Practical -8

Aim: To develop a small network using actual physical components with an IP address scheme.

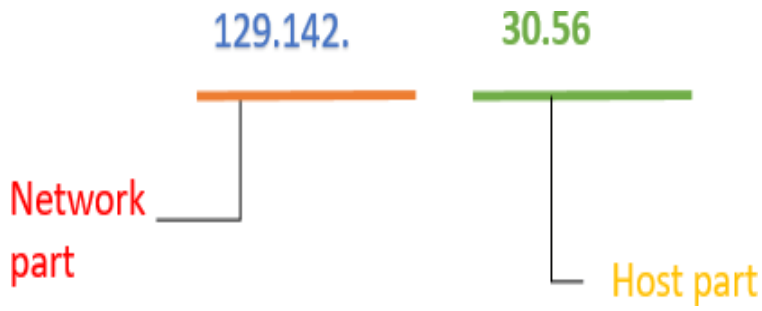
IPv4 address

An IP (Internet Protocol) address is a numerical label assigned to the devices connected to a computer network that uses the IP for communication.

IP address act as an identifier for a specific machine on a particular network. It also helps you to develop a virtual connection between a destination and a source. The IP address is also called IP number or internet address. It helps you to specify the technical format of the addressing and packet scheme. Most networks combine TCP with IP.

IPv4 was the primary version brought into action for production within the ARPANET in 1983. The IPv4 addresses are represented in dot-decimal notation and have the following format: x. x . x . x where x is a decimal number (ranging from 0 to 255). These four numbers are separated by three dots. IPv4 addresses are 32-bit integers that will be expressed in decimal notation.

An example of a valid IP is: 129.142.30.56. IP Address is divided into two parts:



Prefix: The prefix part of IP address identifies the physical network to which the computer is attached. Prefix is also known as a network address.

Suffix: The suffix part identifies the individual computer on the network. The suffix is also called the host address.

Parts of IPv4

Network part: The network part indicates the distinctive variety that's appointed to the network. The network part conjointly identifies the category of the network that's assigned.

Host Part: The host part uniquely identifies the machine on your network. This part of the IPv4 address is assigned to every host.For each host on the network, the network part is the same, however, the host half must vary.

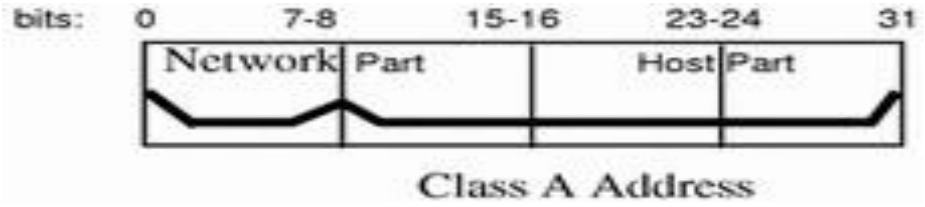
Network Classes

The first step in planning for IP addressing on your network is to determine which network class is appropriate for your network. After you have done this, you can take the crucial second step: obtain the network number from the Inter NIC addressing authority.

Currently, there are three classes of TCP/IP networks. Each class uses the 32-bit IP address space differently, providing more or fewer bits for the network part of the address. These classes are class A, class B, and class C.

Class A Network Numbers

Class A network number uses the first eight bits of the IP address as its "network part." The remaining 24 bits comprise the host part of the IP address, as illustrated in the figure below.

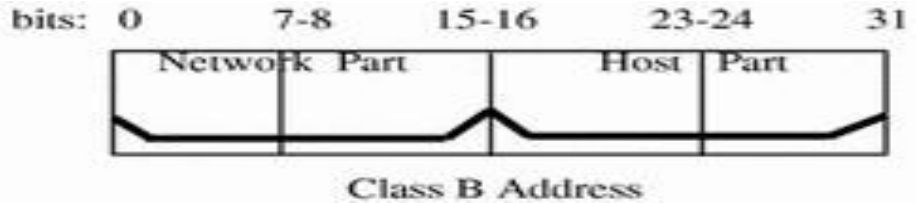


Class A Address

The values assigned to the first byte of class A network numbers fall within the range 0-127. Consider the IP address 75.4.10.4. The value 75 in the first byte indicates that the host is on a class A network. The remaining bytes, 4.10.4, establish the host address. The InterNIC assigns only the first byte of a class A number. Use of the remaining three bytes is left to the discretion of the owner of the network number. Only 127 class A networks can exist. Each one of these numbers can accommodate up to 16,777,214 hosts.

Class B Network Numbers

A class B network number uses 16 bits for the network number and 16 bits for host numbers. The first byte of a class B network number is in the range 128-191. In the number 129.144.50.56, the first two bytes, 129.144, are assigned by the InterNIC, and comprise the network address. The last two bytes, 50.56, make up the host address, and are assigned at the discretion of the owner of the network number. Figure given below graphically illustrates a class B address.



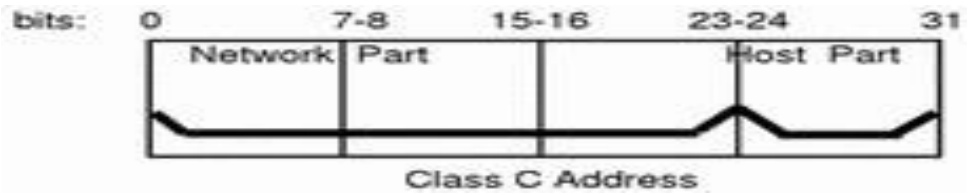
Class B Address

Class B is typically assigned to organizations with many hosts on their networks.

Class C Network Numbers

Class C network numbers use 24 bits for the network number and 8 bits for host numbers. Class C network numbers are appropriate for networks with few hosts--the maximum

being 254. A class C network number occupies the first three bytes of an IP address. Only the fourth byte is assigned at the discretion of the network owners. The figure given below graphically represents the bytes in a class C address.



The first byte of a class C network number covers the range 192-223. The second and third each cover the range 1- 255. A typical class C address might be 192.5.2.5. The first three bytes, 192.5.2, form the network number. The final byte in this example, 5, is the host number.

Administering Network Numbers

If your organization has been assigned more than one network number or uses subnets, appoint a centralized authority within your organization to assign network numbers. That authority should maintain control of a pool of assigned network numbers, assigning network, subnet, and host numbers as required. To prevent problems, make sure that duplicate or random network numbers do not exist in your organization.

Designing Your IP Addressing Scheme

After you have received your network number, you can then plan how you will assign the host parts of the IP address.

The table given below shows the division of the IP address space into network and host address spaces. For each class, "range" specifies the range of decimal values for the first byte of the network number. "Network address" indicates the number of bytes of the IP address that are dedicated to the network part of the address, with each byte represented by xxx. "Host address" indicates the number of bytes dedicated to the host part of the address.

For example, in a class A network address, the first byte is dedicated to the network, and the last three are dedicated to the host. The opposite is true for a class C network.

Table :Division of IP Address Space

Class	Range	Network Address	Host Address
A	0-127	xxx	xxx.xxx.xxx
B	128-191	xxx.xxx	xxx.xxx
C	192-223	xxx.xxx.xxx	xxx
D	224-239	Reserved for multicast groups	
E	240-254	Reserved	

The numbers in the first byte of the IP address define whether the network is class A, B, or C and are always assigned by the InterNIC. The remaining three bytes have a range from 0-255. The numbers 0 and 255 are reserved; you can assign the numbers 1-254 to each byte depending on the network number assigned to you.

What is an IPv6 Address?

Internet Protocol version 6 (IPv6) is the newest version of the Internet Protocol (IP), Similarto IPv4. IPv6 was introduced to remediate the problems and limitations of IPv4. IPv6 is also referred to as IPnext generation or IPng. IPv6 uses 128 bits to identify a host instead of IPv4's32 bits. The 128 bits that IPv6 uses allows the address space up to 2^{128} which equates to over340 undecillion numbers of IP available addresses. The address space of IPv6 is a staggeringnumber compared to ipv4s address space. The number of connected devices to the internethas long outgrown the addressing capacity of IPv4. The adoption of IPv6 has been slow froma technological standpoint. Most Internet Service Providers (ISP) still use IPv4 so version fourwill still be around for some time. Despite computers supporting IPv6 from the Windows XPera.

Address Structure

An IPv6 address is made of 128 bits divided into eight 16-bits blocks. Each block is then converted into 4-digit Hexadecimal numbers separated by colon symbols.

For example, given below is a 128 bit IPv6 address represented in binary format and dividedinto eight 16-bits blocks:

```
0010000000000001 0000000000000000 0011001000111000 1101111111100001
0000000001100011 0000000000000000 0000000000000000 1111111011111011
```

Each block is then converted into Hexadecimal and separated by ':' symbol:

```
2001:0000:3238:DFE1:0063:0000:0000:FEFB
```

Even after converting into Hexadecimal format, IPv6 address remains long. IPv6 providessome rules to shorten the address. The rules are as follows:

Rule.1: Discard leading Zero(es):

In Block 5, 0063, the leading two 0s can be omitted, such as (5th block):

```
2001:0000:3238:DFE1:63:0000:0000:FEFB
```

Rule.2: If two of more blocks contain consecutive zeroes, omit them all and replace withdouble colon sign ::, such as (6th and 7th block):

```
2001:0000:3238:DFE1:63::FEFB
```

Consecutive blocks of zeroes can be replaced only once by :: so if there are still blocks ofzeroes in the address, they can be shrunk down to a single zero, such as

(2nd block):

2001:0:3238:DFE1:63::FEFB

Examples of valid IPv6 addresses

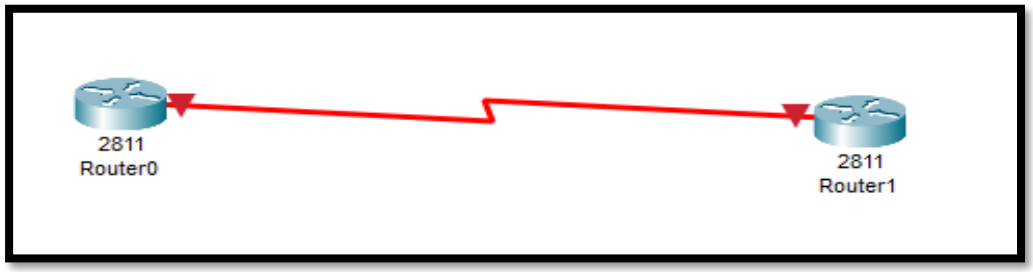
The following list shows examples of valid IPv6 (Normal) addresses:

- 2001 : db8: 3333 : 4444 : 5555 : 6666 : 7777 : 8888
- 2001 : db8 : 3333 : 4444 : CCCC : DDDD : EEEE : FFFF
- : : (implies all 8 segments are zero)
- 2001: db8: : (implies that the last six segments are zero)
- : : 1234 : 5678 (implies that the first six segments are zero)
- 2001 : db8: : 1234 : 5678 (implies that the middle four segments are zero)
- 2001:0db8:0001:0000:0000:0ab9:C0A8:0102 (This can be compressed toeliminate leading zeros, as follows: 2001:db8:1::ab9:C0A8:102)

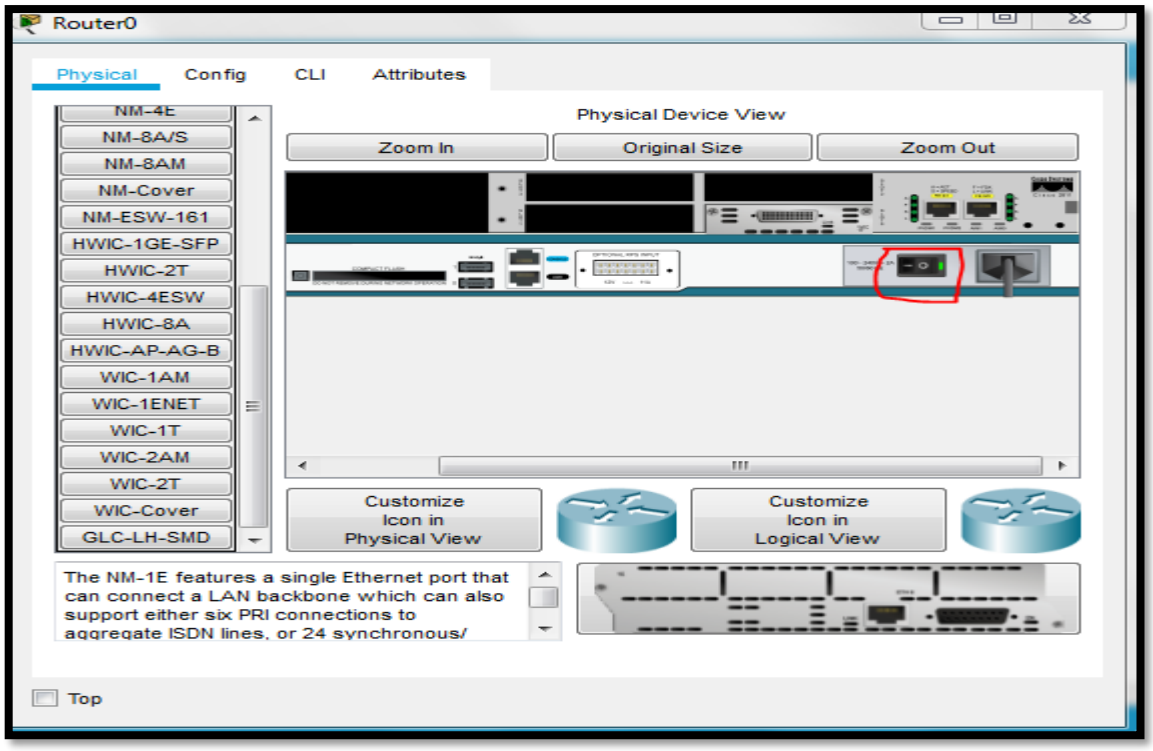
Steps for Implementing Small Network:

1. First drag two routers (2811) on the work page.

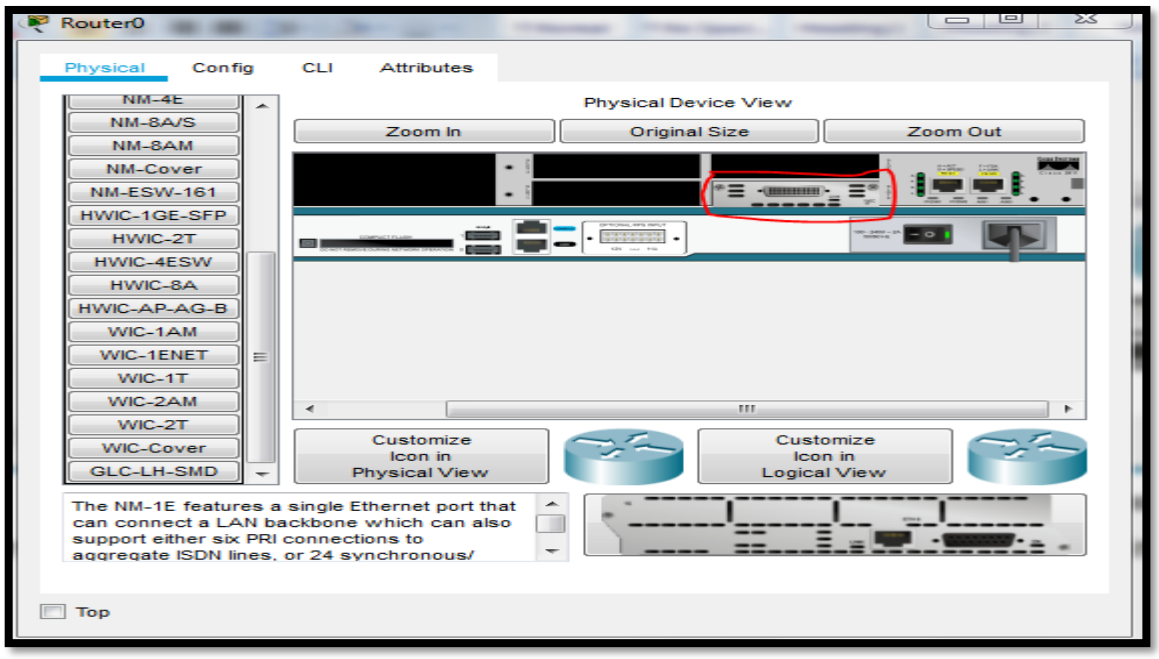
2. Connect both routers with “Serial DCE Cable”.



3. Next Turn off both the router by clicking on the router and include (drag and drop) “WIC - 1T” module on both the router.



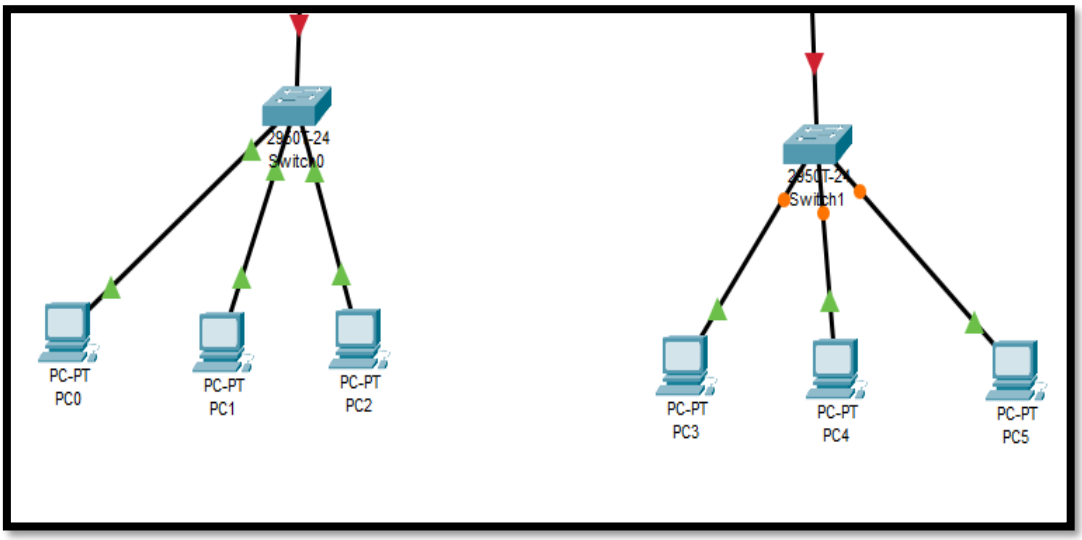
Turn off the router by switch in the red box. Include “WIC – 1T” (Modules are on the left side) on the router below the original size button. “WIC -1T” is described in red box.



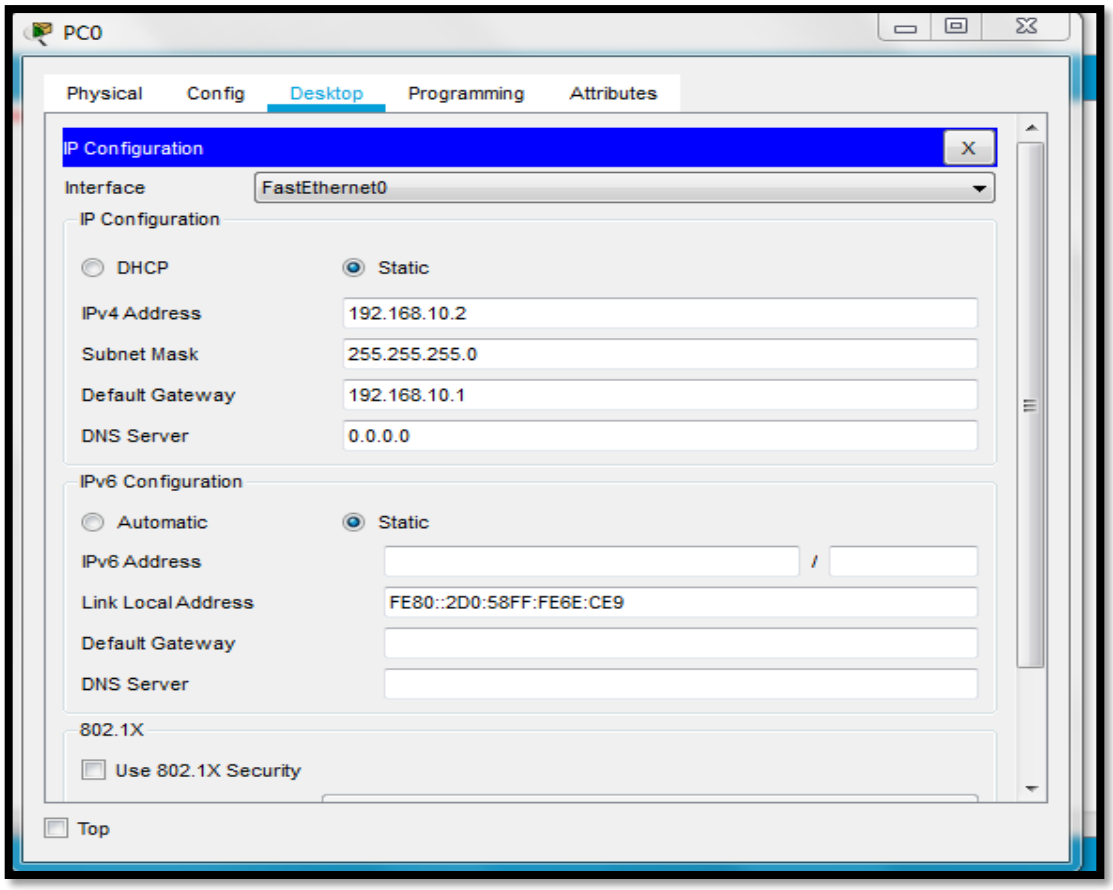
4. Drag and drop two switches on the work page.

Connect both the switches two their respective routers using “Copper Straight Cable”.

5. Drag and drop six end device (PC) on the work page and connect 3 pc with switch 0 and 3 with switch 1 using “Copper Straight cable”.



6. Next do IP configuration for all the six PC’s. Click on First pc go to “desktop” show in title bar then choose “IP Configuration”.

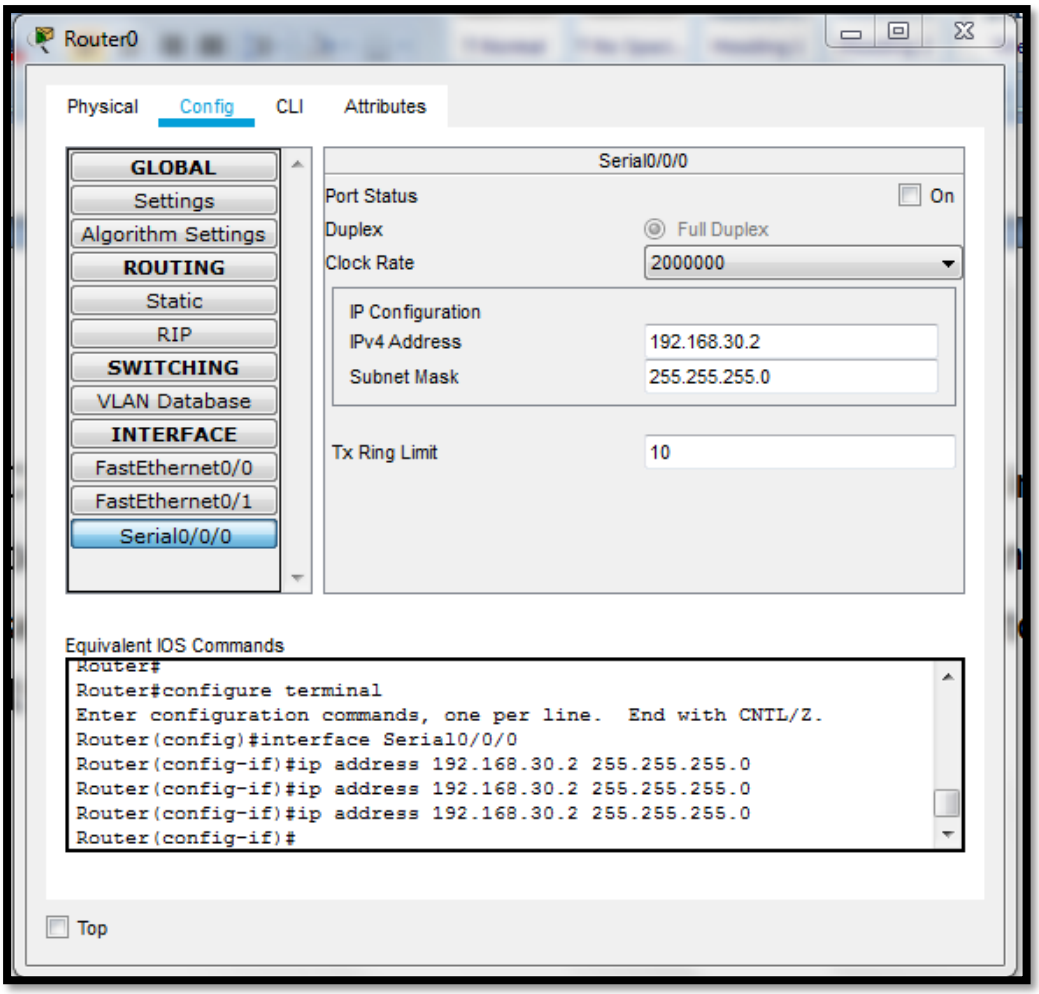


IPv4 Address (For PC 0): 192.168.10.2

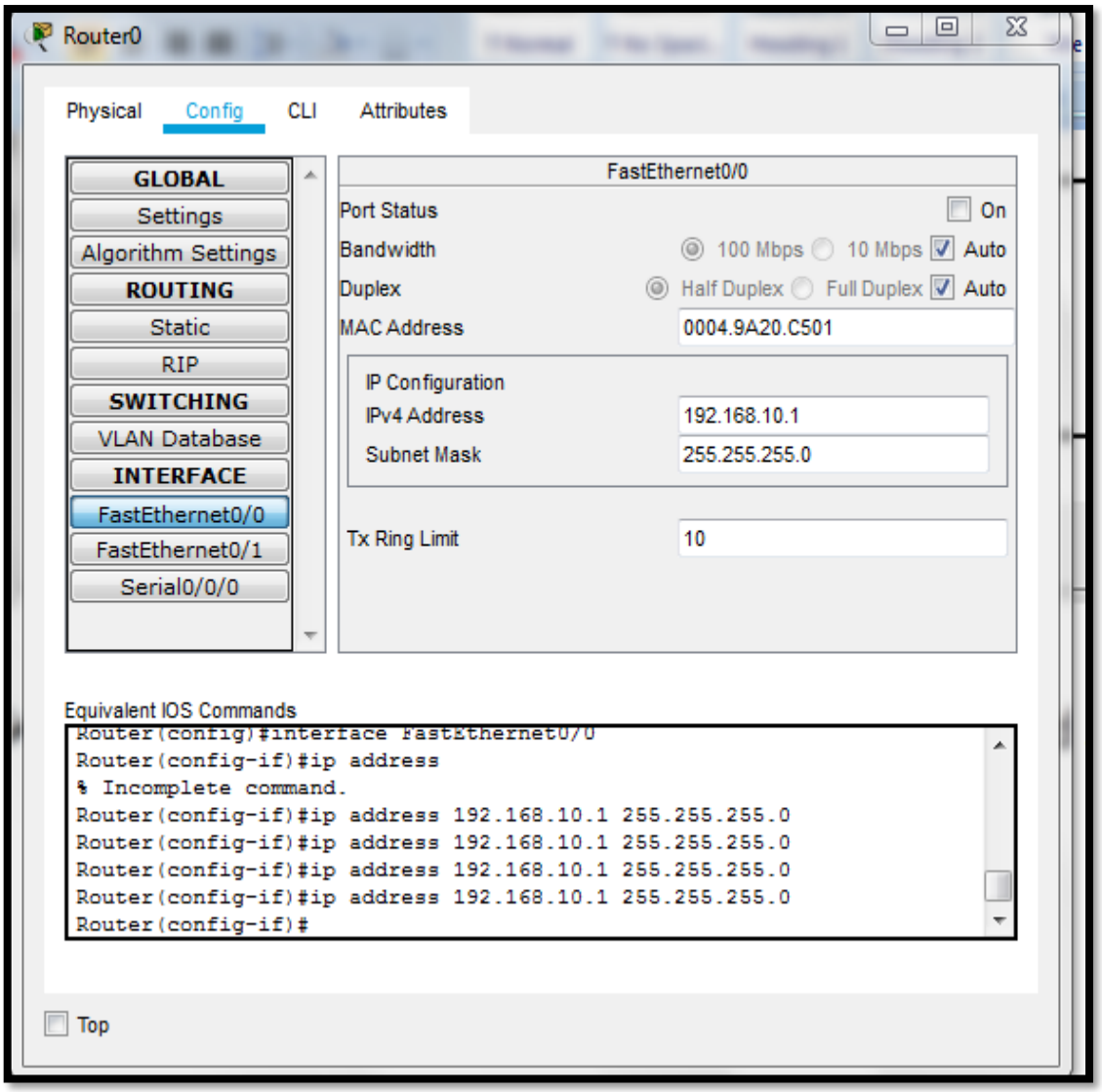
Default Gateway: 192.168.10.1

- For other two pc's increment the last digit of IPv4 address and write it into the textbox and default gateway should be same for the "Switch 0" devices.
- Repeat step 6 for switch 1 devices IPv4 Address should be 192.168.20.2 and increment last digit for next two device.
- Default gateway for switch 2 devices is 192.168.20.1

7. Click on router 0 and go through "Config" shown in title bar and choose "Serial0/0/0" shown in left side and select clock rate 1 lakh 28 thousand and set IPv4 to 192.168.30.2 and turn it on.

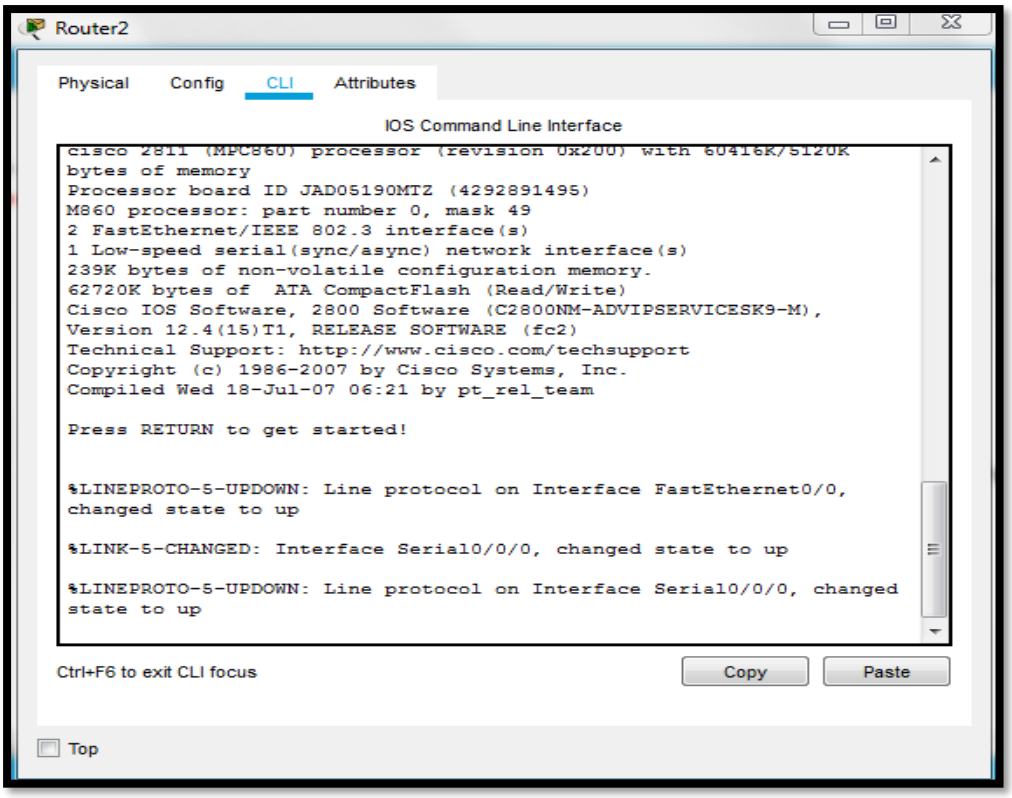


- Select “FastEthernet0/0” shown in left side and set IPv4 to 192.168.10.1

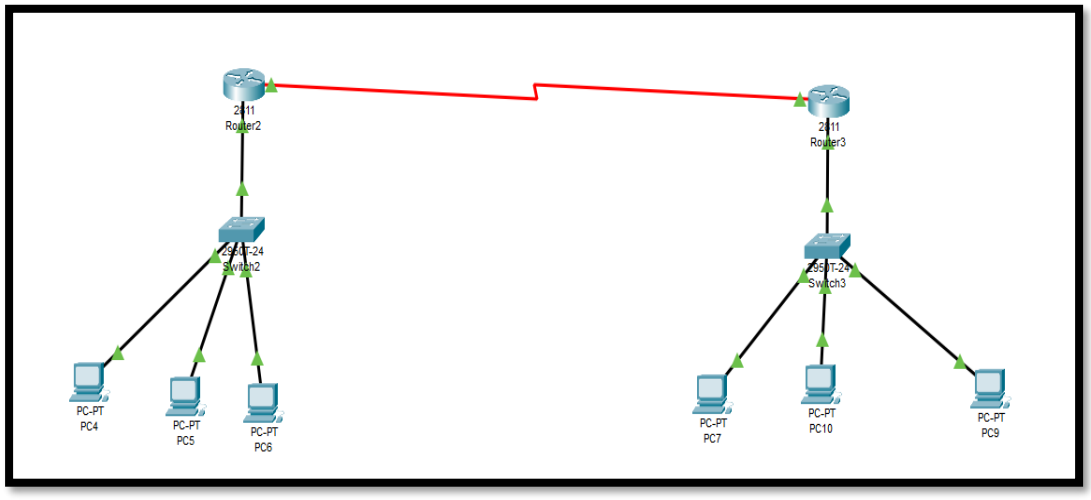


- Repeat step 7 for router 1.
- Serial0/0/0 shown in left side and select clock rate 1 lakh 28 thousand and set IPv4 to 192.168.30.3 and turn it on.
- Select "FastEthernet0/0" shown in left side and set IPv4 to 192.168.20.1

8. Click on router 0 and go through "cli" shown in title bar and press enter in the command line and type "exit" then press enter then type "ip route 0.0.0.0 0.0.0.0 192.168.30.1" then press enter and type exit.



9. Now send the message from one pc to another whether it sending or not. Select Message from the title bar and click on the source PC and then click on destination PC.



Exercise

Q-1 Determine whether the following IPv4 addresses are valid or invalid.

If valid IPv4 addresses then find the class,Network, and Host ID of an IPv4 address.

If an invalid IPv4 address then write the reason for the same.

a) 1.4.5.5
b) 75.45.301.14
c) 111.56.045.78
d) 192.226.12.11
e) 130.45.151.154
f) 11100010.23.14.67
g) 221.34.7.8.20
h) 240.230.220.89

Q-2 Identify valid IPv6 addresses and if an invalid IPv6 address then write the reason for the same.

a)2001 : db8: 3333 : 4444 : 5555 : 6666 : 7777 : 8888

b) : :

c) 225.1.4.2

d) 2001: db8: :

e) : : 1234 : 5678

f) 2001 : db8: : 1234 : 5678

g) 2001:0db8:0001:0000:0000:0ab9:C0A8:0102

h) fe80:2030:31:24
