Nitte Meenakshi Institute of Technology

(AN AUTONOMOUS INSTITUTION, AFFILIATED TO VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM) , (A Unit of Nitte Education Trust, Mangalore)

PB No. 6429, Yelahanka, Bangalore 560-064, Karnataka

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Department of Computer Science and Engineering

Computer Networks Laboratory

PART-B Programs

Must be simulated using CISCO Packet Tracer

PART-B

1. Study of network IP Experiments
   i. Classification of IP address ii. Sub netting iii. Super netting
2. Configure Static and Dynamic Routing information in the router and test the connectivity between two networks.
3. Configure Network Address Translation (NAT) and test Static NAT, Dynamic NAT and PAT.
4. Configuring a Cisco Router as a DHCP Server to dynamically assign IP addres, subnet mask and default gateway to the hosts in the network.
5. Configure and test DNS and Email server in a network.
6. Configure Wireless router to support mobile devices to connect to the internet.

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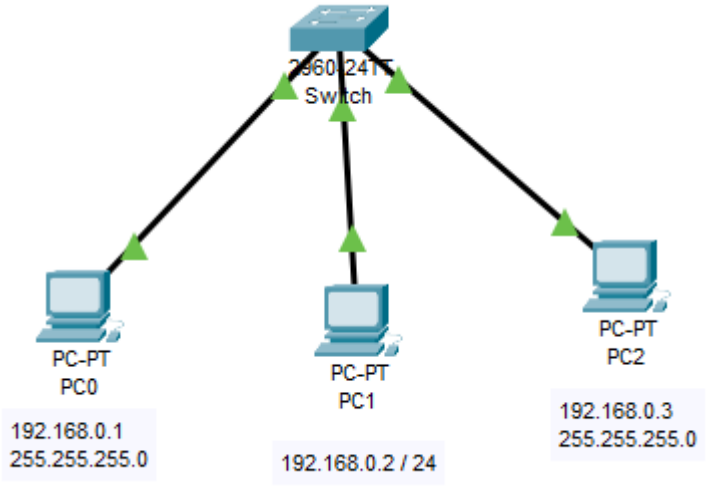
Department of Computer Science and Engineering

1. Study of Networking IP Experiment



a. Demonstration of Class C IP address.

Wired network of 3 systems, All 3 systems have same network ids. The Network id for this network is 192.168.0 and the host id is 1, 2 and 3.

This addresses are class C IP addresses, in which first 3 octet represent network Id (netid) and the 4th octet represents host Id. Out of last octet (8-bit value) 256 IP addresses can be generate out of which first host address 0 is not assigned to any host and IP address with 0 in 4th octet place is used to refer network Id and last addresses are 255 is used as broadcast Id. So effectively 254 Host address are used in Class C addresses.

PC0 command Prompt

C:\>ping 192.168.0.2

Pinging 192.168.0.2 with 32 bytes of data:

Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time=1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128
Reply from 192.168.0.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.0.2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.0.3

Pinging 192.168.0.3 with 32 bytes of data:

Reply from 192.168.0.3: bytes=32 time=1ms TTL=128
Reply from 192.168.0.3: bytes=32 time=3ms TTL=128
Reply from 192.168.0.3: bytes=32 time<1ms TTL=128
Reply from 192.168.0.3: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.0.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 3ms, Average = 1ms

Similarly

1. **Ping from PC1 to PC0 and PC2**
2. **Ping from PC2 to PC0 and PC1**

b. Subnetting

Subnetting allows you to create multiple logical networks that exist within a single Class A, B, or C network. If you do not subnet, you are only able to use one network from your Class A, B, or C network, which is unrealistic.

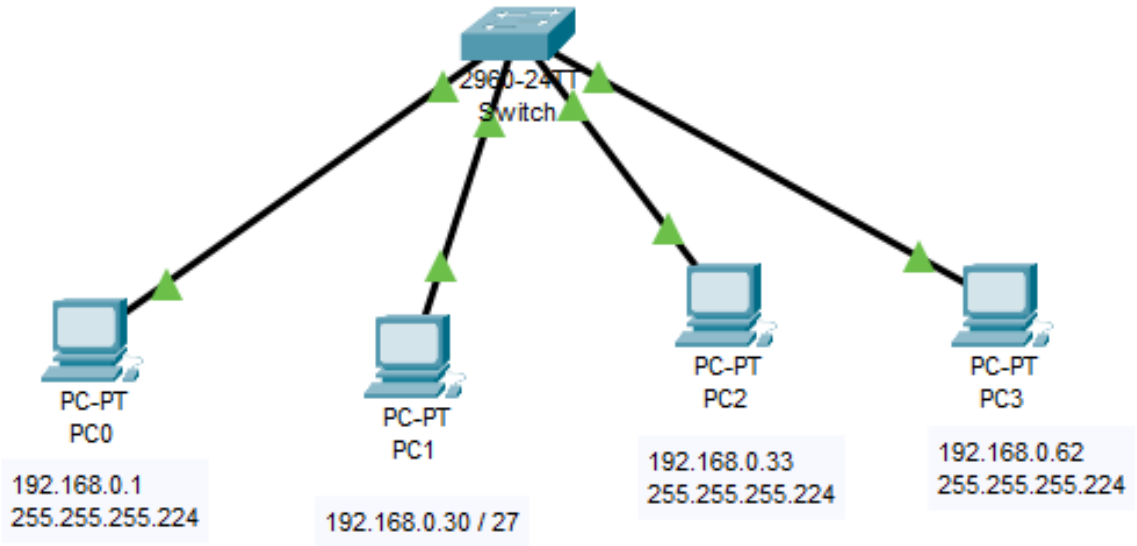
Each data link on a network must have a unique network ID, with every node on that link being a member of the same network. If you break a major network (Class A, B, or C) into smaller subnetworks, it allows you to create a network of interconnecting subnetworks. Each data link on this network would then have a unique network/subnetwork ID. Any device, or gateway, that connects n networks/subnetworks has n distinct IP addresses, one for each network / subnetwork that it interconnects.

In order to subnet a network, extend the natural mask with some of the bits from the host ID portion of the address in order to create a subnetwork ID. For example, given a Class C network of 204.17.5.0 which has a natural mask of 255.255.255.0, you can create subnets in this manner:

```
204.17.5.0 -      11001100.00010001.00000101.00000000
255.255.255.224 - 11111111.11111111.11111111.11100000
                  -------------------------|sub|----
```

By extending the mask to be 255.255.255.224, you have taken three bits (indicated by "sub") from the original host portion of the address and used them to make subnets. With these three bits, it is possible to create eight subnets. With the remaining five host ID bits, each subnet can have up to 32 host addresses (2^5), 30 of which can actually be assigned to a device since host ids of all zeros or all ones are not allowed (it is very important to remember this). So, with this in mind, these subnets have been created.

```
204.17.5.0 255.255.255.224      host address range 1 to 30
204.17.5.32 255.255.255.224     host address range 33 to 62
204.17.5.64 255.255.255.224     host address range 65 to 94
204.17.5.96 255.255.255.224     host address range 97 to 126
204.17.5.128 255.255.255.224    host address range 129 to 158
204.17.5.160 255.255.255.224    host address range 161 to 190
204.17.5.192 255.255.255.224    host address range 193 to 222
204.17.5.224 255.255.255.224    host address range 225 to 254
```



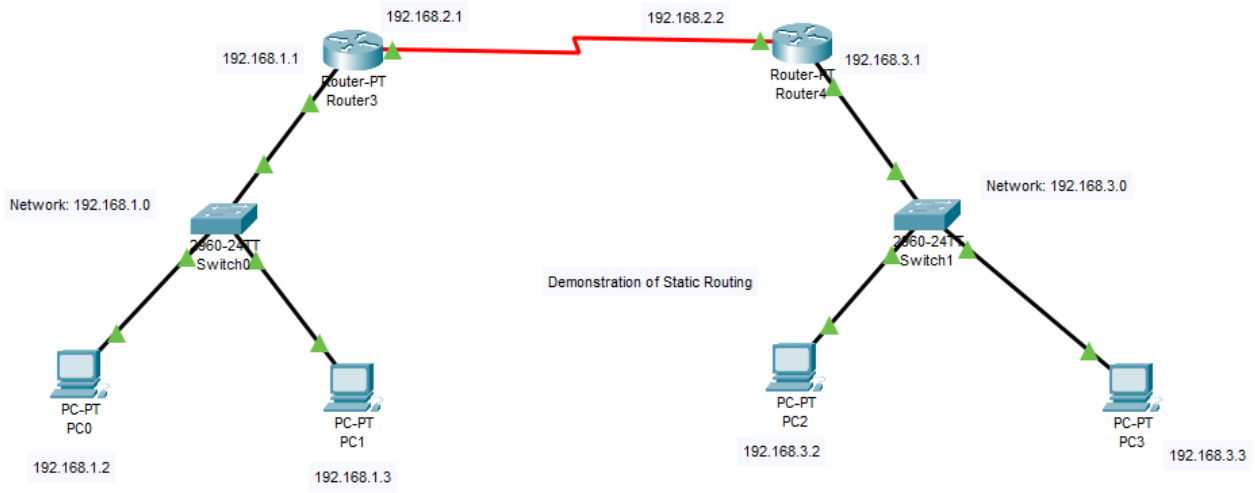
PC0 and PC1 are in one subnet and PC2 and PC3 are another subnet. PC0 can communicate with PC1 and vice versa but not with PC2 and PC3 Similarly PC2 and PC3 can communicate with each other but cannot communicate PC0 and PC1.

2. Configure static and Dynamic Routing Information in the router and test the connectivity between networks.

Static Routing is also known as **non-adaptive** routing which doesn't change routing table unless the network administrator changes or modify them manually. Static routing does not use complex routing algorithms and It provides high or more security than dynamic routing.

Dynamic routing is also known as **adaptive** routing which change routing table according to the change in topology. Dynamic routing uses complex routing algorithms and it does not provide high security like static routing. When the network change(topology) occurs, it sends the message to router to ensure that changes then the routes are recalculated for sending updated routing information.

a. Static Routing Demonstration



On router-3

```
Router>enable
Router#config ter
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int
Router(config)#int fa0/0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
```

```
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#inter se2/0
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial2/0, changed state to down
Router(config-if)#clock rate 64000
Router(config-if)#exit
Router(config)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

Router(config)#ip route 192.168.3.0 255.255.255.0 192.168.2.2
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
Router#copy run star
Router#copy run startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
```

On router-4

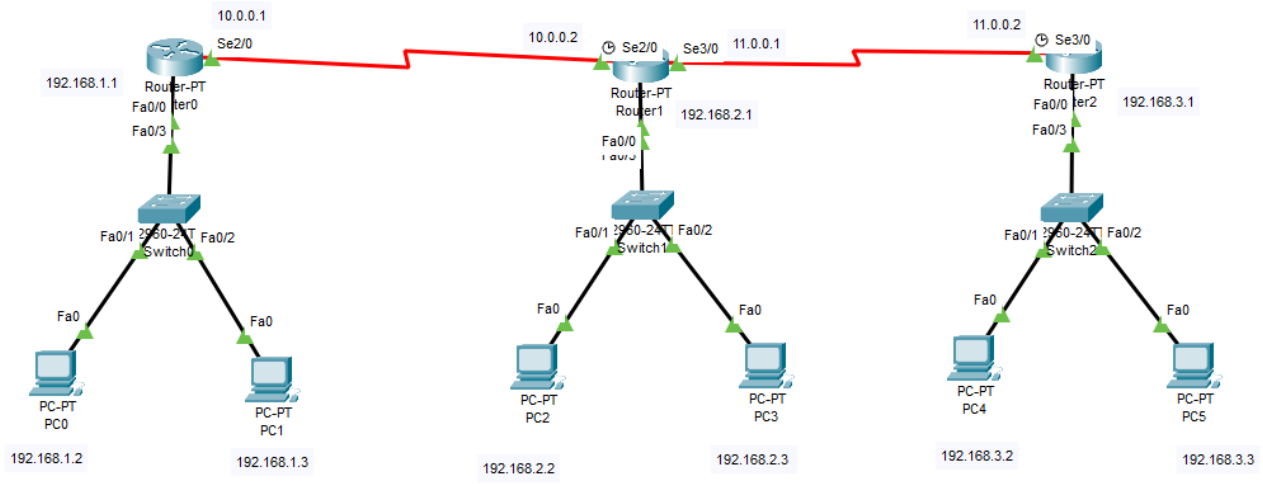
```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip address 192.168.2.2 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#
Router(config-if)#ip address 192.168.3.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#inte se2/0
Router(config-if)#ip address 192.168.2.2 255.255.255.0
Router(config-if)#no shutdown
```

Router(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

Router(config-if)#exit
Router(config)#ip route 192.168.1.0 255.255.255.0 192.168.2.1

Router#wr
Building configuration...
[OK]

b. Dynamic Routing Demonstration



In Router-0

Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0

```
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#network 10.0.0.0
Router(config-router)#network 11.0.0.0
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#network 192.168.3.0
Router(config-router)#exit
Router(config)#exit
Router#copy run startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
```

In Router-1

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.2.1 255.255.255.0
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
Router(config-if)#exit
Router(config)#interface Serial2/0
Router(config-if)#ip address 10.0.0.2 255.0.0.0
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
Router(config-if)#exit
Router(config)#interface Serial3/0
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up
ip address 11.0.0.1 255.0.0.0
Router(config-if)#ip address 11.0.0.1 255.0.0.0
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial3/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to up
Router(config-if)#exit

Router(config)#router rip
```

```
Router(config-router)#network 10.0.0.0
Router(config-router)#network 11.0.0.0
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#network 192.168.3.0
Router(config)#exit
Router#copy run start
Router#copy run startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
```

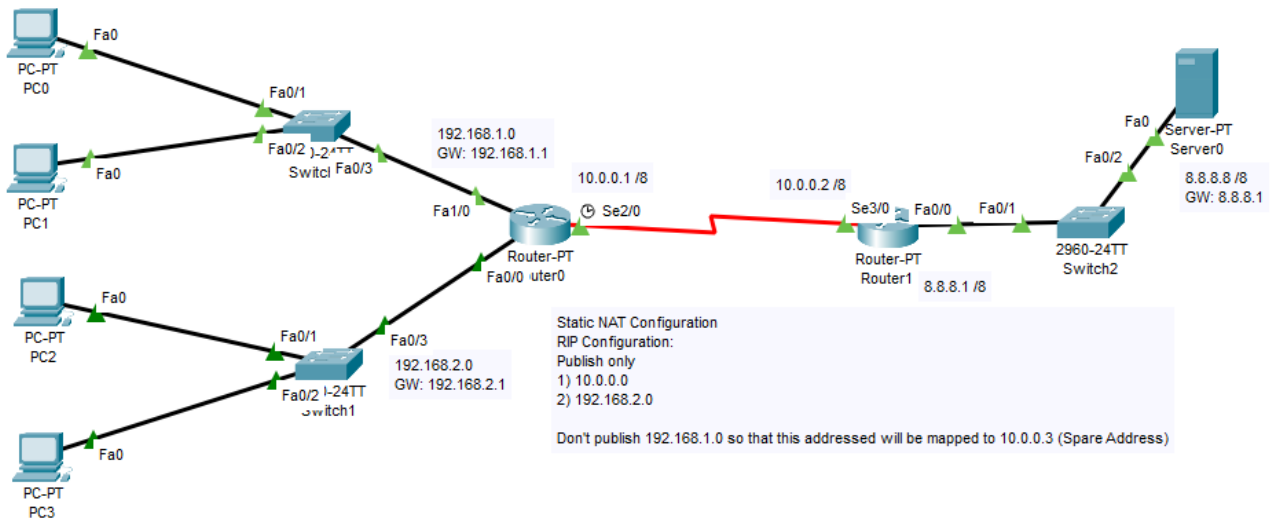
In Router-2

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.3.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface Serial3/0
Router(config-if)#ip address 11.0.0.2 255.0.0.0
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial3/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial3/0, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#router rip
Router(config-router)#network 10.0.0.0
Router(config-router)#network 11.0.0.0
Router(config-router)#network 192.168.1.0
Router(config-router)#network 192.168.2.0
Router(config-router)#network 192.168.3.0
Router(config-router)#exit
Router(config)#exit
Router#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

3. Configure Network Address Translation (NAT) and test static NAT, dynamic NAT and PAT.

a. Static NAT

Static NAT (Network Address Translation) - Static NAT (Network Address Translation) is one-to-one mapping of a private IP address to a public IP address. Static NAT (Network Address Translation) is useful when a network device inside a private network needs to be accessible from internet.



Ip address 192.168.1.2 is statically mapped to 10.0.0.3 Public IP

Router-0

```
Router>enable
Router#configure terminal
Router(config)#interface Serial2/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface FastEthernet1/0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.2.1 255.255.255.0
```

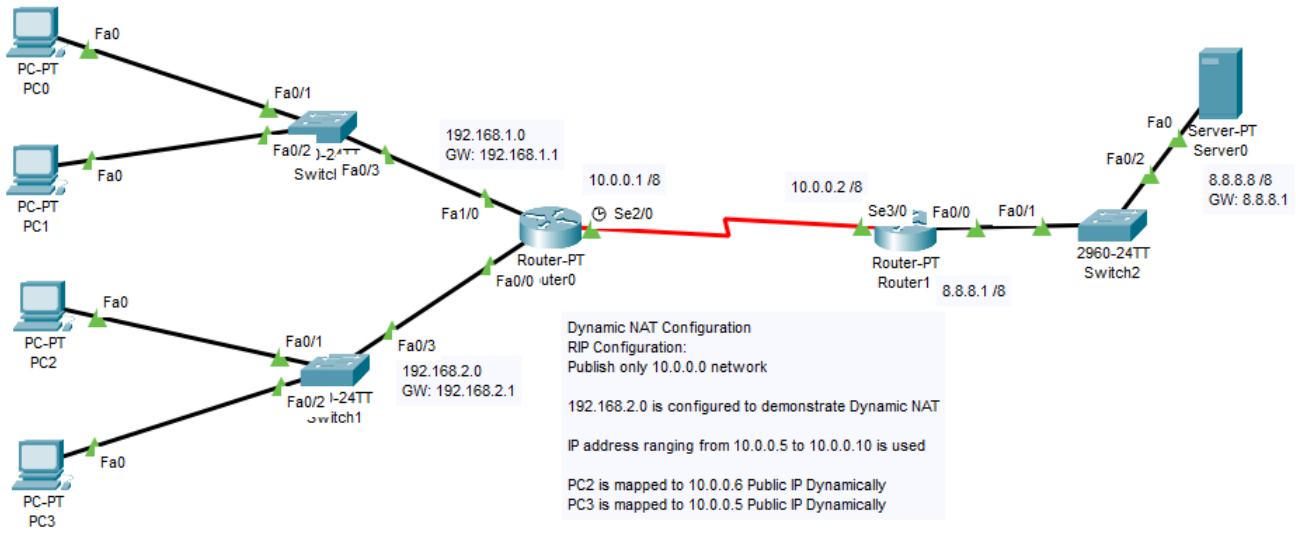
```
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#network 192.168.2.0
Router(config-router)#network 10.0.0.0
Router(config-router)#exit
Router(config)#inter se2/0
Router(config-if)#ip nat out
Router(config-if)#inter fa1/0
Router(config-if)#ip nat in
Router(config)#ip nat inside source static 192.168.1.2 10.0.0.3
Router(config)#exit
Router#wr
Building configuration...
[OK]
```

Router-1

```
Router>enable
Router#configure terminal
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 8.8.8.1 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#interface Serial3/0
Router(config-if)#ip address 10.0.0.2 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#network 10.0.0.0
Router(config-router)#network 8.0.0.0
```

b. Dynamic NAT

Dynamic NAT can be defined as mapping of a private IP address to a public IP address from a group of public IP addresses called as NAT pool. Dynamic NAT establishes a one-to-one mapping between a private IP address to a public IP address. Here the public IP address is taken from the pool of IP addresses configured on the end NAT router. The public to private mapping may vary based on the available public IP address in NAT pool.



Router-0

```
Router>enable
Router#conf t
Router(config)#int se2/0
Router(config-if)#ip nat outside
Router(config)#int fa0/0
Router(config-if)#ip nat inside
Router(config-if)#exit
Router(config)#acc
Router(config)#access-list 1 permit 192.168.2.0 0.0.0.255
Router(config)#ip nat pool NAT 10.0.0.5 10.0.0.10 netmask 255.255.255.0
Router(config)#ip nat inside source list 1 pool NAT
Router(config)#exit
Router#show ip nat translations
```

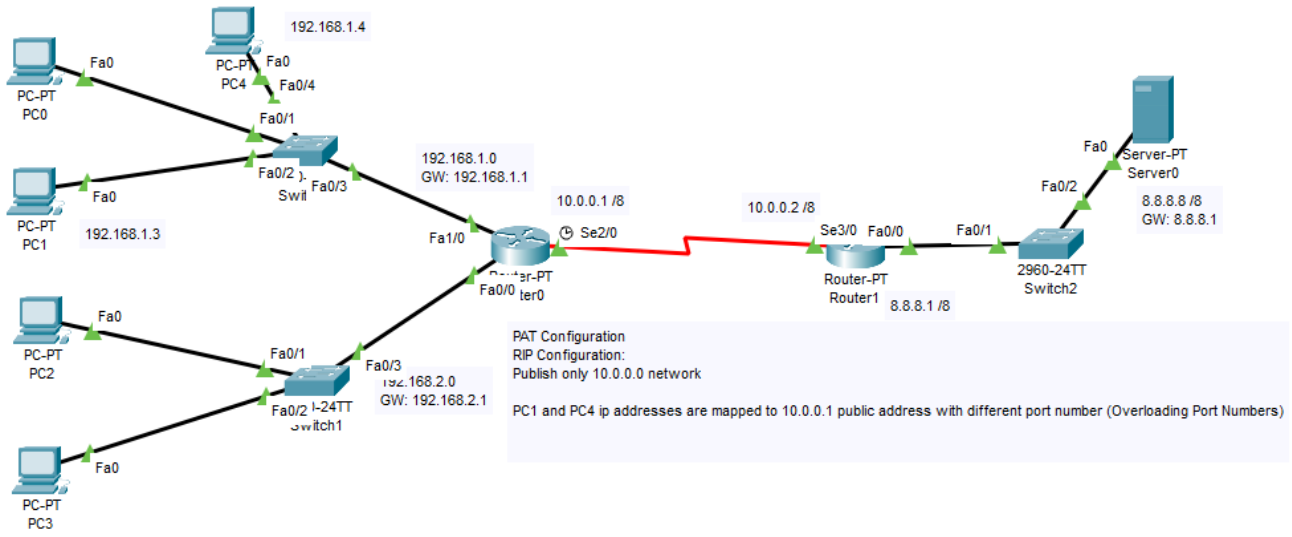
```
Router#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside global
icmp 10.0.0.5:10       192.168.2.3:10     8.8.8.8:10         8.8.8.8:10
icmp 10.0.0.5:11       192.168.2.3:11     8.8.8.8:11         8.8.8.8:11
icmp 10.0.0.5:12       192.168.2.3:12     8.8.8.8:12         8.8.8.8:12
icmp 10.0.0.5:13       192.168.2.3:13     8.8.8.8:13         8.8.8.8:13
---  10.0.0.3          192.168.1.2        ---                ---
tcp 10.0.0.6:1025      192.168.2.2:1025   8.8.8.8:80         8.8.8.8:80
```

c. PAT

PAT (Port Address Translation) - Port Address Translation (PAT) is another type of dynamic NAT which can map multiple private IP

addresses to a single public IP address by using a technology known as Port Address Translation.

Here when a client from inside network communicate to a host in the internet, the router changes the source port (TCP or UDP) number with another port number. These port mappings are kept in a table. When the router receive from internet, it will refer the table which keep the port mappings and forward the data packet to the original sender.



Router - 0

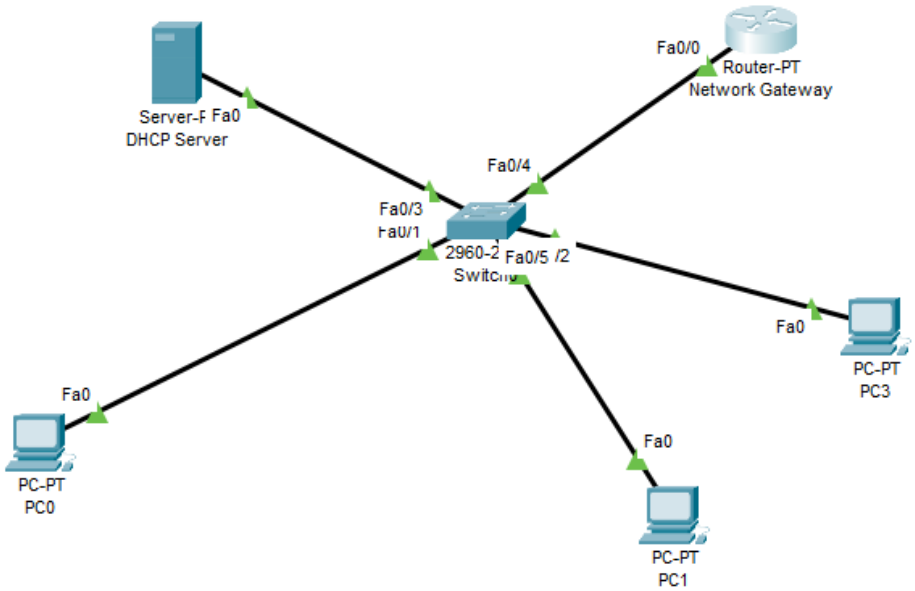
```
Router#conf t
Router(config)#inte se2/0
Router(config-if)#ip nat outside
Router(config-if)#int fa0/0
Router(config-if)#ip nat inside
Router(config)#access-list 1 permit 192.168.1.0 0.0.0.255
Router(config-if)#ip nat inside source list 1 interface se2/0 overload
Router(config)#exit
```

```
Router#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside global
---  10.0.0.3          192.168.1.2        ---                ---
tcp 10.0.0.1:1024      192.168.1.4:1025   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.1:1025      192.168.1.3:1025   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.3:1025      192.168.1.2:1025   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.3:1026      192.168.1.2:1026   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.3:1027      192.168.1.2:1027   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.3:1028      192.168.1.2:1028   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.3:1029      192.168.1.2:1029   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.3:1030      192.168.1.2:1030   8.8.8.8:80         8.8.8.8:80
tcp 10.0.0.6:1025      192.168.2.2:1025   8.8.8.8:80         8.8.8.8:80
```

4. Configure a DHCP server to dynamically assign IP address, subnet mask and default gateway to the hosts in the network.

A **DHCP Server** is a network server that automatically provides and assigns IP addresses, default gateways and other network parameters to client devices. It relies on the standard protocol known as Dynamic Host Configuration Protocol or DHCP to respond to broadcast queries by clients.

A DHCP server automatically sends the required network parameters for clients to properly communicate on the network. Without it, the network administrator has to manually set up every client that joins the network, which can be cumbersome, especially in large networks. DHCP servers usually assign each client with a unique dynamic IP address, which changes when the client's lease for that IP address has expired.



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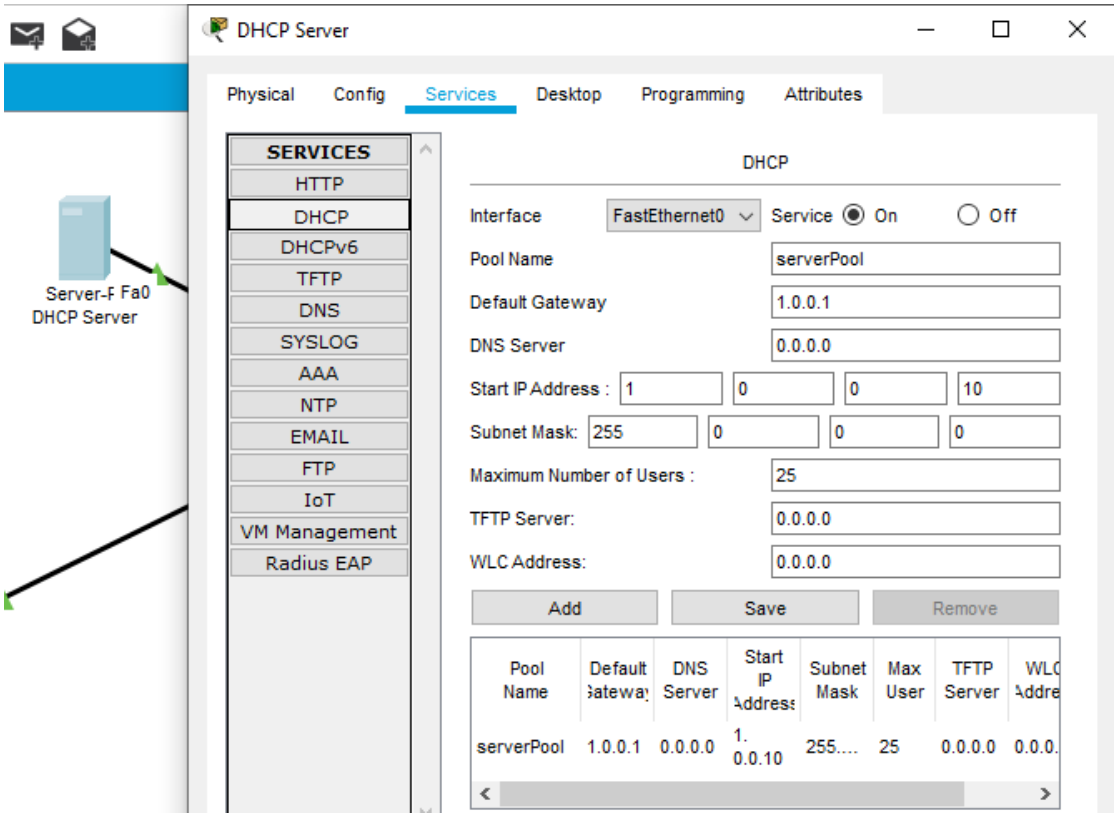
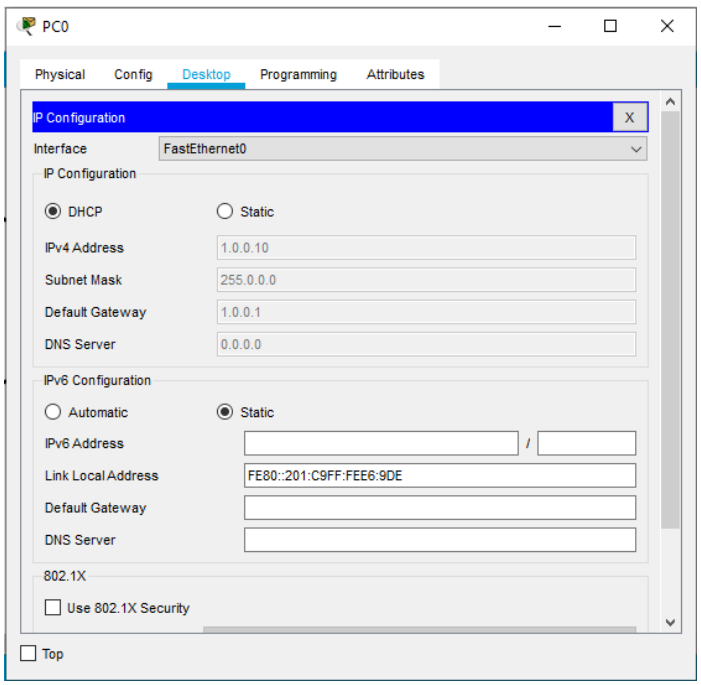




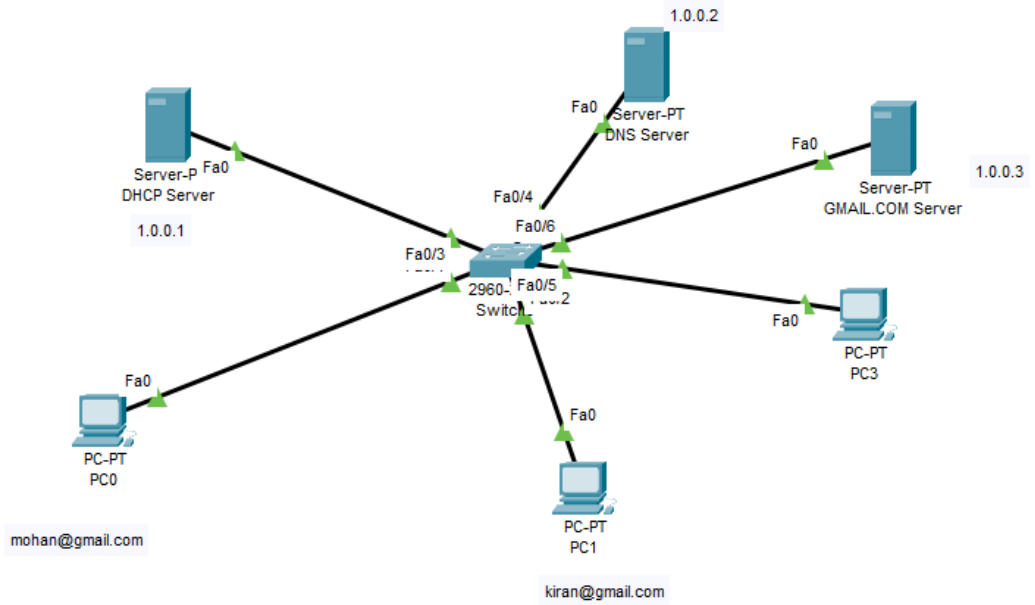
Router>enable
Router#configure terminal

```
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 1.0.0.1 255.0.0.0
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
Router#copy run start
Router#copy run startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

5. Configure and test DNS and Email server in a network.

The Domain Name System (DNS) is the phonebook of the Internet. Humans access information online through domain names, like nytimes.com or espn.com. Web browsers interact through Internet Protocol (IP) addresses. DNS translates domain names to IP addresses so browsers can load Internet resources.

Each device connected to the Internet has a unique IP address which other machines use to find the device. DNS servers eliminate the need for humans to memorize IP addresses such as 192.168.1.1 (in IPv4), or more complex newer alphanumeric IP addresses such as 2400:cb00:2048:1::c629:d7a2 (in IPv6).



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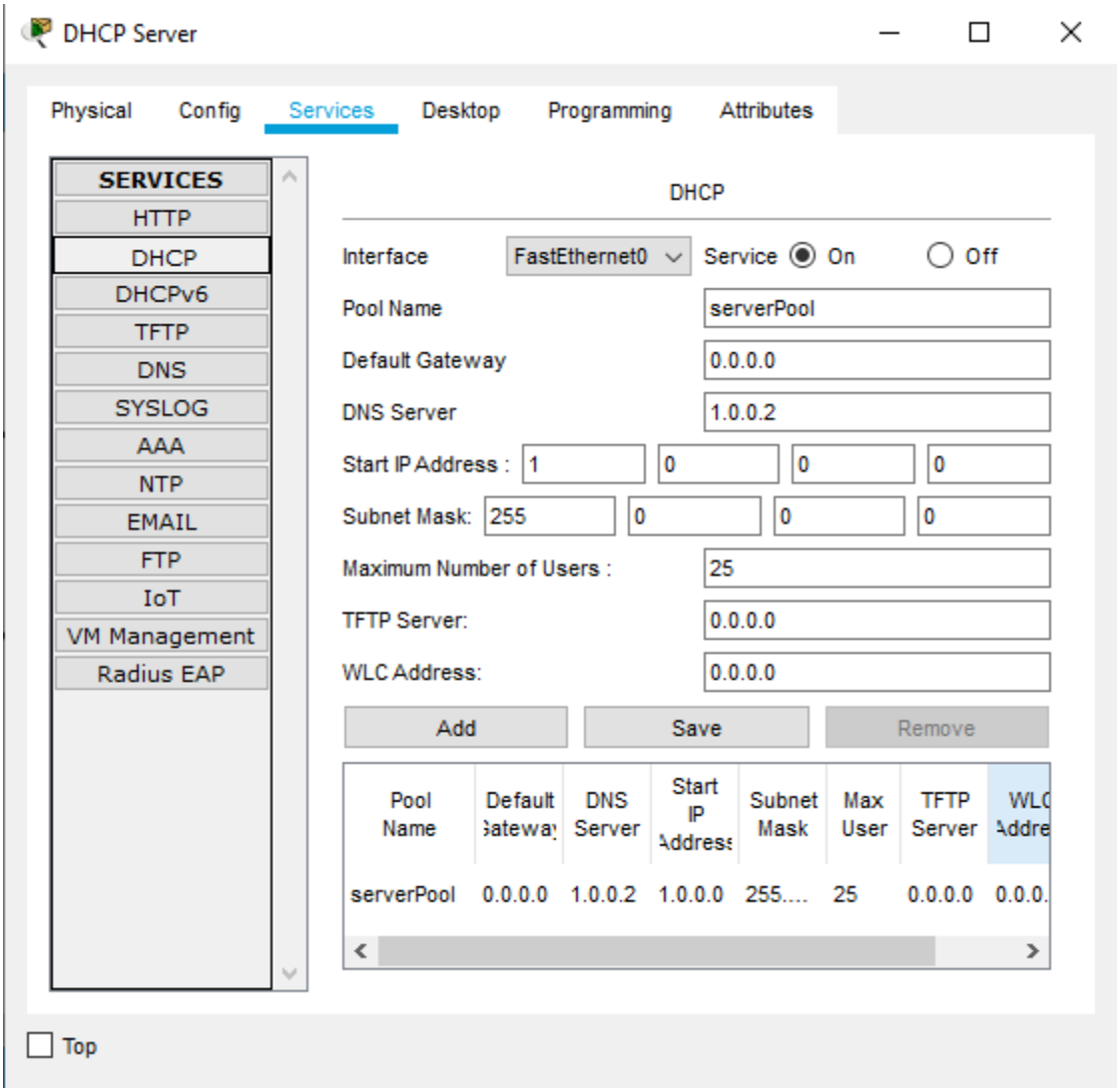

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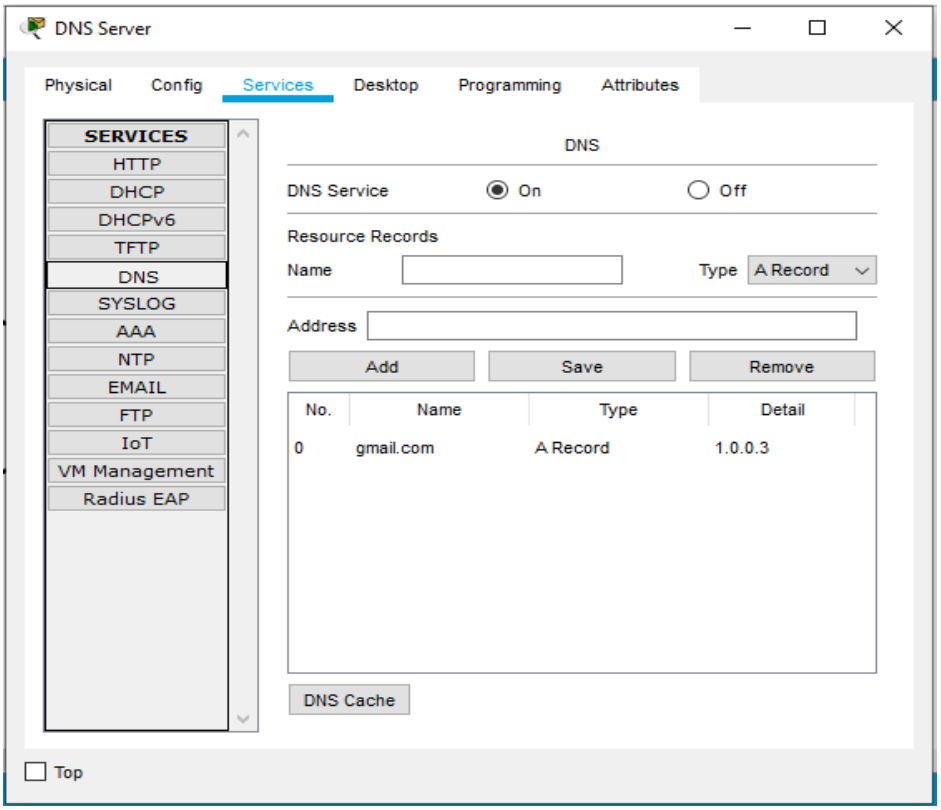
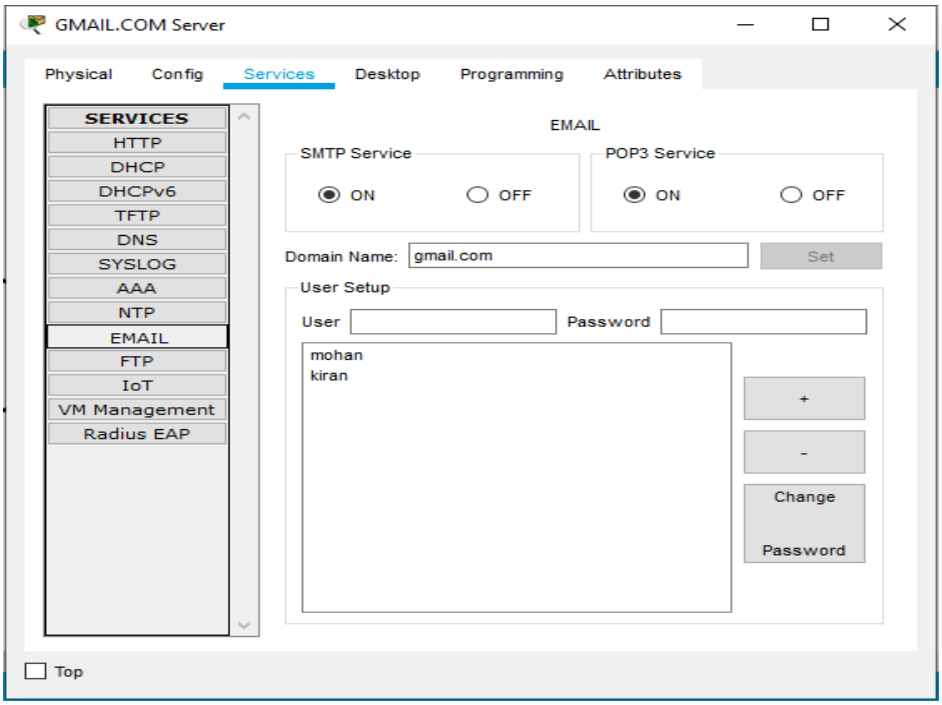
Telephone: 080- 22167860, Fax: 080 – 22167805

Department of Computer Science and Engineering





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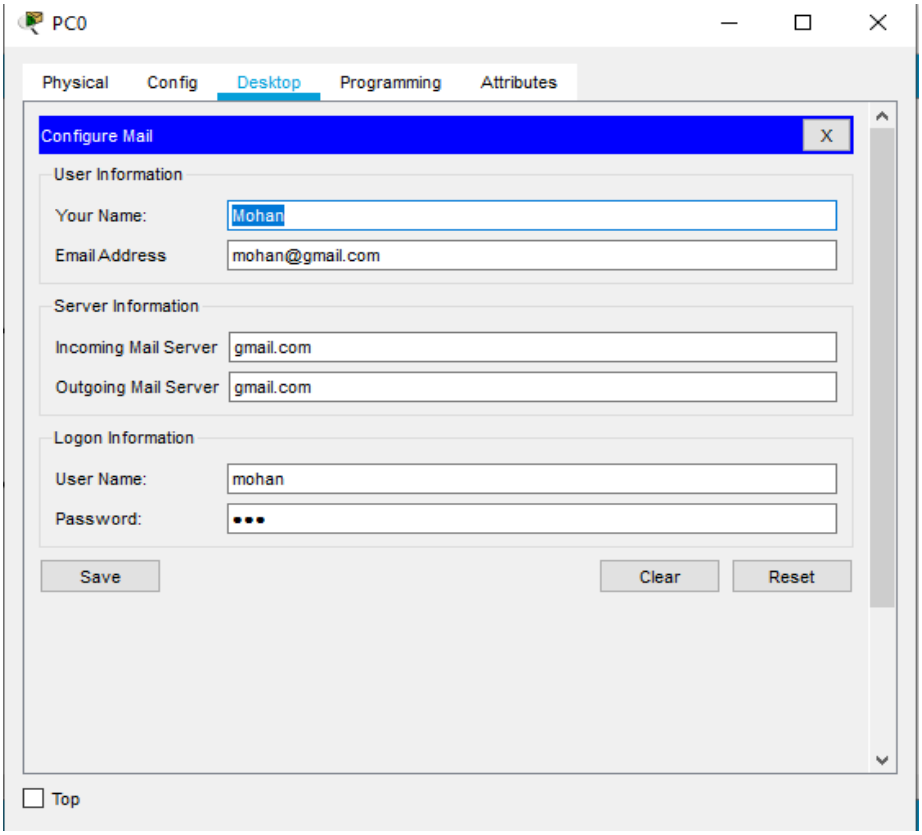
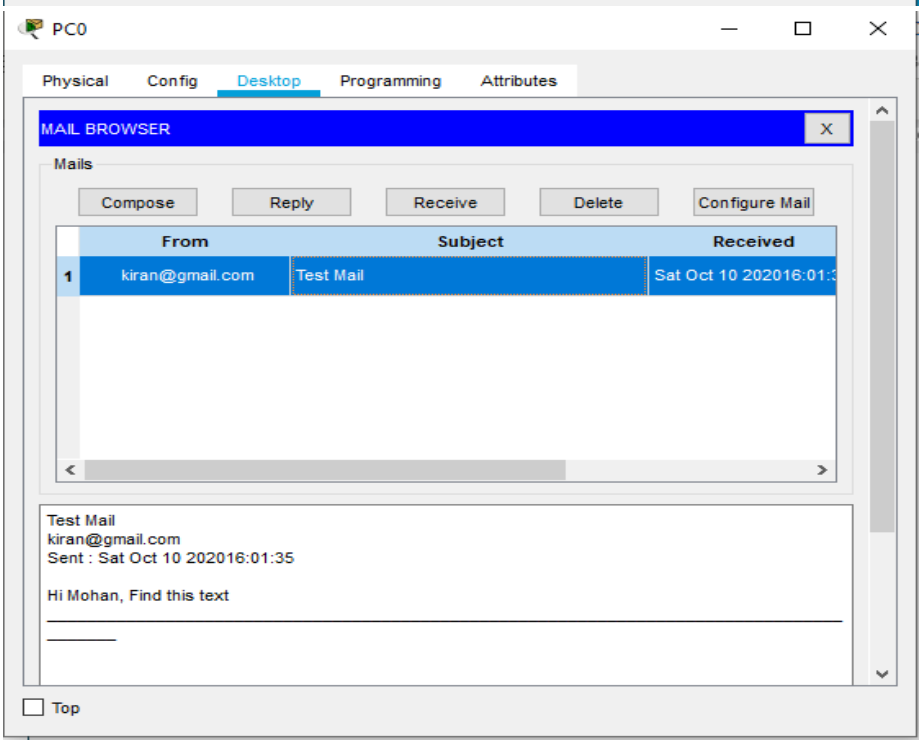
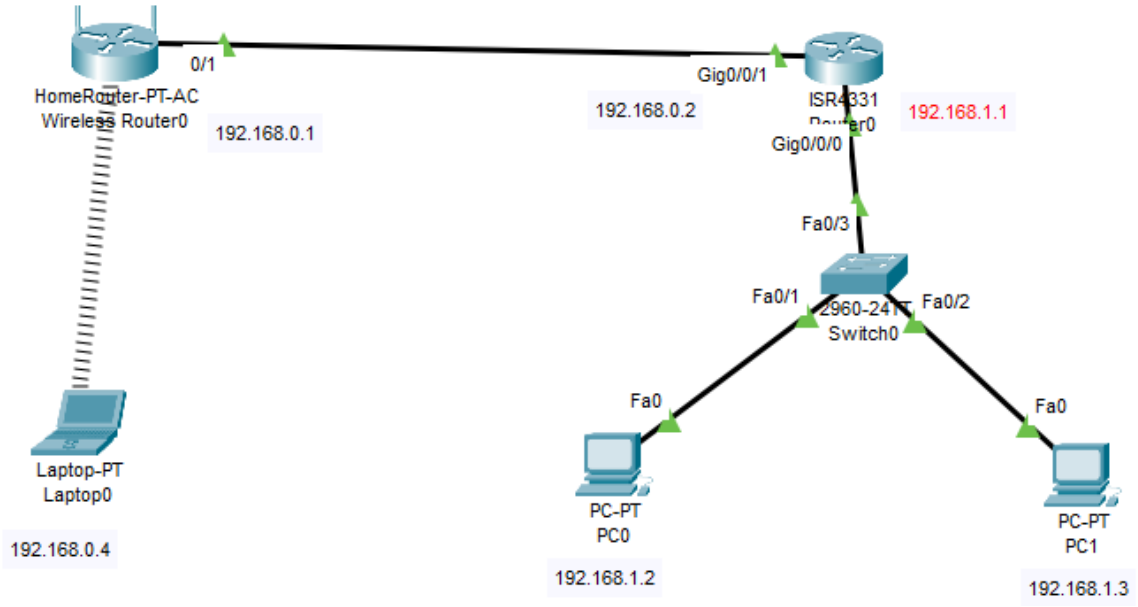
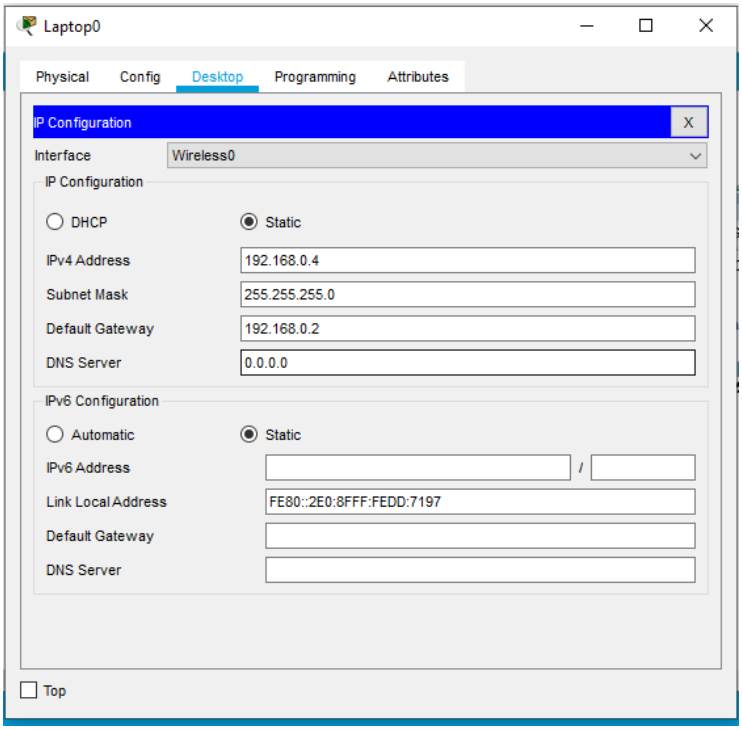




6. Configure Wireless router to support mobile devices to connect to the internet.





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