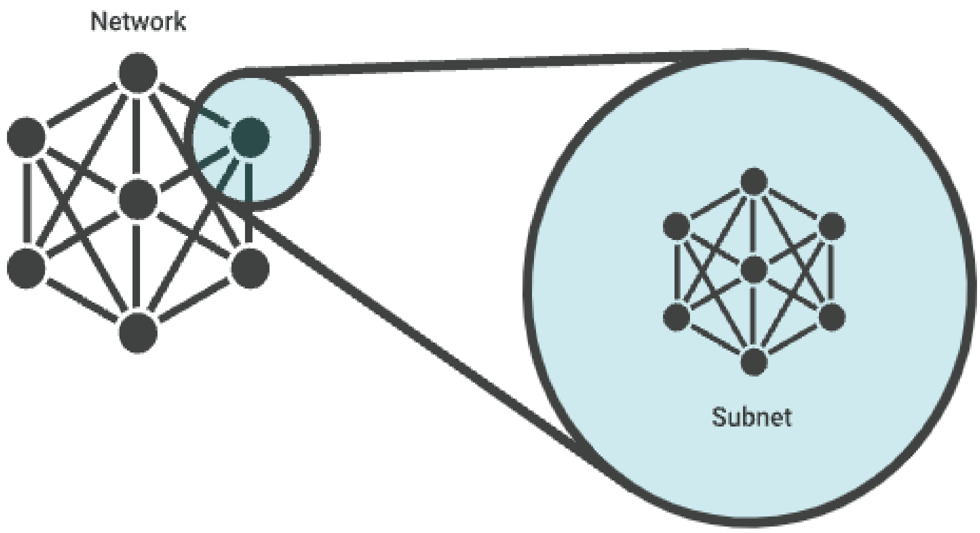
National University of Computer & Emerging Sciences, Karachi
FAST School of Computing
Fall 2021, Lab Manual 09

Course Code: CL-3001	**Course: Computer Networks Lab**
Instructor(s):	**Amin Sadiq, Muhammad Kariz Kamal**

Contents:

1. What is Subnet?

A subnet, or subnetwork, is a network inside a network. Subnets make networks more efficient. Through subnetting, network traffic can travel a shorter distance without passing through unnecessary routers to reach its destination.



Imagine Alice puts a letter in the mail that is addressed to Bob, who lives in the town right next to hers. For the letter to reach Bob as quickly as possible, it should be delivered right from Alice's post office to the post office in Bob's town, and then to Bob. If the letter is first sent to a post office hundreds of miles away, Alice's letter could take a lot longer to reach Bob.

Like the postal service, networks are more efficient when messages travel as directly as possible. When a network receives data packets from another network, it will sort and route those packets by subnet so that the packets do not take an inefficient route to their destination.

2. What is Subnetting?

A **subnet** is just a range of IP addresses. All the devices in the same subnet can communicate directly with one another without going through any routers. In IPv4, a network interface is connected to only one subnet and has only one IP address. In IPv6 things are slightly more complicated, so we'll save IPv6 subnetting for another article. But it's useful to understand IPv4 first because the basic concepts are the same.

My laptop is on a subnet that also includes a server, a printer, a couple of other workstations, and a router. If I want to communicate with another device in my subnet, I can send packets to it directly. If it's not on my subnet, I need to forward the packet to a router first. That router also needs to be on my subnet. My computer knows that another device is in my subnet by looking at my own IP address and my **subnet mask**.

Suppose my IP address is 192.168.101.15 and my subnet mask is 255.255.255.0. There are 32 bits in the IP address and the same number in the mask. We always write those 32 bits as four 8-bit numbers, often called **octets**. The thing that can make it confusing is that we use decimal notation for each of those 8-bit numbers, but the mechanics of subnetting are really going on in binary.

3. Purpose of Subnetting

To subnet a network means to create logical divisions of the network. Subnetting, therefore, involves dividing the network into smaller portions called subnets. Subnetting applies to IP addresses because this is done by borrowing bits from the host portion of the IP address. In a sense, the IP address then has three components - the network part, the subnet part and, finally, the host part.

We create a subnet by logically grabbing the last bit from the network component of the address and using it to determine the number of subnets required. In the following example, a Class C address normally has 24 bits for the network address and eight for the host, but we are going to borrow the left-most bit of the host address and declare it as identifying the subnet

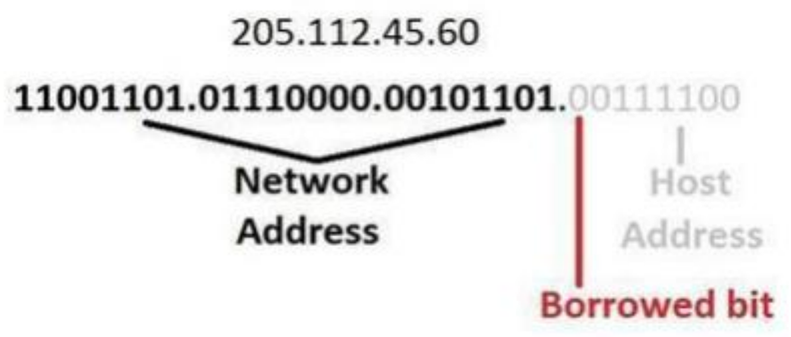


Figure 1(Understanding the bits)

If the bit is a 0, then that will be one subnet; if the bit is a 1 that would be the second subnet. Of course, with only one borrowed bit we can only have two possible subnets. By the same token, that also reduces the number of hosts we can have on the network to 127 (but actually 125 useable addresses given all zeros and all ones are not recommended addresses), down from 255.

So how can you tell how many bits should be borrowed, or, in other words, how many subnets we want to have on our network? The answer is with a subnet mask

Subnet masks sound a lot scarier than they really are. All that a subnet mask does is indicate how many bits are being "borrowed" from the host component of an IP address.

If you can't remember anything about subnetting, remember this concept. It is the foundation of all subnetting. The reason a subnet mask has this name is that it literally masks out the host bits being borrowed from the host address portion of the IP address. In the following diagram, there is a subnet mask for a Class C address. The subnet mask is 255.255.255.128 which, when translated into bits, indicates which bits of the host part of the address will be used to determine the subnet number.

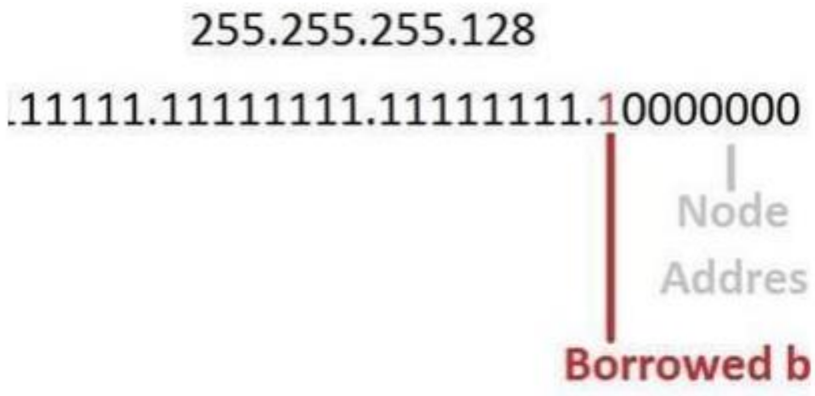


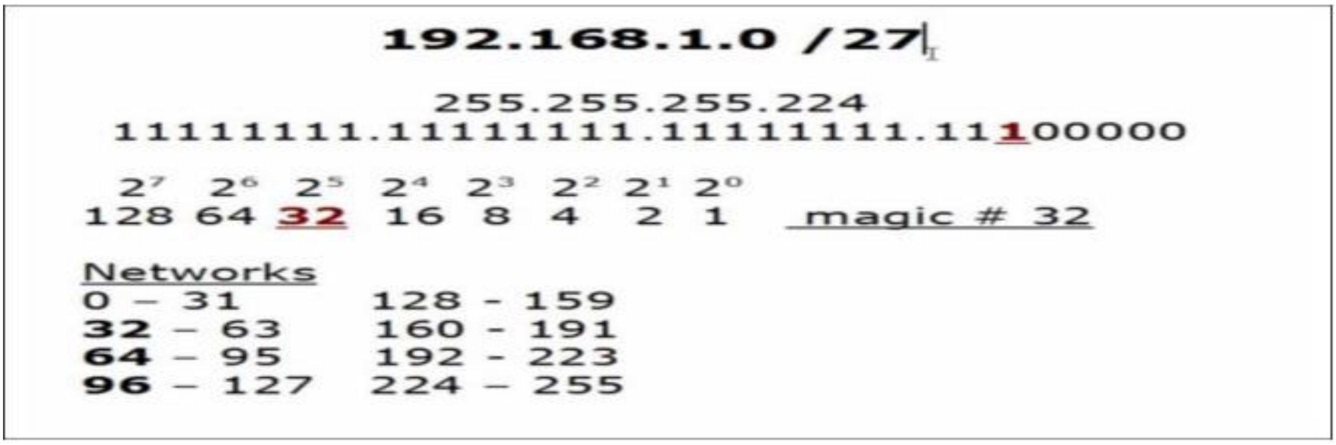
Figure 2 (Borrowing of Bits)

Of course, more bits borrowed means fewer individually addressable hosts that can be on the network. Sometimes, all the combinations and permutations can be confusing, so here are some tables of subnet possibilities.

4. Implementation of Subnetting on Packet Tracer

Consider an IP of Class C 192.168.1.0/27, using above IP calculate the subnets and implement the scenario in Cisco Packet Tracer.

Figure 3(Logical Subnets)



Calculation:
From above figure 3, we have:
Possible Subnets: $2^n = 2^3 = 8$
Possible Hosts = 32
Usable Hosts in each Subnet = 32 - 2 = 30

Note: 1st address of every subnet shows network address and last address shows Broadcast address. e.g. 0,32,64 & 96 represent Network address where 31,63,95 &127 represent Broadcast address.
Custom Subnet Mask = 255.255.255.224

Now implementing below figure 4 scenario on Cisco packet Tracer.

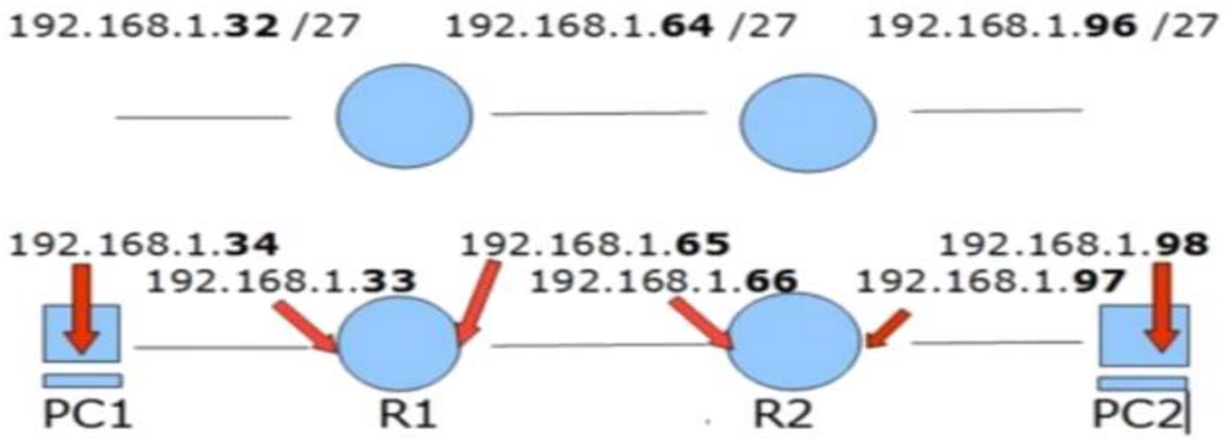


Figure 4(Scenario to implement)

We have taken two routers R1 & R2 and connected their Fast Ethernet interface Fa 0/0 with the switch. While routers connected with their serial interface 2/0.

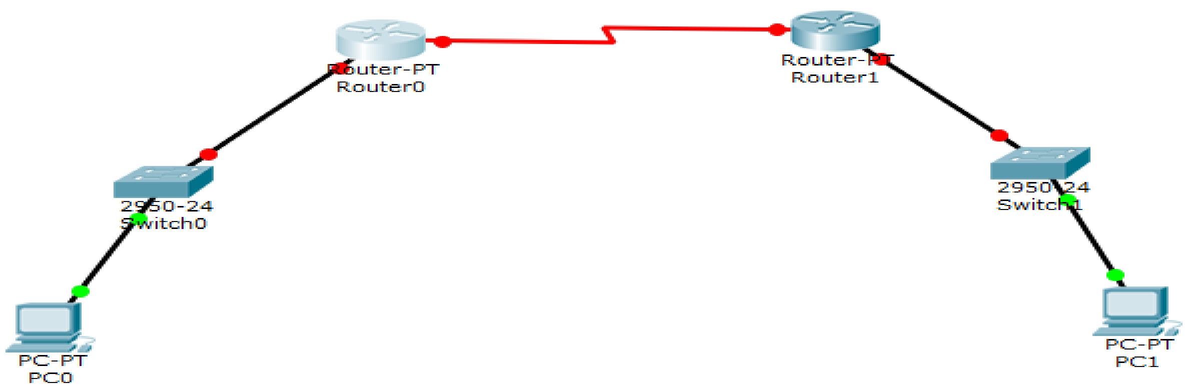


Figure 5(Topology of the network)

Now configuring PC0.

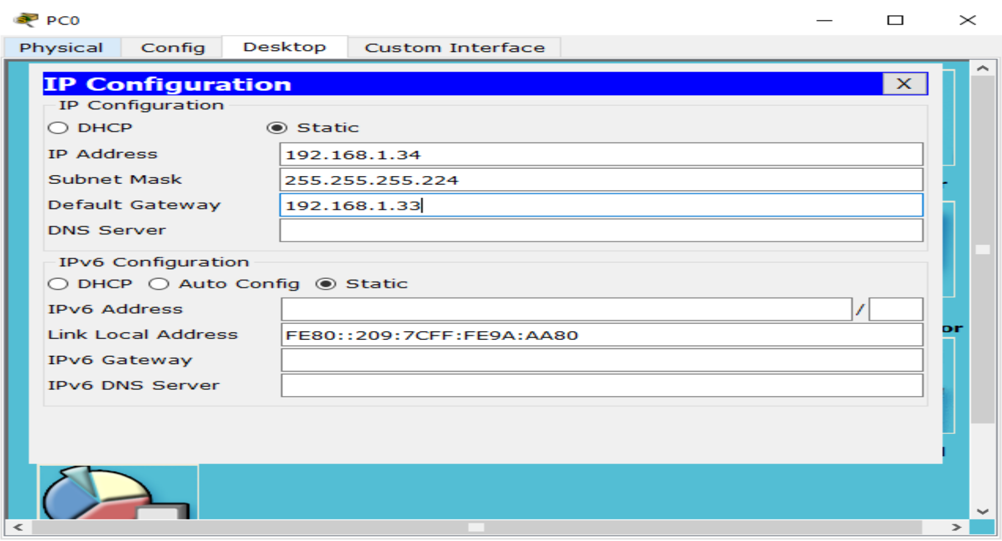


Figure 6(Configuration of PC1)

Now configure the Interface FastEthernet0/0 of Router R0.

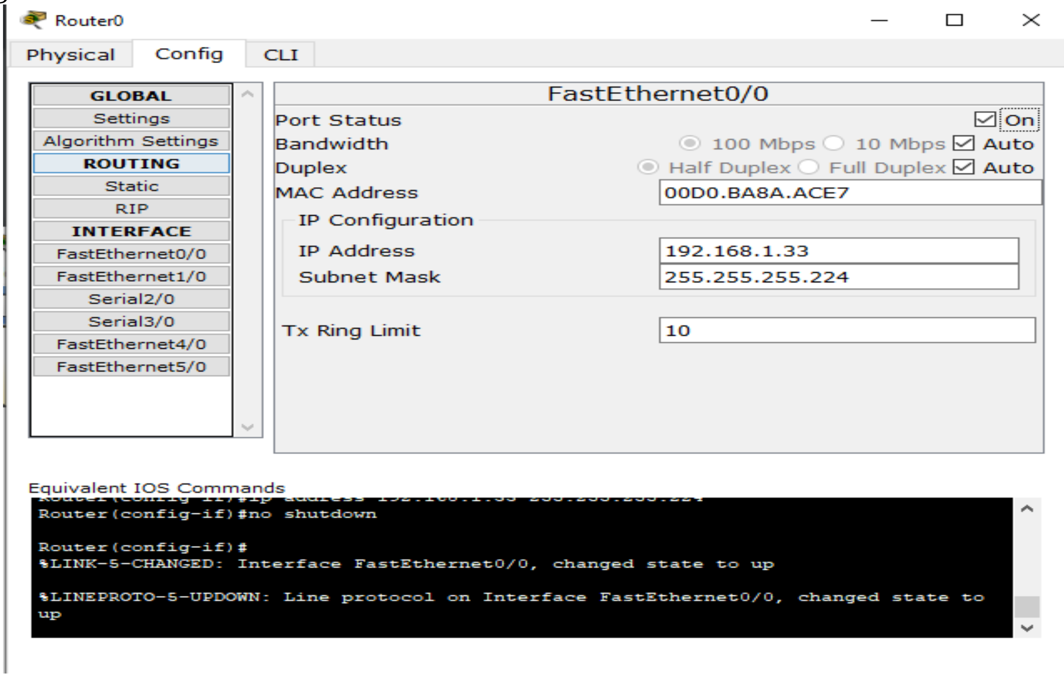


Figure 7 (Assigning IP to Fa0/0 of R0)

Now configure the Interface Serial2/0 of Router R0

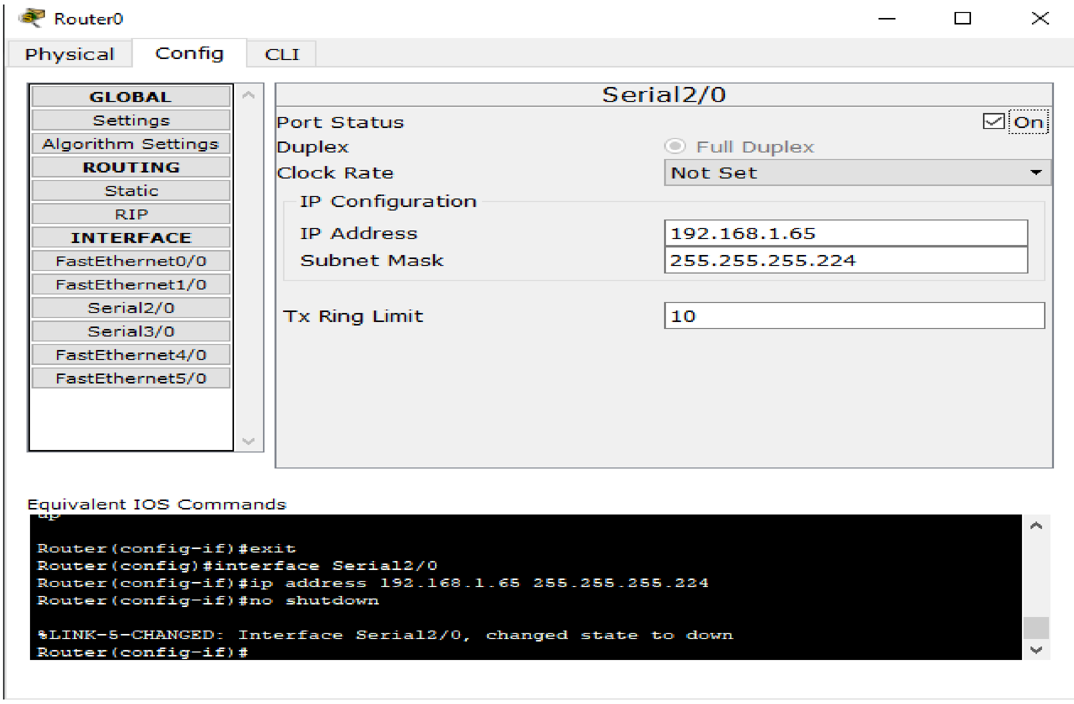


Figure 8 (Assigning IP to Se2/0 of R0)

After the configuring the Interface FastEthernet0/0 and Serial2/0 of Router R0. The topology of the network will be look like the below figure 9

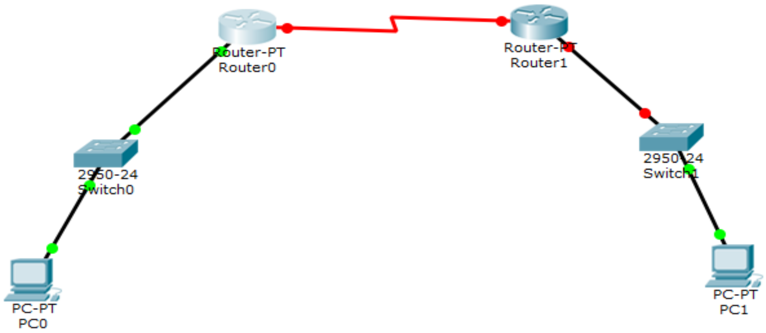


Figure 9 (Network Topology)

Now configure the Interface FastEthernet0/0 of Router R1

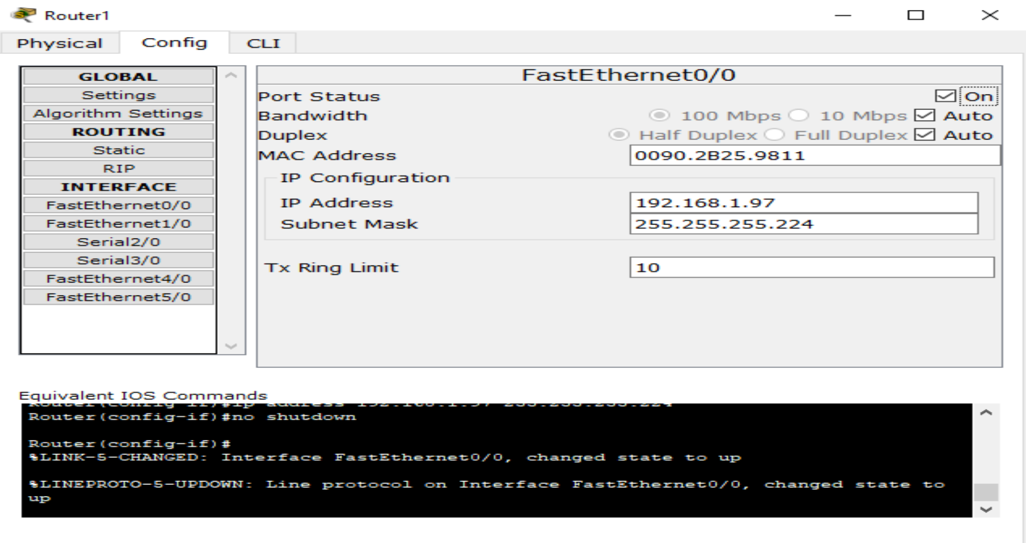


Figure 10 (Assigning IP to Fa0/0 of R1)

Configure the Interface Serial2/0 of Router R1

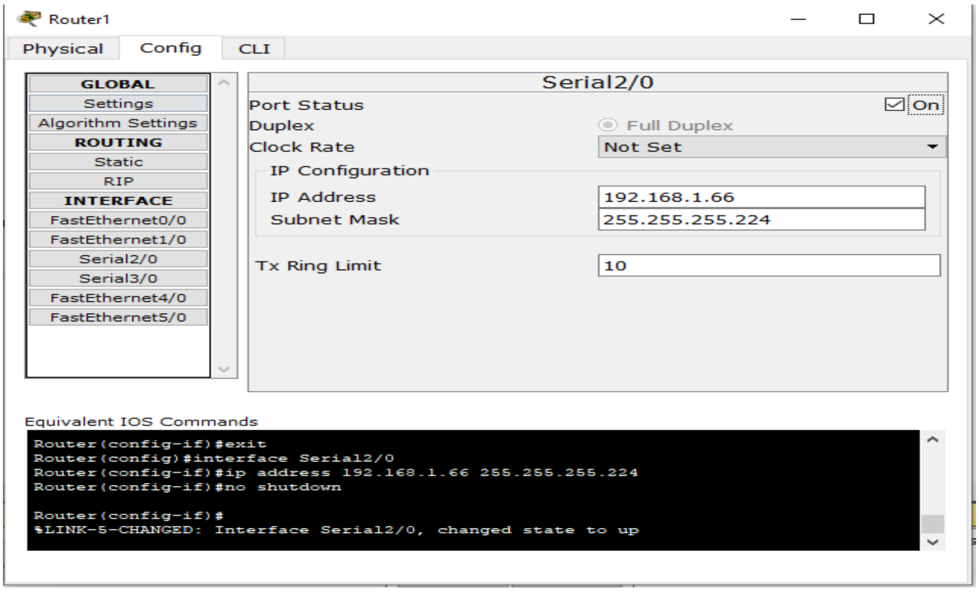


Figure 10 (Assigning IP to Se2/0 of R1)

Now configuring PC1.

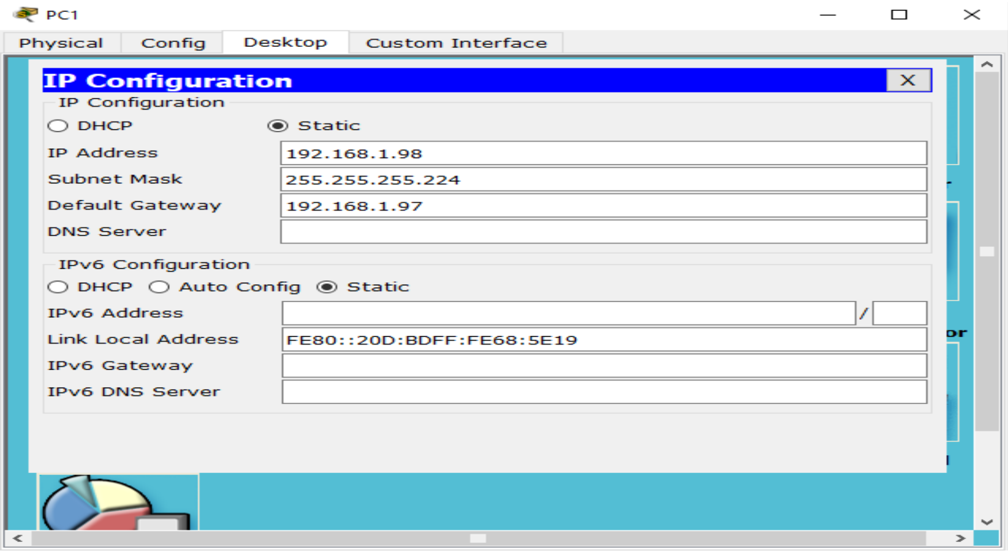


Figure 11(Configuration of PC1)

Now we have gone through the entire configuration, all the interfaces are up as shown in figure 12

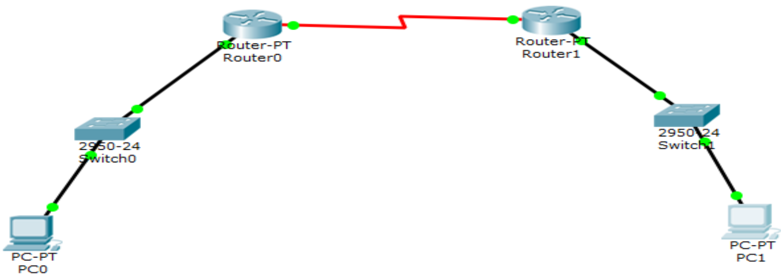


Figure 12(Topology with all interfaces up)

Now let start the pinging the interfaces from PC0.As we ping 192.168.1.33 and 192.168.1.65 we got the reply because these interface are directly connected to Router R0.

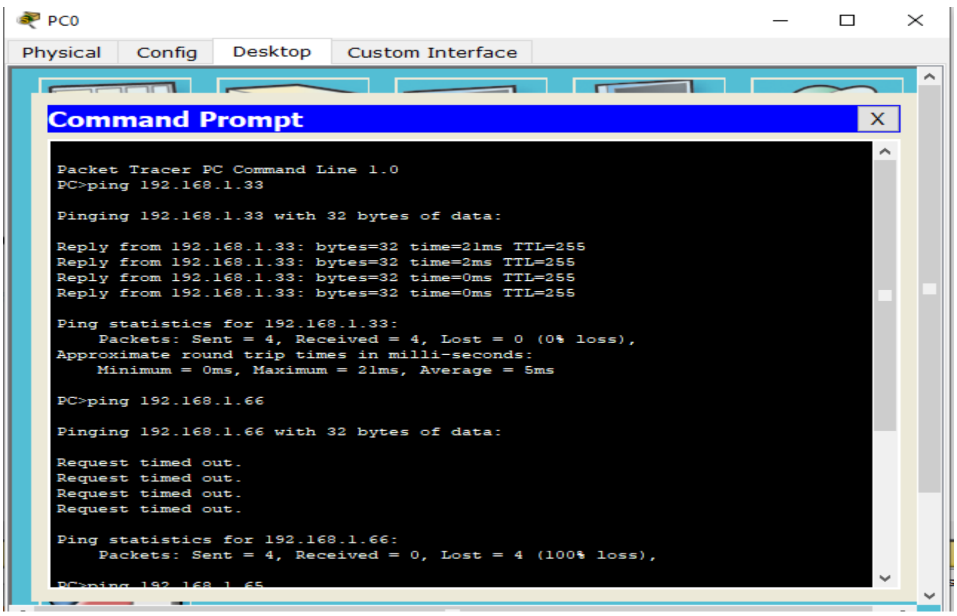


Figure 13(Ping on same and different network)

But when we ping 192.168.1.66 we got the Timed out because these interface are not directly connected to Router R1 as shown in figure 13.

Therefore, we have to add static route in Router R0.

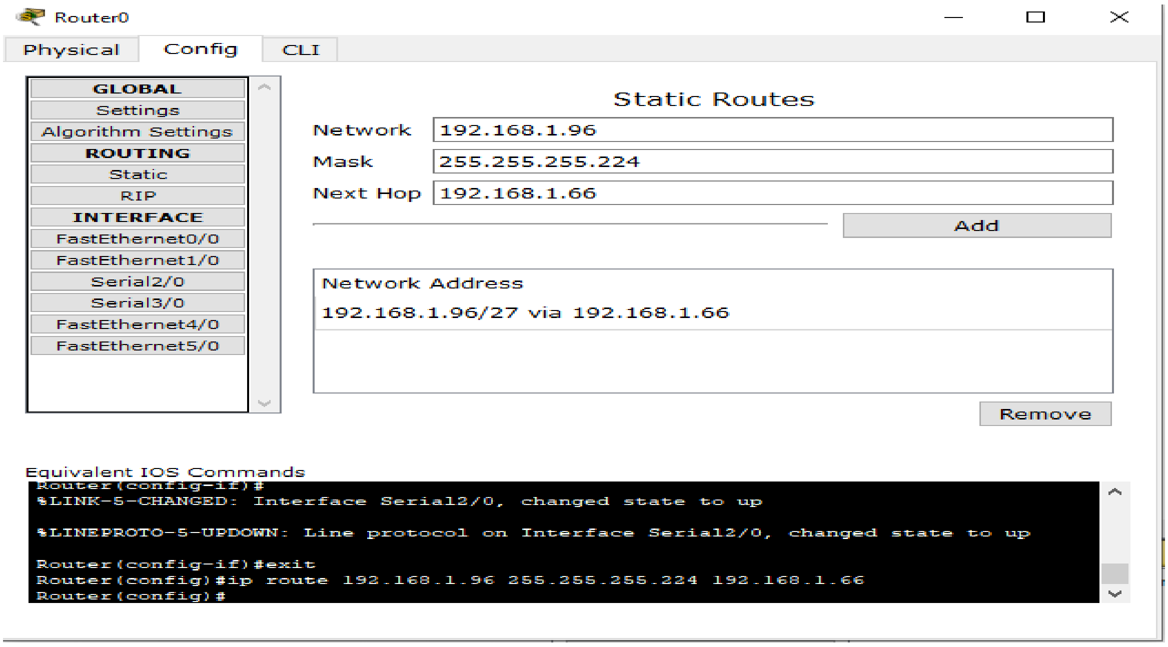


Figure 14(Adding static route on R0)

Therefore, we have to add static route in Router R1.

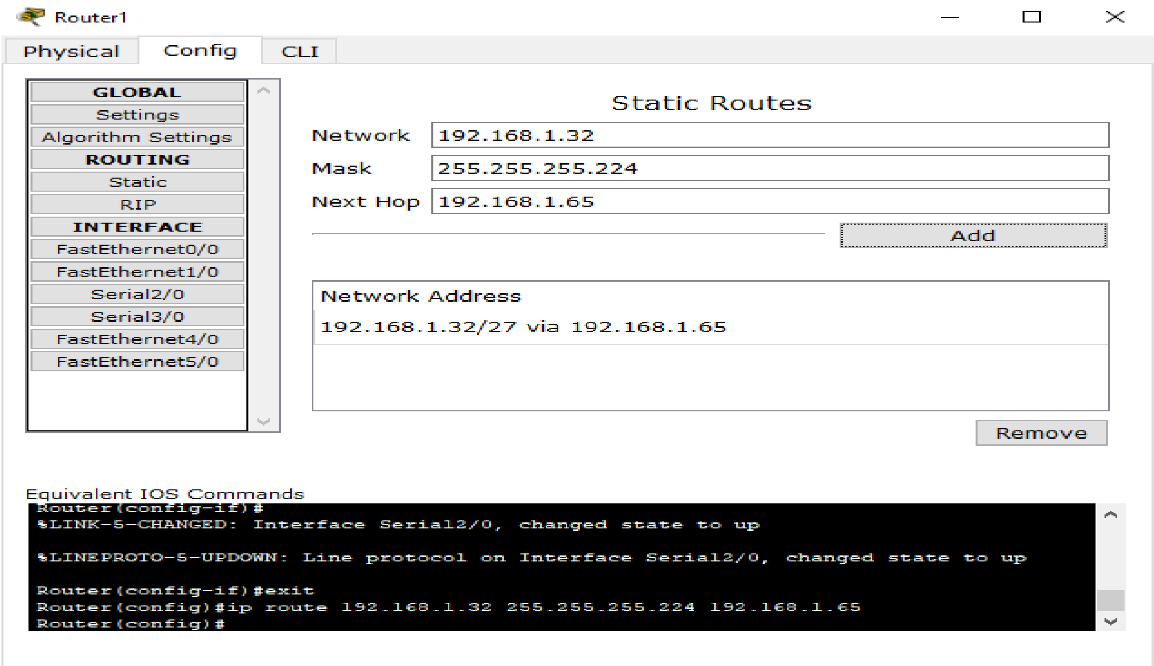


Figure 15(Adding static route on R0)

As you can see that we got the reply after adding the static route in Router R0

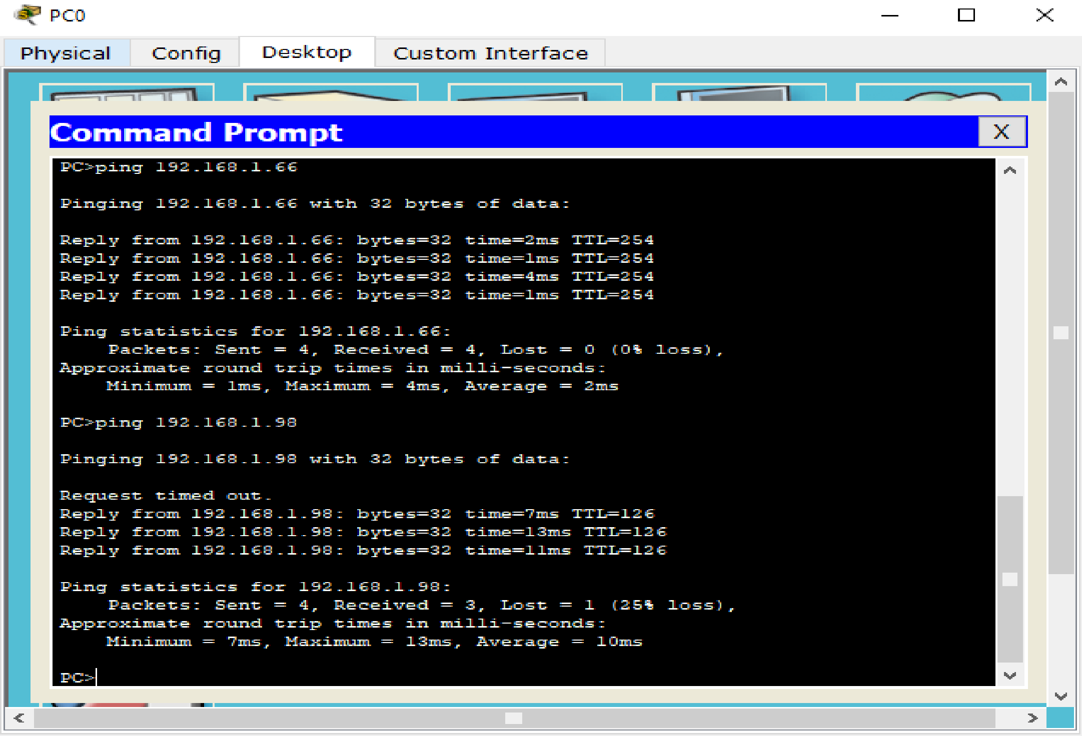


Figure 16(Ping Command Successful for indirect Network)

Now using show ip route command we can see all the details of routing table saved in R0.

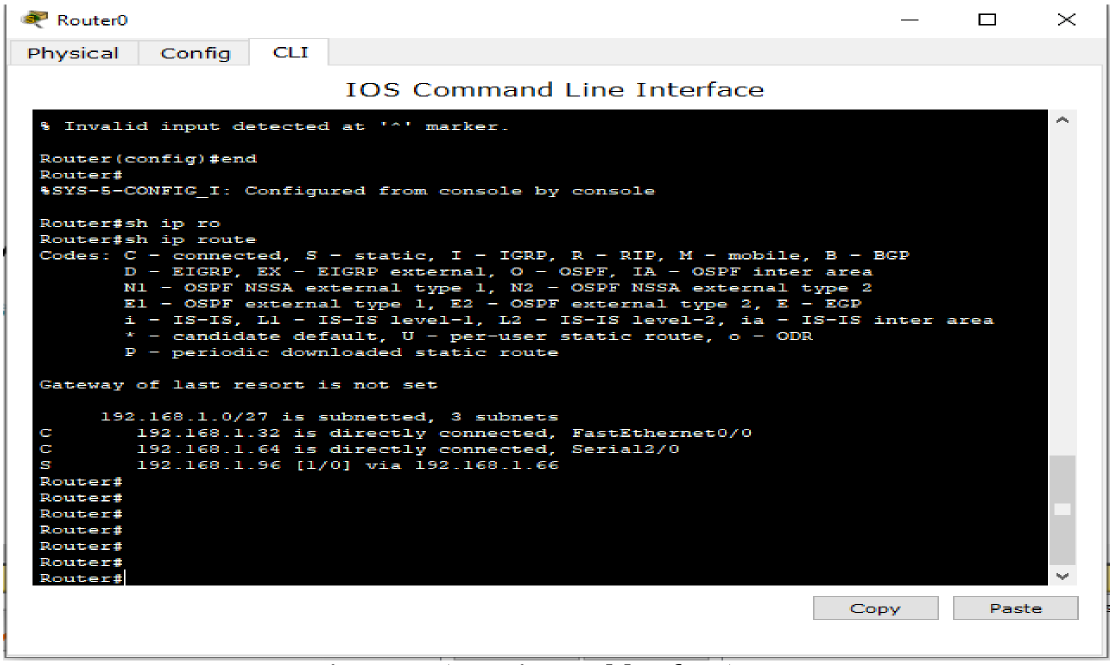


Figure 17(Routing Table of R0)

Now similarly add static route in Router R1 as shown in figure 18

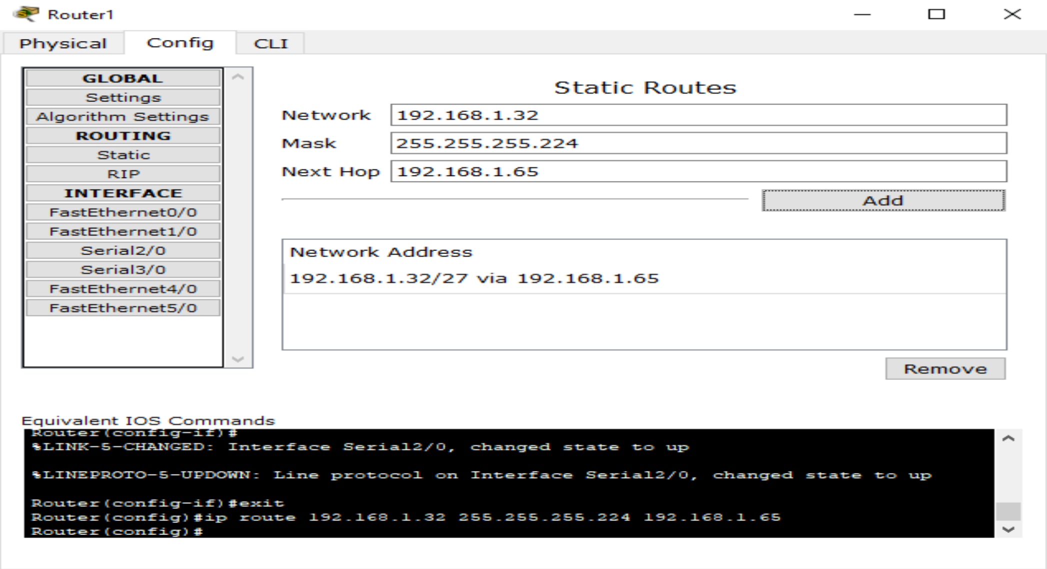


Figure 18(Adding static route on R1)

as you can see that we got the reply after adding the static route in Router R1

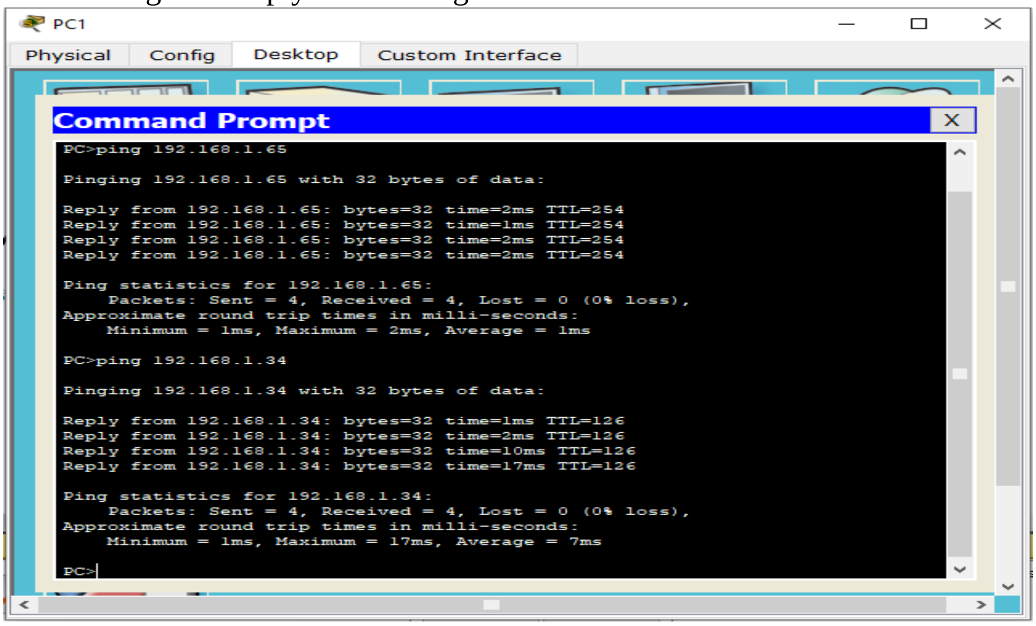


Figure 19(Ping Command Successful for indirect Network)

Now using show ip route command we can see all the details of routing table saved in R1.

Figure 20(Routing Table of R1)

5. Lab Exercise

Q1: Implement the above given example on cisco packet tracer but use network address as 10.20.0.0/24.

Q2: Let consider an example of subnetting for ABC Company. There are 3 departments i.e. Finance, HR and Development. You have to perform subnetting for the allocation of the given requirement

1. 120 PCs for Development
2. 35 PCs for Finance
3. 10 PCs for HR

The network address for the given scenario is 200.16.100.0/24.

Q3: Let consider an example of subnetting for FAST NUCES. There are 3 department i.e. CS, EE and BBA. You have to perform subnetting for the allocation of the given requirement

1. 90 PCs for CS
2. 50 PCs for EE
3. 20 PCs for BBA

The network address for the given scenario is 195.168.10.0/24.