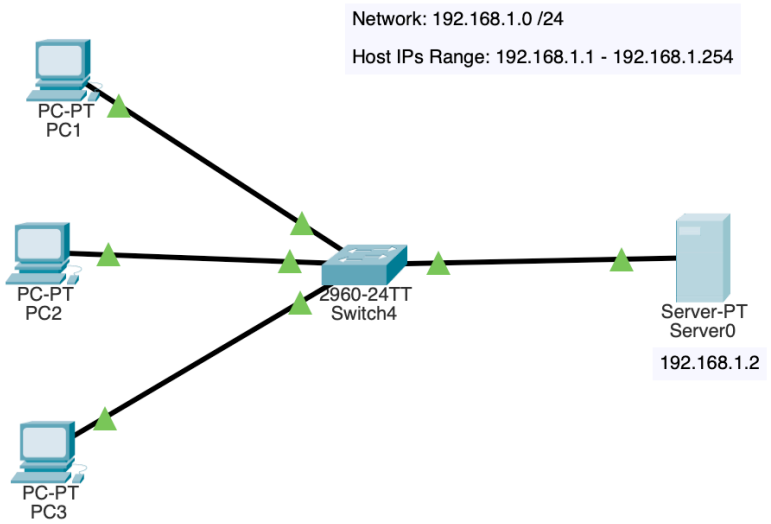
Do this for the other PCs.

You can test the configuration by pinging PC2 from PC1. Ping should succeed.

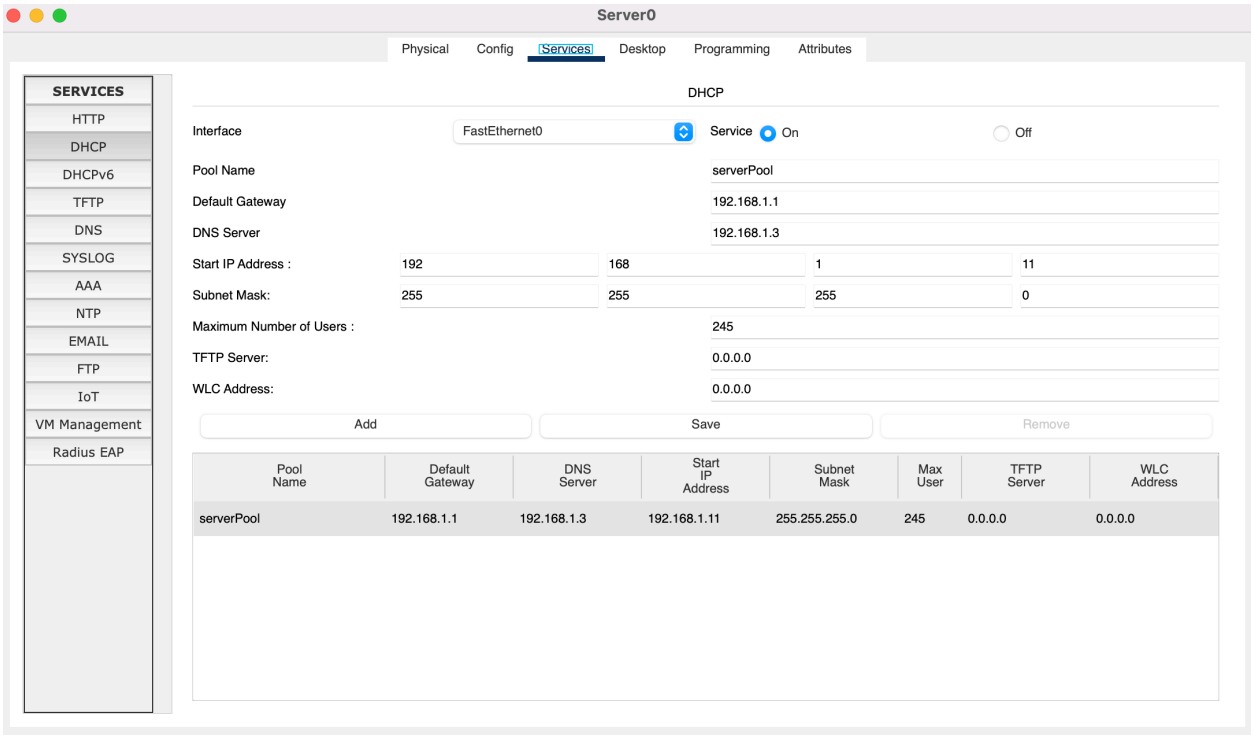
It's that simple!

Now let's do the same thing using a Generic server in place of a router:

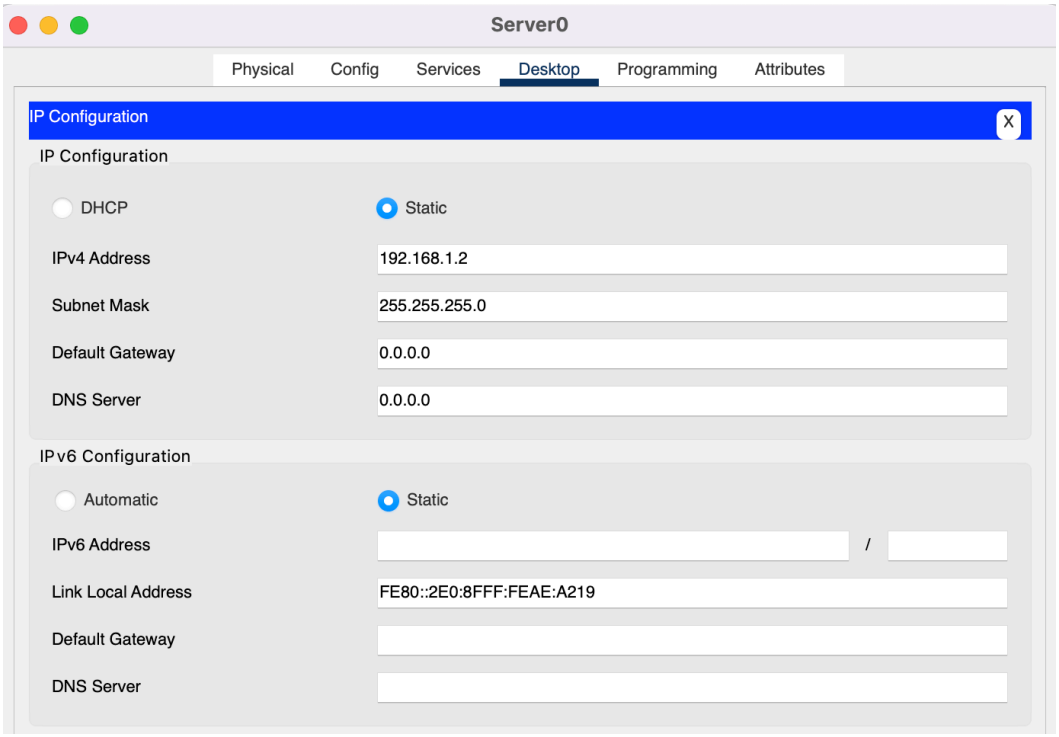
Configuring DHCP server on a Generic server



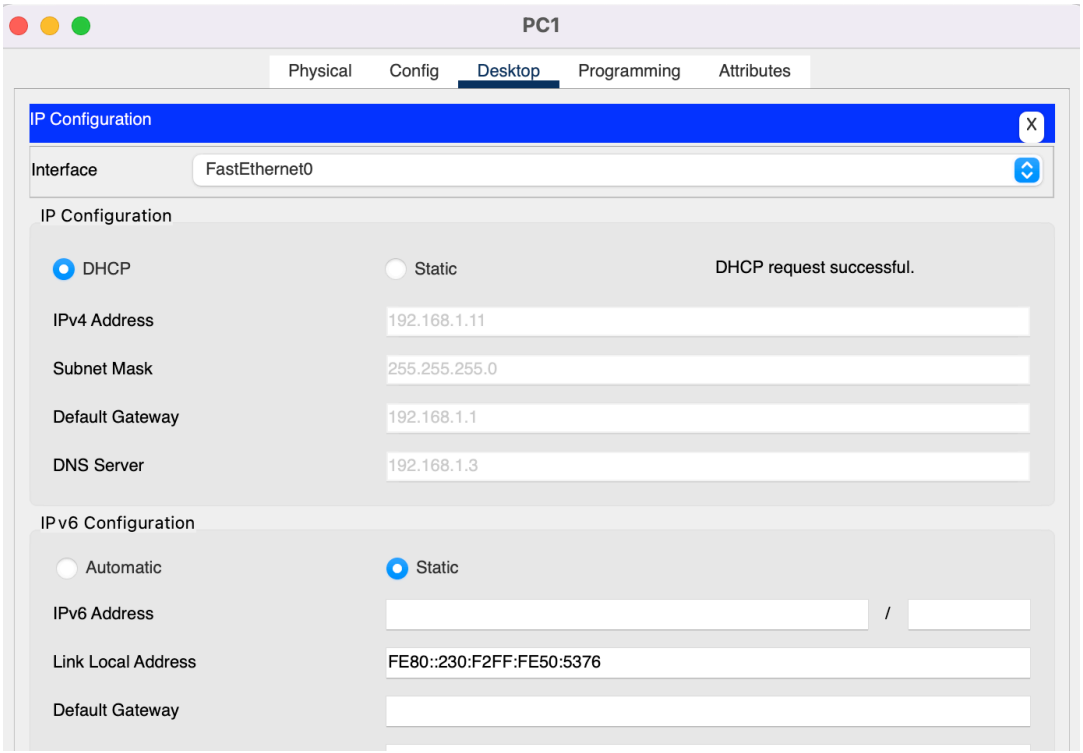
1. Configure static IP address on the server (192.168.1.2/24).
2. Now configure DHCP service on the generic server.
3. To do this, click on the server, then click on Services tab. You will pick DHCP on the menu. Then proceed to define the DHCP network parameters as follows:
    - Pool name: serverPool
    - Default Gateway: 192.168.1.1
    - DNS Server: 192.168.1.3
    - Start IP Address: 192.168.1.11
    - Subnet Mask: 255.255.255.0
    - Maximum Number of users: 245



Assign the Ip Address to DHCP



Now go to each PC and on their IP configuration tabs, enable DHCP. Every PC should be able to obtain an IP address, default gateway and DNS server, as defined in step 2. For example, to enable DHCP on PC1: **Click PC1->Desktop->IP configuration. Then enable DHCP:**



Do this for the other PCs.

You can test the configuration by pinging PC2 from PC1. Ping should succeed.

IP Helper-Addresses

The ip helper-address command is generally used to configure a DHCP Relay Agent on a Layer 3 interface on a Cisco IOS device. Broadcast messages are not forwarded from one subnet to another by a router. In order for DHCP clients on each subnet to receive their IP configuration via DHCP, we would need to deploy a DHCP server on each subnet. This could quickly become expensive and cumbersome to manage as the number of subnets grows.

A more scalable solution would be to deploy a single DHCP server to serve clients on all the subnets - as long as we have some way of forwarding all the broadcast DHCP messages from all the different subnets to this single DHCP server.

Problem

You want to configure your router to pass DHCP requests from local clients to a centralized DHCP server.

Solution

The *ip helper-address* configuration command allows the router to forward local DHCP requests to one or more centralized DHCP servers:

```
Router1#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router1(config)#interface Ethernet0
Router1(config-if)#ip helper-address 172.25.1.1
Router1(config-if)#ip helper-address 172.25.10.7
Router1(config-if)#exit
Router1(config)#end
Router1#
```

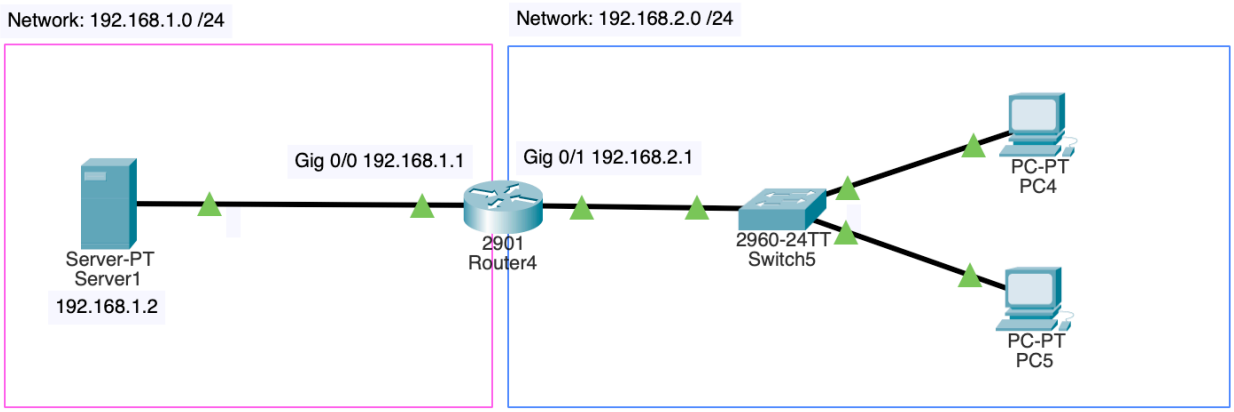
The traditional role of routers in DHCP has been simply to act as a proxy device, forwarding information between the client and server. Since IOS level 12.0(1)T, Cisco routers also have DHCP server and client features. But the DHCP proxy function is still the most common for routers.

Because the initial DHCP request comes from a client that typically doesn't have an IP address, it must find the server using a Layer 2 broadcast. So, if the router was not able to function as a proxy for these broadcasts, it would be necessary to put a DHCP server on every network segment.

The DHCP server needs two critical pieces of information before it can allocate an IP address to the client. It must know the subnet that the client is connected to, and it needs the client device's MAC address. The subnet information is needed to ensure that the address that the server allocates will actually work on client's network segment. And the MAC ...

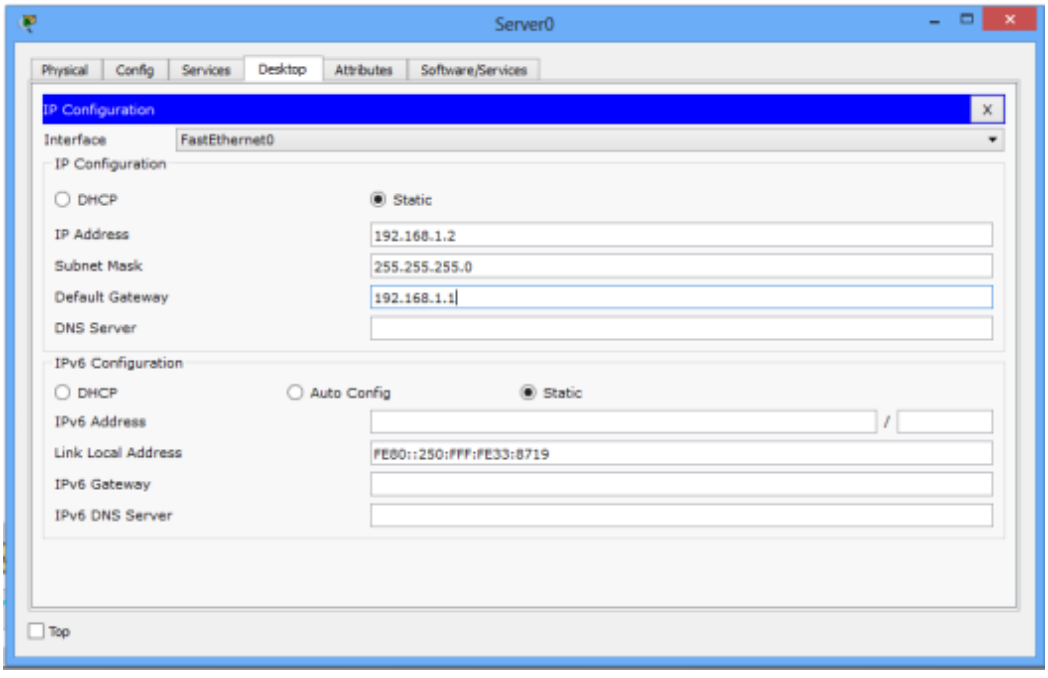
Configuring an IP helper address

Create the following topology:



Assign a static IP address to the server.

Server: IP address: 192.168.1.2 **Subnet mask:** 255.255.255.0 **Default gateway**: 192.168.1.1



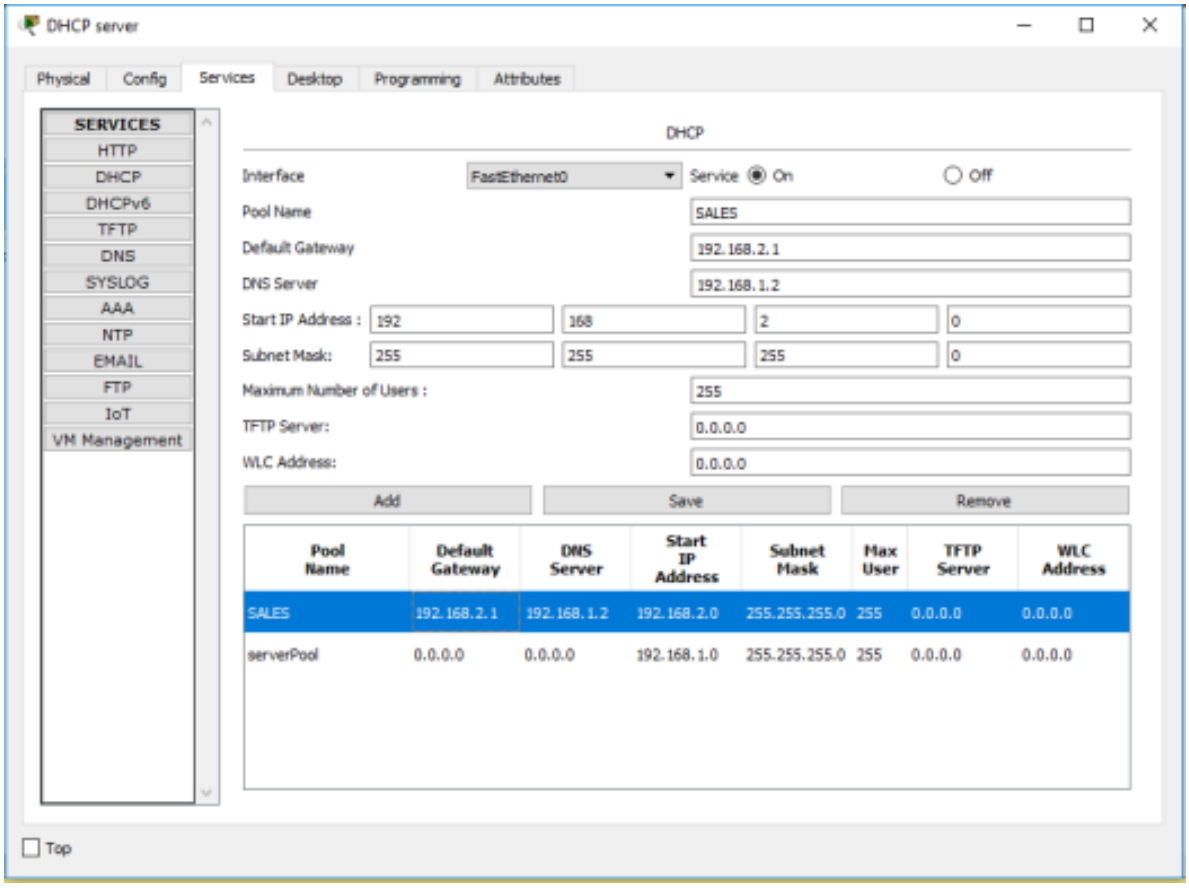
Router interface configurations

```
Router2(config)#interface fa 0/0
Router2(config-if)#ip address 192.168.2.1 255.255.255.0
Router2(config-if)#no shutdown
Router2(config-if)#
Router2(config-if)#interface fa 0/1
Router2(config-if)#ip add 192.168.1.1 255.255.255.0
Router2(config-if)#no shutdown
```

Click on **DHCP Server->Services->DHCP.**

Turn **ON** the DHCP service on the server. We'll configure DHCP server pool named **SALES** on the generic server (Located on the network 192.168.1.0/24). This pool will provide IP addresses to hosts in **SALES LAN** (Network 192.168.2.0/24). Here we go:

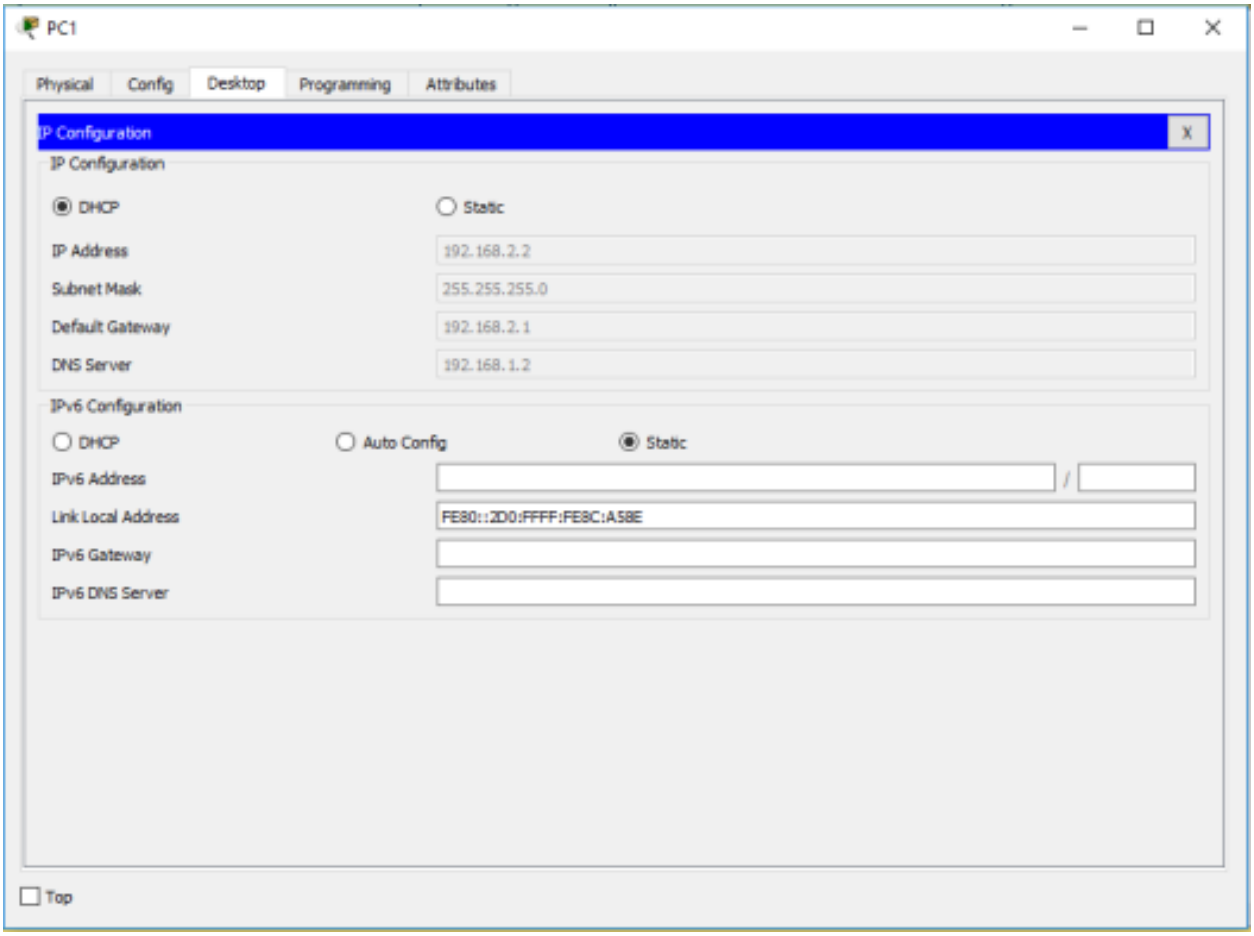
Pool Name: SALES **Default Gateway:** 192.168.2.0 **DNS server:** 192.168.1.2 **Start IP address:** 192.168.2.0 **Subnet Mask:** 255.255.255.0 **Maximum no. of Users:** 255



Add the command *ip helper-address 192.168.1.2* on the interface configuration mode of fa 0/0 of **Router 2,** just as we've done before.

```
Router2(config)#interface fa0/0
Router2(config-if)#ip helper-address 192.168.1.2
```

Lastly enable DHCP on the PCs in SALES LAN. The PCs will obtain their address from the DHCP server.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Lab Task 04

Task 1: Configure DHCP server on a Router

Task 2: Configure DHCP server on a Generic server

Task 3 : Configure static path and centralized DHCP server