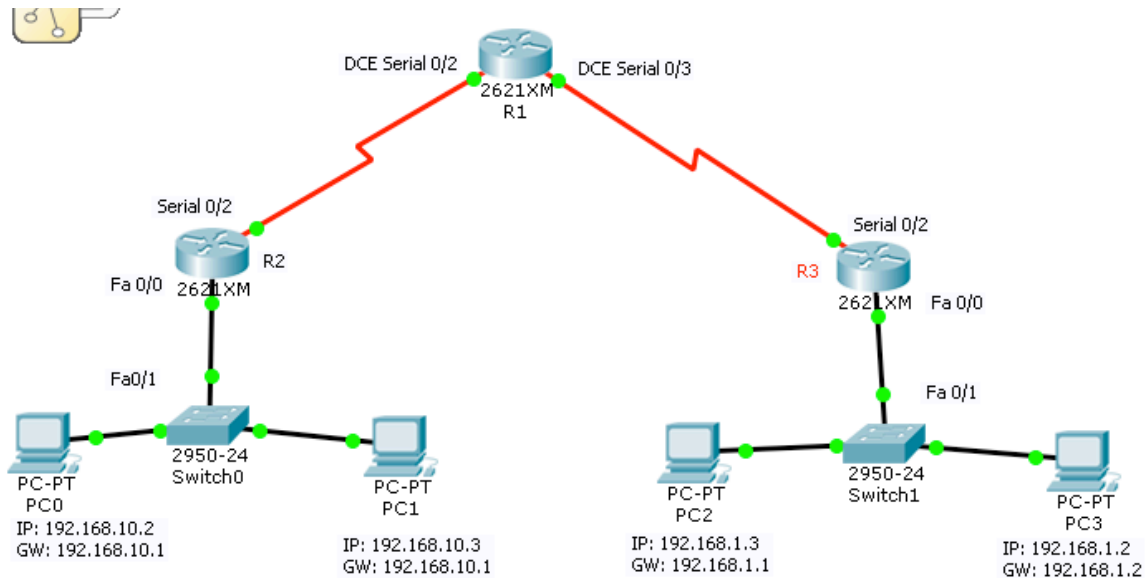


1. Configure OSPF Routing Protocol



Configuration of OSPF routing protocol is easy as RIP Routing. The Open Shortest Path First (OSPF) is a routing protocol for wide area networks and enterprise network. OSPF is perhaps the most widely used interior gateway protocol (IGP) in large enterprise networks. The most widely used exterior gateway protocol is the Border Gateway Protocol (BGP), the principal routing protocol between autonomous systems on the Internet.

Router 1

R1>enable

R1#configure terminal

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

Router(config)#hostname R1

R1(config)#interface serial 0/3

R1(config-if)#ip address 10.10.10.1 255.255.255.252

R1(config-if)#clock rate 64000

R1(config-if)#no shutdown

R1(config-if)#exit

R1(config)#

R1(config)#interface serial 0/2

Prepared by Sanoop Mallissery

```
R1(config-if)#ip address 10.10.10.5 255.255.255.252  
R1(config-if)#clock rate 64000  
R1(config-if)#no shutdown
```

Router 2

```
Router#enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#hostname R2  
R2(config)#interface serial 0/2  
R2(config-if)#ip address 10.10.10.6 255.255.255.252  
R2(config-if)#no shutdown  
R2(config-if)#exit  
R2(config)#interface fastEthernet 0/0  
R2(config-if)#ip address 192.168.10.1 255.255.255.0  
R2(config-if)#no shutdown
```

Router 3

```
Router#enable  
Router#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
Router(config)#hostname R3  
R3(config)#interface serial 0/2  
R3(config-if)#ip address 10.10.10.2 255.255.255.252  
R3(config-if)#no shutdown  
R3(config-if)#exit  
R3(config)#interface fastEthernet 0/0  
R3(config-if)#ip address 192.168.1.1 255.255.255.0  
R3(config-if)#no shutdown
```

Configure OSPF Routing Protocol

```
R1>enable  
R1#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
R1(config)#router ospf 1
```

Prepared by Sanoop Mallissery

```
R1(config-router)#network 10.10.10.0 0.0.0.3 area 0  
R1(config-router)#network 10.10.10.4 0.0.0.3 area 0  
R1(config-router)#
```

The router OSPF command is enable OSPF routing on the router, and the 1 before OSPF is the process ID of the OSPF Protocol. You can set different process id from “1-65535” for each router.

The network command with network ID “network 20.10.10.0” is the network identifier, and the “0.0.0.3” is the wildcard mask of 20.10.10.0 network. Wildcard mask determine which interfaces to advertise, because OSPF advertise interfaces, not networks

```
R2>enable  
R2#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
R2(config)#router ospf 1  
R2(config-router)#network 192.168.10.0 0.0.0.255 area 0  
R2(config-router)#network 10.10.10.4 0.0.0.3 area 0
```

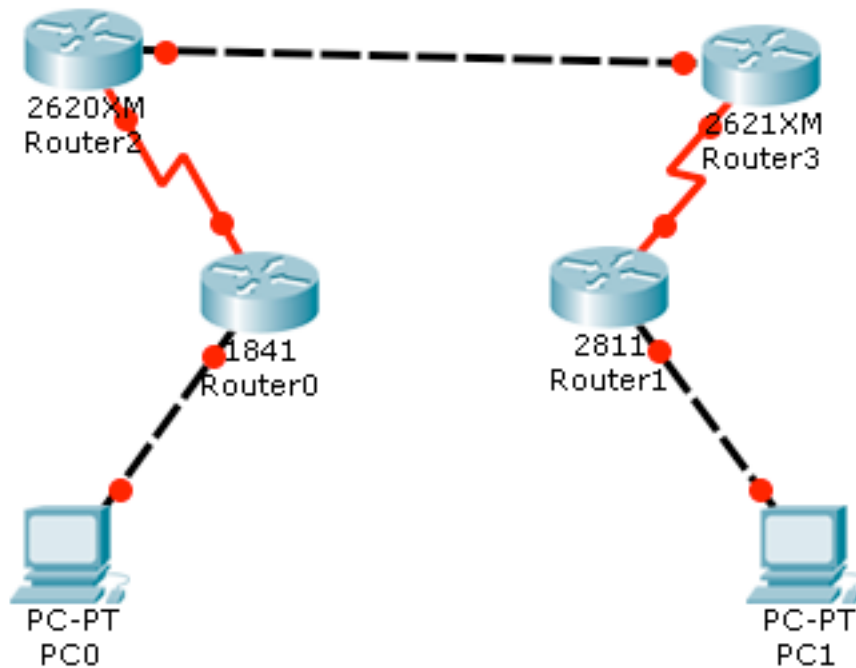
```
R3>enable  
R3#configure terminal  
Enter configuration commands, one per line. End with CNTL/Z.  
R3(config)#router ospf 1  
R3(config-router)#network 192.168.1.0 0.0.0.255 area 0  
R3(config-router)#network 10.10.10.0 0.0.0.3 area 0
```

OSPF routing configuration has been finished successfully, now test your network whether they can ping with each other or not.

Various Commands

Commands	Descriptions
Router(config)#router ospf 1	Starts OSPF process 1. The process ID is any positive integer value between 1 and 65,535.
Router(config-router)#network 172.16.0.0 0.0.255.255 area 0	OSPF advertises interfaces, not networks. Uses the wildcard mask to determine which interfaces to advertise.
Router(config-if)#ip ospf hellointerval timer 20	Changes the Hello Interval timer to 20 seconds.
Router(config-if)#ip ospf deadinterval 80	Changes the Dead Interval timer to 80 seconds.
NOTE: Hello and Dead Interval timers must match for routers to become neighbors	
Router#show ip protocol	Displays parameters for all protocols running on the router
Router#show ip route	Displays a complete IP routing table
Router#show ip ospf	Displays basic information about OSPF routing processes
Router#show ip ospf interface	Displays OSPF info as it relates to all interfaces
Router#show ip ospf interface fastethernet 0/0	Displays OSPF information for interface fastethernet 0/0
Router#show ip ospf border-routers	Displays border and boundary router information
Router#show ip ospf neighbor	Lists all OSPF neighbors and their states
Router#show ip ospf neighbor detail	Displays a detailed list of neighbors
Router#clear ip route *	Clears entire routing table, forcing it to rebuild
Router#clear ip route a.b.c.d	Clears specific route to network a.b.c.d
Router#clear ip ospf counters	Resets OSPF counters
Router#clear ip ospf process	Resets entire OSPF process, forcing OSPF to re-create neighbors, database, and routing table
Router#debug ip ospf events	Displays all OSPF events
Router#debug ip ospf adjacency	Displays various OSPF states and DR/ BDR election between adjacent routers
Router#debug ip ospf packets	Displays OPSF packets

2. Configure OSPF Routing Protocol



3. Configure DHCP on a Router

DHCP stands for Dynamic Host Configuration Protocol, as the name indicates it dynamically controls the hosts.

DHCP is very common in home networks and in most enterprise networks.

DHCP (Dynamic Host Configuration Protocol) is a networking protocol that permits network administrators centrally manage and automate the assignment of network parameters to a client device like PCs or Laptops.

1. **DHCPDISCOVER**: Server Discovery – Broadcast

In server discovery process, when a computer or other networked device connects to a DHCP network, it starts *trying to discover whether there is any DHCP server available* in the network by sending broadcast to 255.255.255.255 destination address. This is called **DHCPDISCOVER**.

2. **DHCPOFFER**: IP Lease Offer – Unicast

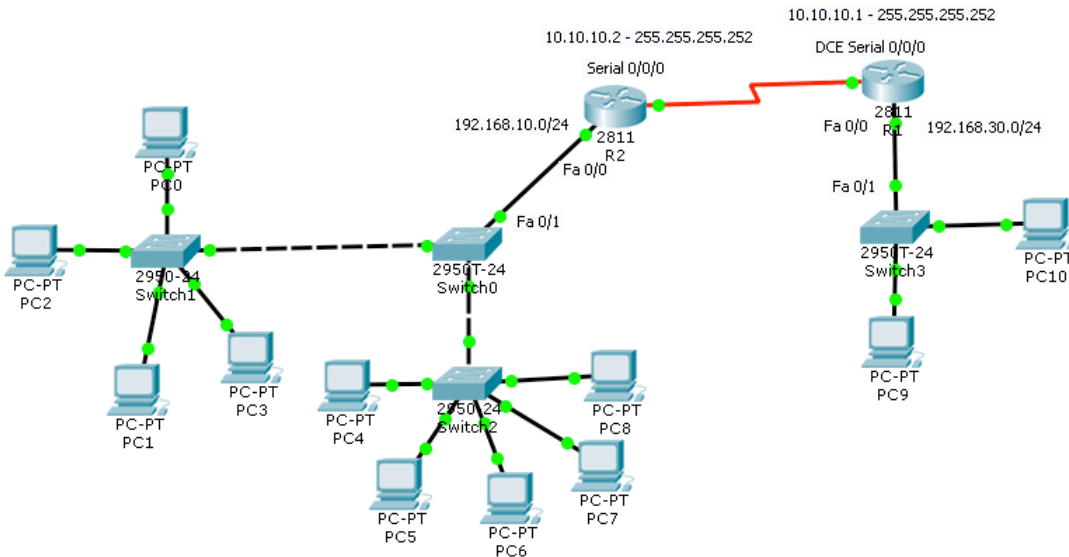
After the DHCP server accepts the DHCPDISCOVER message, it **replies with a DHCPOFFER** message. This could be **Unicast to the MAC address of the client** and those packet includes an IPv4 address lease among the pool of IPs, Subnet mask, Gateway, DNS, lease duration.

3. **DHCPREQUEST**: IP request – Broadcast

Clients take the first offer received from DHCP server by **broadcasting** a DHCP Request packet called **DHCPREQUEST**. This message allowing the server to know that the **client supposed to use the address offered by the server**.

4. **DHCPACK**: IP lease acknowledgment – Unicast

The server directs an acknowledgment (**DHCPACK**) message in **unicast**, confirming that **acceptance** of the allotted **IP** for a specified period of time. It **also used to renew the lease time**.



Configure the Router 1

Router>enable

Router#configure terminal

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

Router(config)#hostname R1

R1(config)#interface serial 0/0/0

R1(config-if)#ip address 10.10.10.1 255.255.255.252

R1(config-if)#no shutdown

R1(config-if)#clock rate 64000

R1(config-if)#

Configure the Router 2

Router>enable

Router#configure terminal

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

Router(config)#hostname R2

R2(config)#interface serial 0/0/0

Prepared by Sanoop Mallissery

```
R2(config-if)#ip address 10.10.10.2 255.255.255.252
R2(config-if)#no shutdown
R2(config-if)#
R2(config)#interface fastEthernet 0/0
R2(config-if)#ip address 192.168.10.1 255.255.255.0
R2(config-if)#no shutdown
```

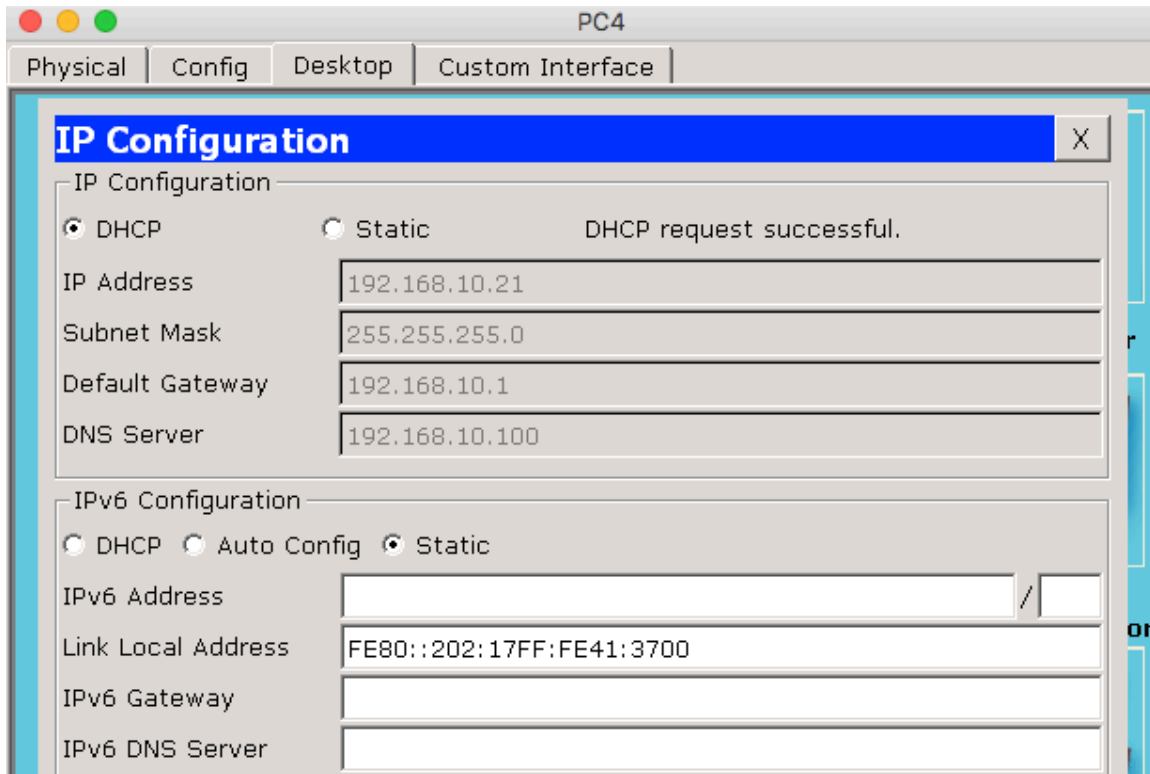
Lets config Router 2 as DHCP Server and set the clients to get there IP addresses from DHCP Server.

In the R2 while you are in the config mode, type the command 'ip dhcp excluded-address 192.168.10.1 192.168.10.20' and then press enter. This command 'ip dhcp excluded-address' will create an exclusive range of IP addresses which reserved for Network Servers and DHCP Server will not assign theme to clients.

The 'ip dhcp pool' command create a pool for a network. You can create many pools on a router for all Local area network that connected to the router.

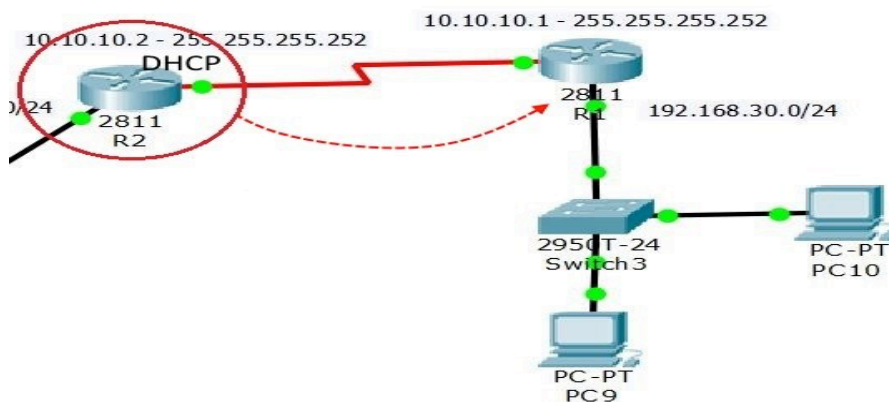
```
R2>enable
R2#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ip dhcp excluded-address 192.168.10.1 192.168.10.20
R2(config)#ip dhcp pool mynetwork (you can give any name)
R2(dhcp-config)#
R2(dhcp-config)#network 192.168.10.0 255.255.255.0
R2(dhcp-config)#default-router 192.168.10.1
R2(dhcp-config)#dns-server 192.168.10.100
R2(dhcp-config)#
```

Now go to client setting and set the IP Configuration to DHCP and see the client get new IP address from DHCP Server.



DHCP Options on Cisco Router

Remember some DHCP options when you need to provide IP addresses from a DHCP server to clients that are outside of your network or are not in the same Local Area Network. You must use the 'ip helper-address' to forward the DHCP client requests to remote host.



Prepared by Sanoop Mallissery

Configure the R1 to relay the DHCP client request. It will not work without routing. So configure Routers with static or dynamic routing. Here I'm testing with RIP.

```
R1>enable
```

```
R1#configure terminal
```

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

```
R1(config)#interface fastEthernet 0/0
```

```
R1(config-if)#ip helper-address 10.10.10.2
```

```
R1(config-if)#exit
```

```
R1(config)#router rip
```

```
R1(config-router)#network 10.10.10.0
```

```
R1(config-router)#network 192.168.30.0
```

```
R1(config-router)#exit
```

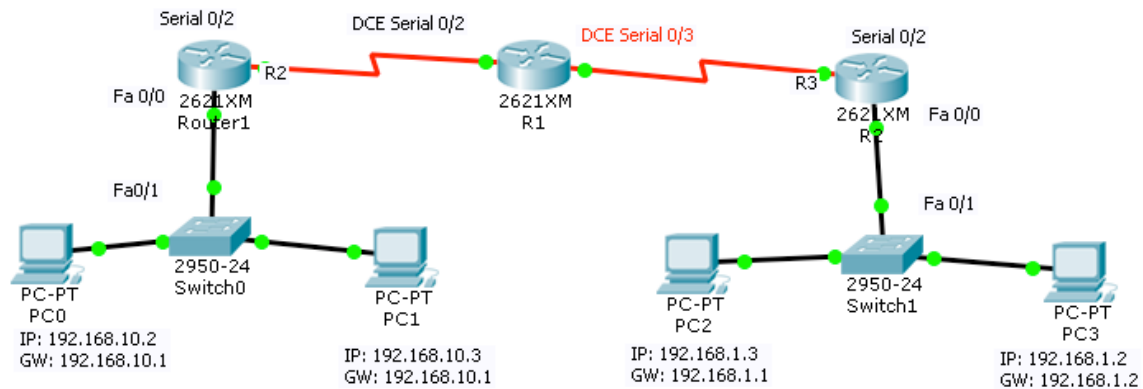
Go to the client IP configuration setting and see the forwarded request by DHCP Server.

The screenshot shows a window titled "PC9" with tabs for "Physical", "Config", "Desktop", and "Custom Interface". The "Config" tab is active, displaying the "IP Configuration" dialog box. The dialog has two sections: "IP Configuration" and "IPv6 Configuration". In the "IP Configuration" section, the "DHCP" radio button is selected, and the "Static" radio button is unselected. The fields for IP Address, Subnet Mask, Default Gateway, and DNS Server are populated with the values 192.168.30.11, 255.255.255.0, 192.168.30.1, and 192.168.10.100 respectively. In the "IPv6 Configuration" section, the "Static" radio button is selected, and the fields for IPv6 Address, Link Local Address, IPv6 Gateway, and IPv6 DNS Server are empty. The Link Local Address field contains the value FE80::201:43FF:FEED:6A2.

IP Configuration	
<input checked="" type="radio"/> DHCP <input type="radio"/> Static	
IP Address	192.168.30.11
Subnet Mask	255.255.255.0
Default Gateway	192.168.30.1
DNS Server	192.168.10.100

IPv6 Configuration	
<input type="radio"/> DHCP <input type="radio"/> Auto Config <input checked="" type="radio"/> Static	
IPv6 Address	
Link Local Address	FE80::201:43FF:FEED:6A2
IPv6 Gateway	
IPv6 DNS Server	

4. Configure DHCP for the following configuration



References

- <http://www.ciscopress.com/articles/article.asp?p=2180208&seqNum=6> (online)
- <http://computernetworkingnotes.com> (online)
- <http://blog.alexwilde.net/cisco-router-basic-network-configuration-ccna-lab-1-1/> (online)
- <http://www.smartpctricks.com/2013/06/basic-cisco-router-configuration-step-by-step-getting-started-with-cisco-networking.html> (online)
- <http://ipcisco.com/router-dhcp-configuration-with-packet-tracer/> (online)
- <http://www.slideshare.net/arzsy91/lab-practice-1-configuring-basic-routing-and-switching-with-answer> (online)
- <https://www.packtpub.com/packtlib/book/Networking-and-Servers/9781782170426/7/ch07lv1sec40/Configuring%20BGP%20in%20Packet%20Tracer> (online)
- <http://networkingtips-tricks.blogspot.in/2010/05/configure-router-with-packet-tracer.html> (online)