University of Engineering and Technology Peshawar
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19JZELE0338

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REG_NUMBER : *19JZELE0338*

SECTION : *A*

SUBJECT : *COMPUTER COMMUNICATION NETWORKING*

SUBMITTED TO : *SYED UZAIR GILLANI*

DEPT : *ELECTRICAL COMMUNICATION*

SEMESTER PROJECT

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PROJECT TITLE: CAMPUS/UNIVERSITY SYSTEM NETWORK DESIGNING

INTRODUCTION:

A large university which has two campuses situated 20 miles apart. The university's students and staff are distributed in 4 faculties; these include the faculties of Health and Sciences, Business, Engineering/Computing and Art/Design.

Each member of staff has a PC and students have access to PCs in the labs. Create a network topology with the main components to support the following:

- **CAMPUS NETWORK:**

  A Campus network, Campus area network, corporate area network or CAN is a computer network made up of an interconnection of local area networks (LANs) within a limited geographical area.The networking equipments (switches routers) and transmission media (optical fiber, copper , CAT5 cabling etc.) are almost entirely owned by the campus tenant / owner.
  A campus area network is larger than a local area network but smaller than a metropolitan area network (MAN) or wide area network (WAN).
  College or university campus area networks often interconnect a variety of buildings, including administrative buildings, academic buildings, university libraries, campus or student centers, residence halls, gymnasiums, and other outlying structures, like conference centers, technology centers, and training institutes.

MAIN OBJECTIVES:

The main objectives of a campus network design are to provide efficient and reliable communication between devices on the campus, while also providing security and management of the network. Some of the specific objectives that a campus network design may aim to achieve include:

- **Scalability:** The ability to easily add new devices and users to the network without disrupting existing communication.
- **High availability:** The ability to ensure that the network remains operational even in the event of component failures.
- **Performance:** Providing fast and reliable communication between devices, with minimal delays and data loss.
- **Security:** Protecting the network and its users from unauthorized access and malicious attacks.
- **Manageability:** Having a centralized management system for monitoring and controlling the network.
- **Interconnectivity:** Allowing communication between different networks, such as between different buildings, as well as between wired and wireless devices.
- **Quality of Service (QoS):** The ability to provide different levels of service to different types of network traffic, such as prioritizing voice and video traffic over data traffic.
- **Flexibility and Adaptability**: Having a network design which can be easily adapted to changing requirements, such as accommodating wifi over new areas, on-demand bandwidth needs.

COMPONENTS USED:

- Three Routers(Main-Router,Branch-Campus-Router & Cloud-Router)
- Two multilayer(L3) Switches (Main-campus L3 switch & Branch campus L3 switch)
- Access Layer Switches
- PC’s and printers(End devices)
- Servers(FTP,Web & Email servers)

METHODOLOGY:

a. Create a network topology with the main components to support the following;

- Main Campus:
  - **Building A:** Administrative staff in the departments of management, HR and finance. The admin staff PCs are distributed in the building offices and it is expected that they will share some networking equipment (Hint: use of VLANs is expected here). The Faculty of Business is also situated in this building.
  - **Building B:** Faculty of Engineering and Computing and Faculty of Art and Design.
  - **Building C:** Students' labs and IT department. The IT department hosts the University Web server and other servers - There is also an email server hosted externally on the cloud.
- Smaller campus:
  - Faculty of Health and Sciences (staff and students' labs are situated on separate floors).

b. You will be expected to configure the core devices and few end devices to provide end-to-end connectivity and access to the internet servers and the external servers.

- Each department/faculty is expected to be on its own separate IP network.
- The switches should be configured with appropriate VLANs and security settings.
- RIPv2 will be used to provide routing for the routers in the internal network and static routing for the external server.
- The devices in building A will be expected to acquire dynamic IP addresses from a router-based DHCP server.

MAIN TASKS:

TASK 1**:** Our task is to Plan,Design and Prototype the network topology for university's network using Cisco Packet Tracer.

TASK 2: Configure in Packet Tracer the network with appropriate settings to achieve the connectivity and functionalities specified in the requirements.

TECHNOLOGIES IMPLEMENTED:

1. Creating a network topology using Cisco Packet Tracer.
2. Hierarchical Network Design.
3. Connecting Networking devices with Correct cabling.
4. Creating VLANs and assigning ports VLAN numbers.
5. Subnetting and IP Addressing.
6. Configuring Inter-VLAN Routing (Router on a stick).
7. Configuring DHCP Server (Router as the DHCP Server).
8. Configuring SSH for secure Remote access.
9. Configuring RIPv2 as the routing protocol.
10. End-Device Configurations.
11. Test and Verifying Network Communication.

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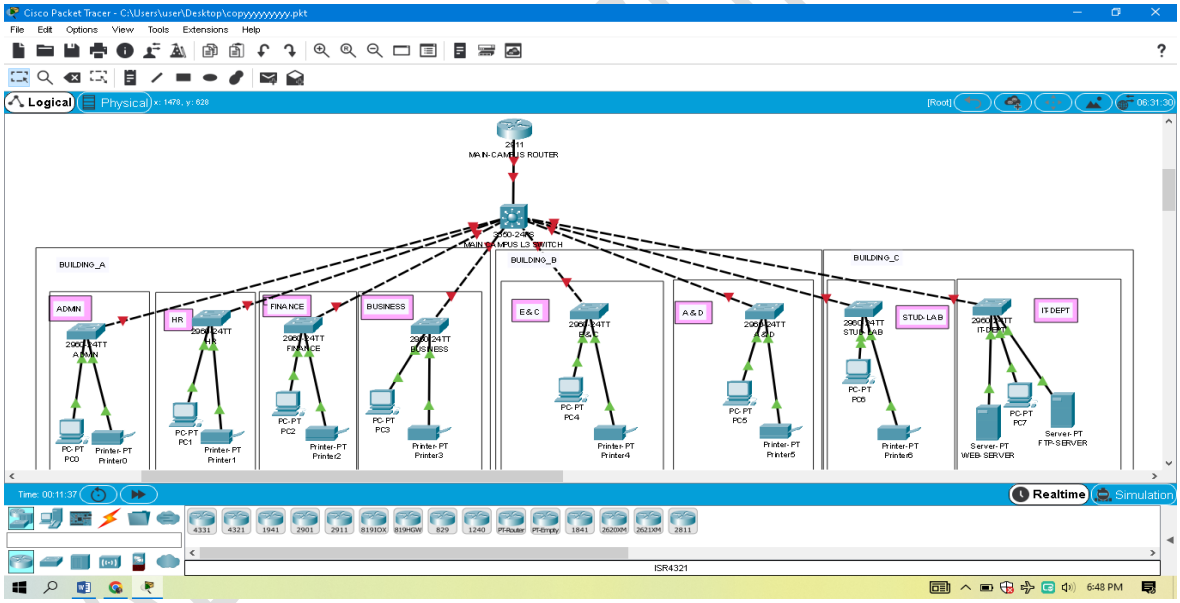
1. Procedure For Creating A Hierarchical Network Topology:

First of all we have to open Cisco Packet Tracer and then we have to do work in the workspace for creating a network topology.

As we have to build hierarchical model for creating network topology. We have **Core**, **distribution** & **Access layers** at hierarchical model. So we have to add *Router* at the *Core layer*, at *distribution layer* we have to add/set *distribution layer switches(L3)* & at the *Access layer* we have to add *Access layer Switches.*

Now we have to 1st drag a Router to the workspace and named it as Main-campus-router and then drag L3 switch to the workspace and then we have to drag access layer switches for each department in the buildings. At last we have to connect the End-devices with Access layer Switches as shown in the below screenshot;



Now we have to create a Branch Campus in the same way as mentioned above , so that we have to connect that campus to the main campus through Routers as shown in the below screenshot;

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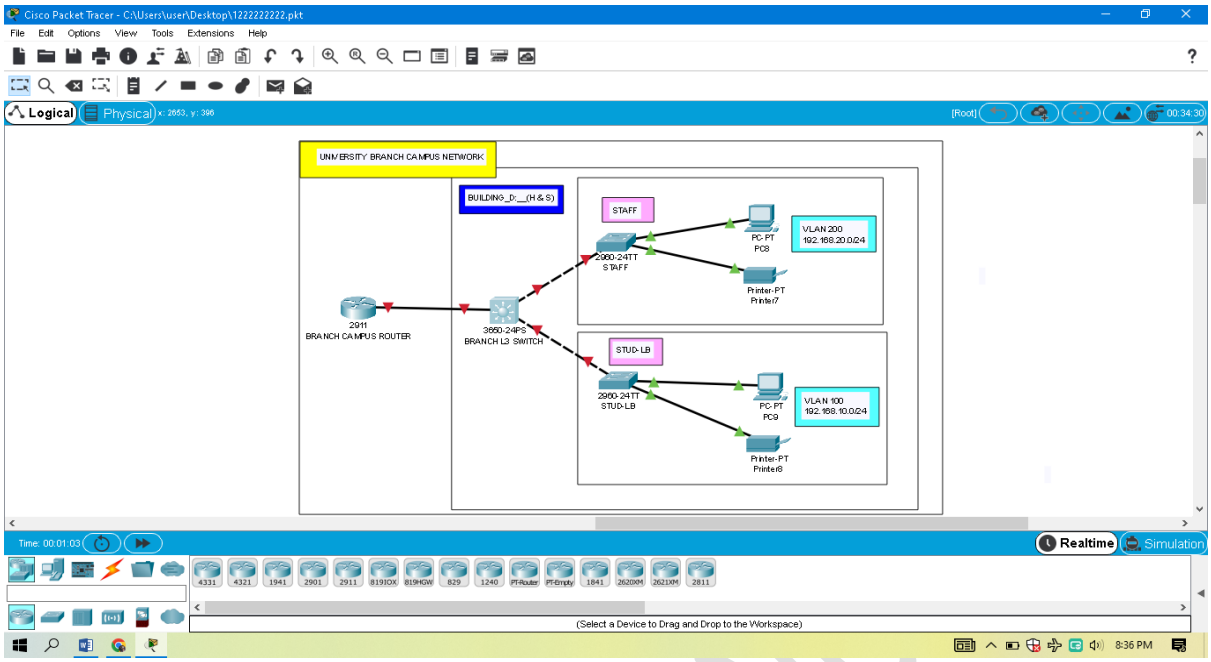
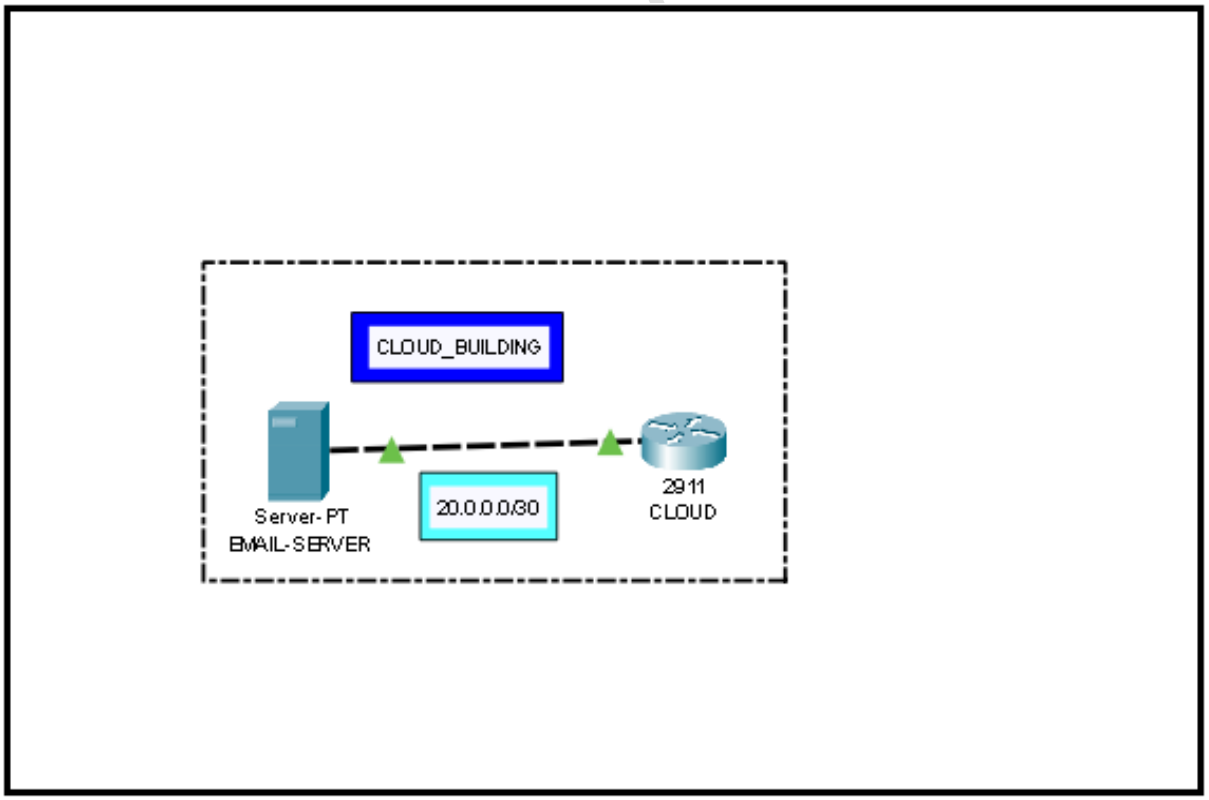


In the same way we have to create a cloud building also and then we have to connect Cloud_Router to the Main router as shown below;



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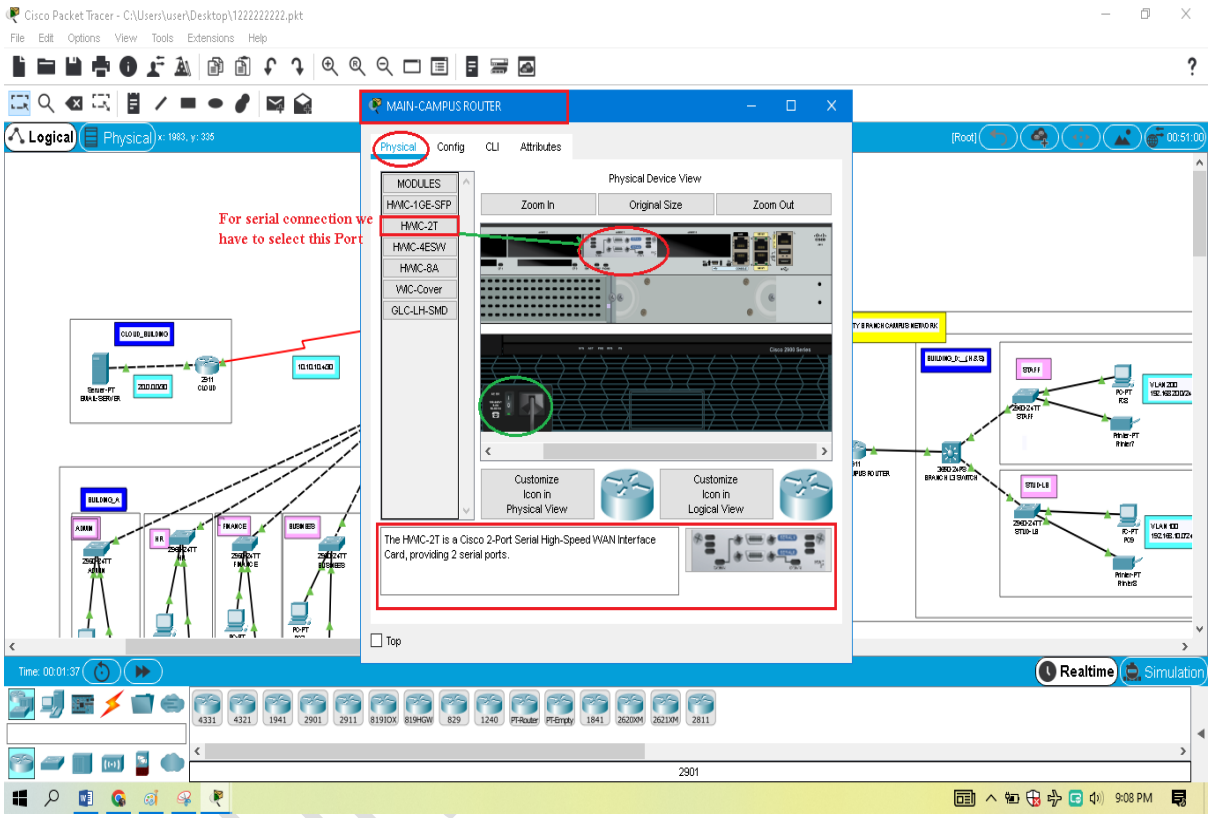
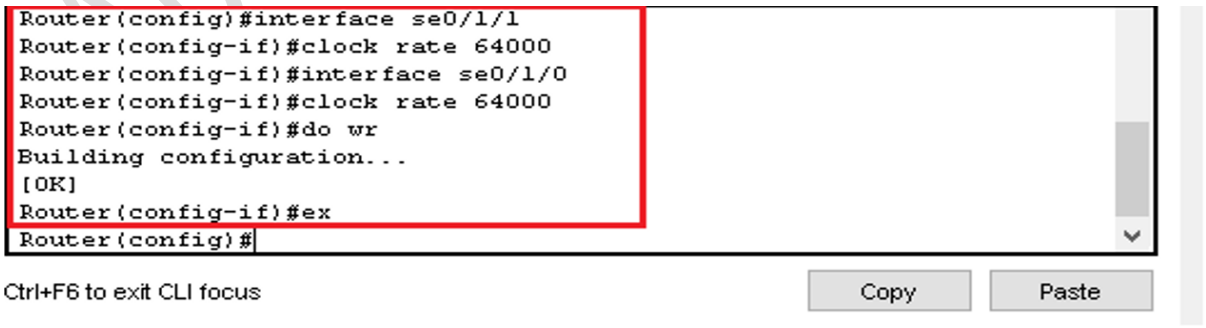
2. Procedure For Connecting Networking devices with Correct cabling:

Now we have to connect these all building's routers to the Main-Router serially.

For serially connecting Routers, we have to first add a ***HWIC-2T port*** to each Router as shown below;



Now we have to *Configures INTERFACES serially*,by doing so we have to type commands in the CLI of the routers as shown in the below screenshot;



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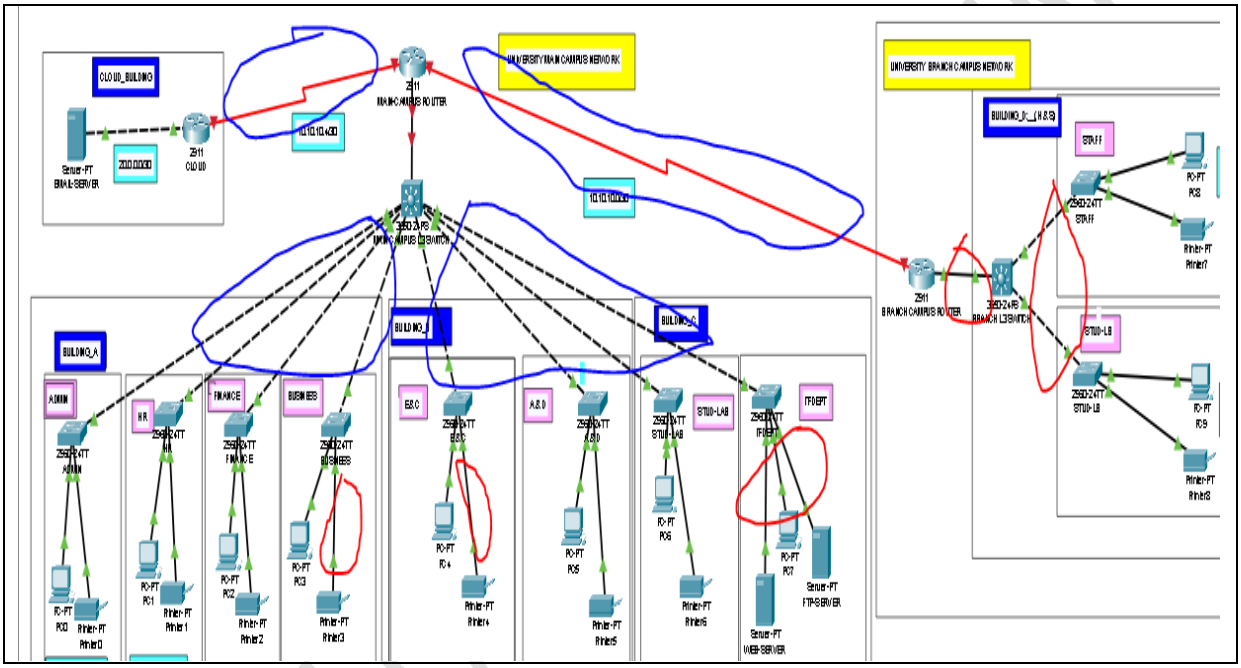
Do the same for all Routers,so to configure it as serially.

For other connections we had just choosen **Automatic Choose Connection Type** in the packet tracer for our ease. But actually we have to choose proper cables for proper connection,as for *different devices* connectivity we have to choose **Copper Straight Through Cable** and for *same devices* we have to choose **Copper-Cross Over Cable** as shown below;



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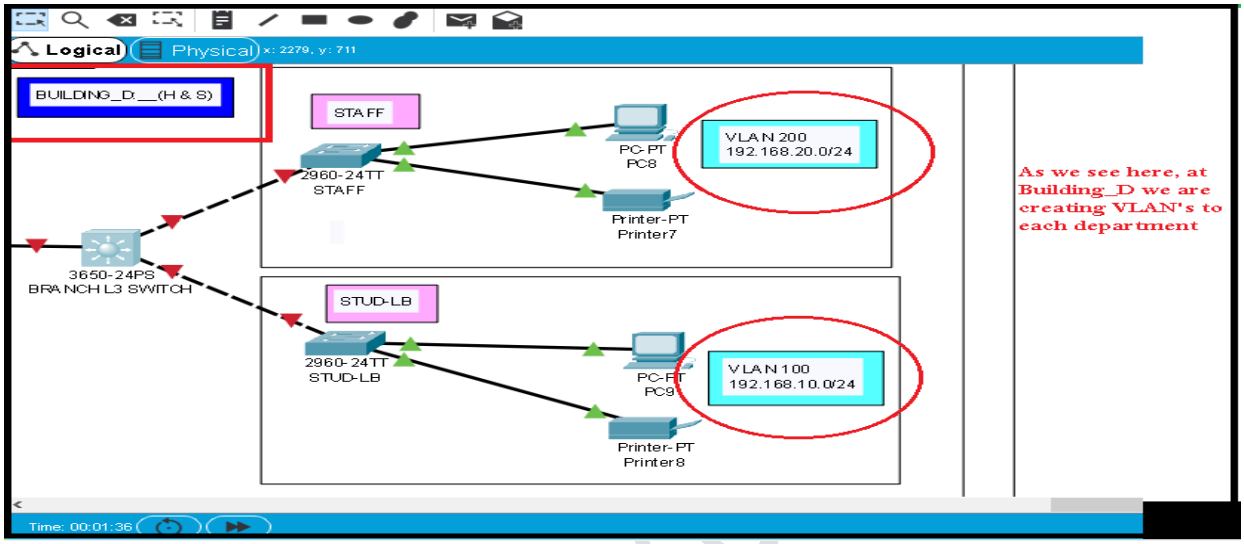
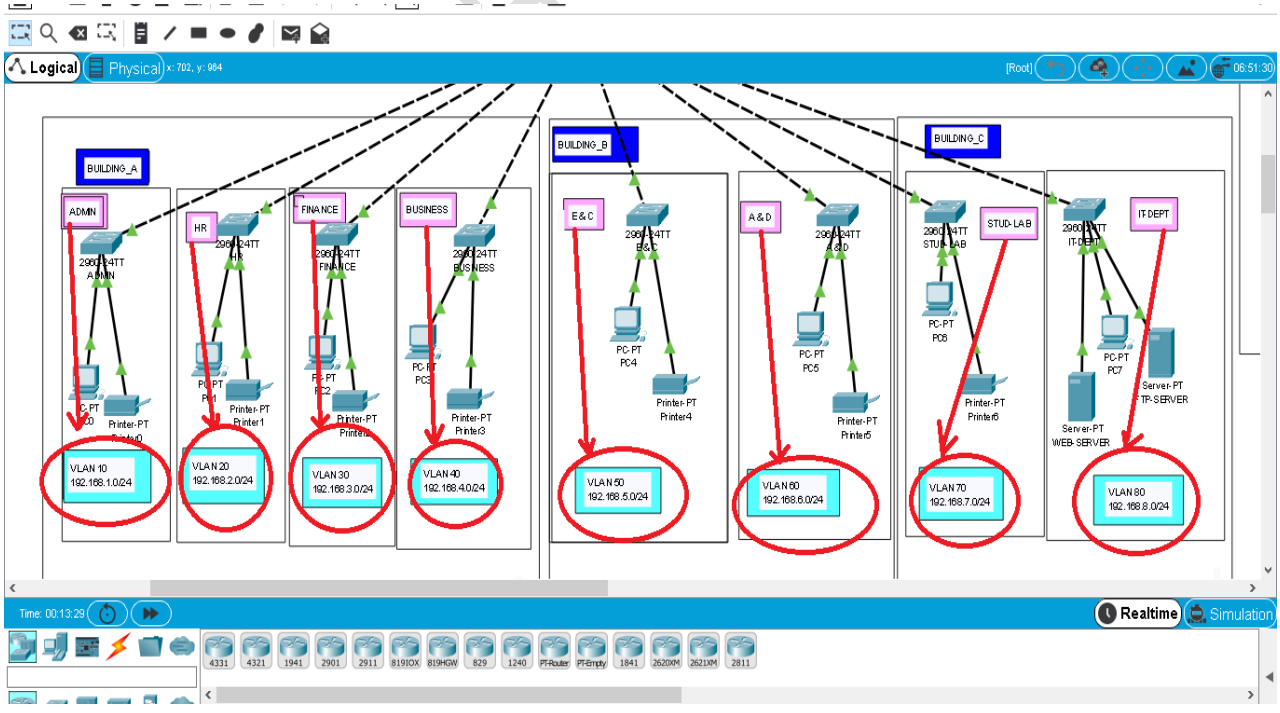
3. Procedure For Creating Vlans And Assigning Ports VLAN Numbers:

Now we have to create VLAN for each department as shown in the below screenshots.

Branch Campus;



Main Campus;



Router interfaces and Cloud department;

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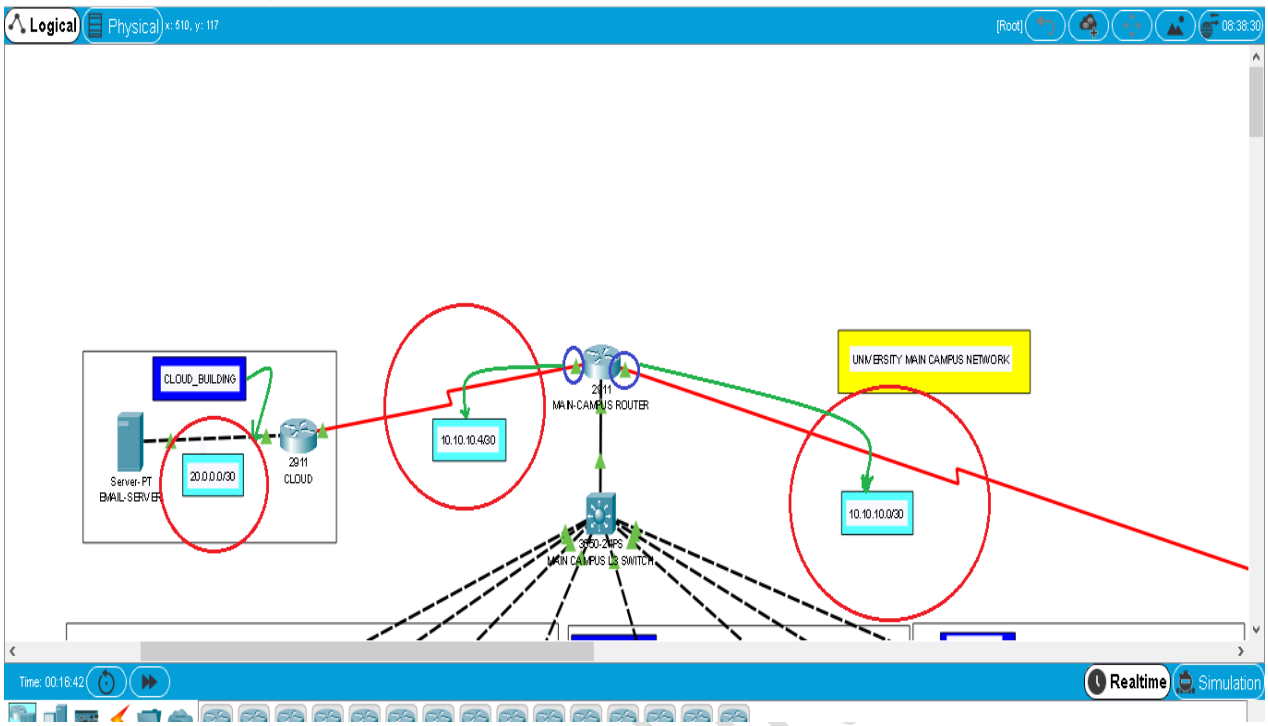
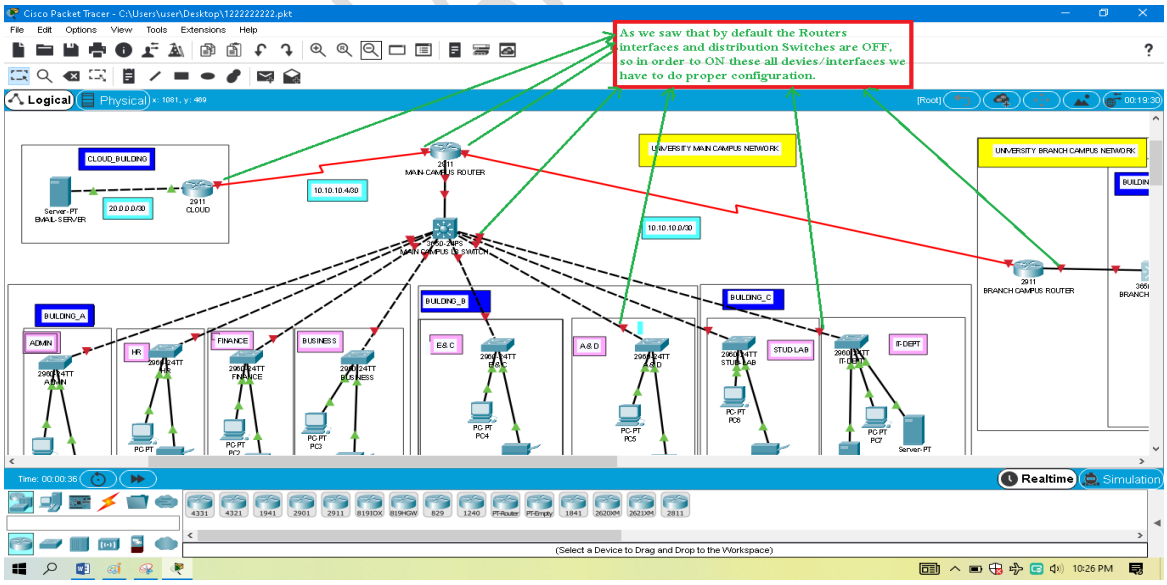


4. Procedure for Configuration of different devices:

- Routers



As in the above pic we saw that by default all the *interfaces of the Routers* and *L3 switches* are OFF so we have to Turn it ON, for this we have to do proper configuration.

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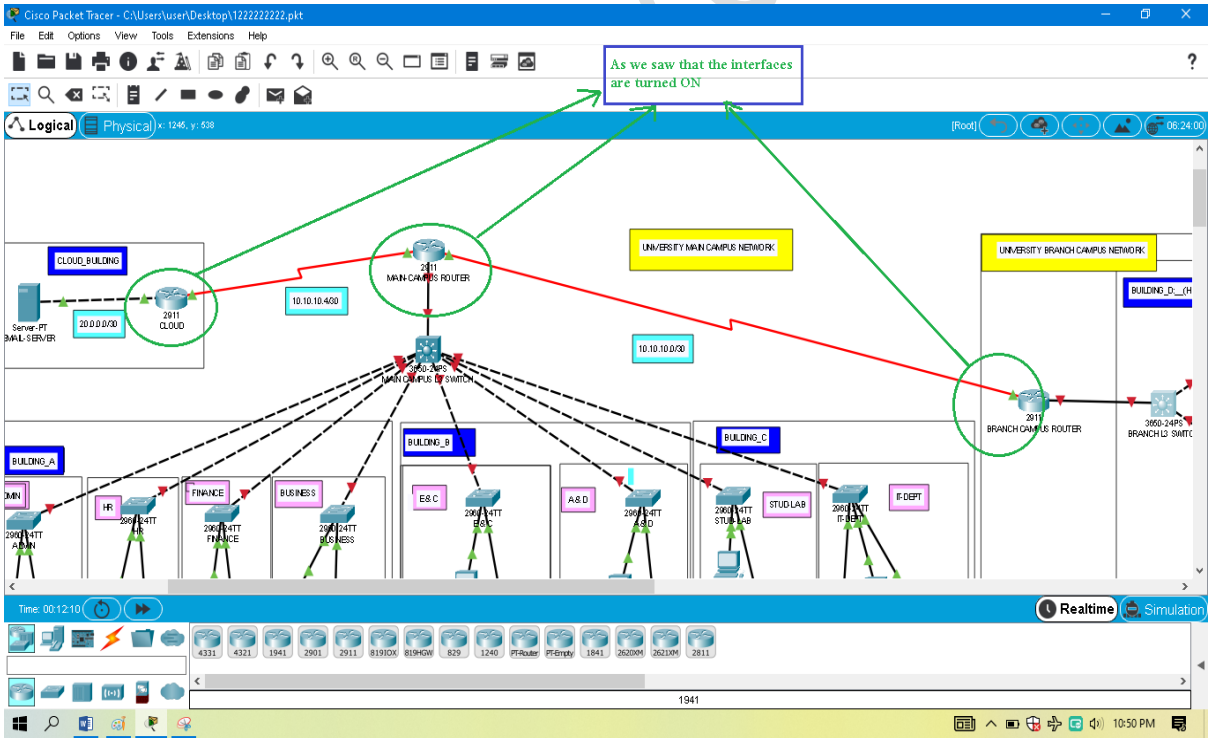
Now we have to enter commands in CLI to turn ON various interfaces of the Routers.

```
Router#
Router#
Router#en
Router#
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int gig0/0
Router(config-if)#no sh
Router(config-if)#
Router#
```

Now we have to do the same in other routers too to turn ON its specific interfaces that which we needed as shown below;



- L3 Switches

  To turn ON the L3_Switches we have to simply go to the switch and open its physical Tab and just Drag an AC-POWER_SUPPLY to its empty port as shown below;

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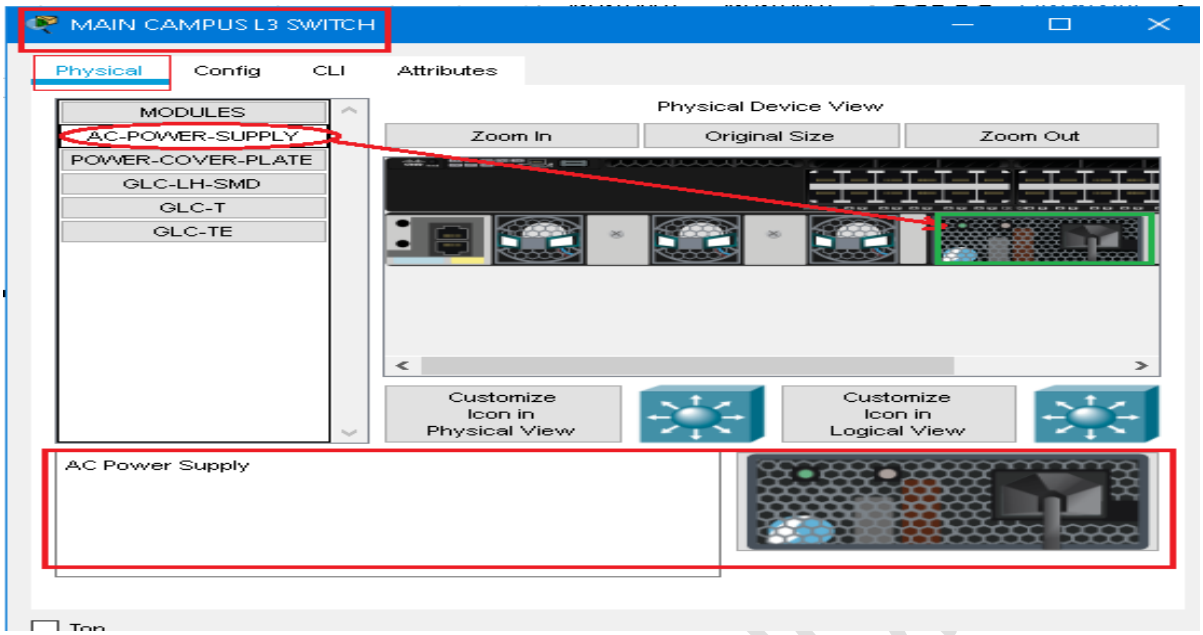
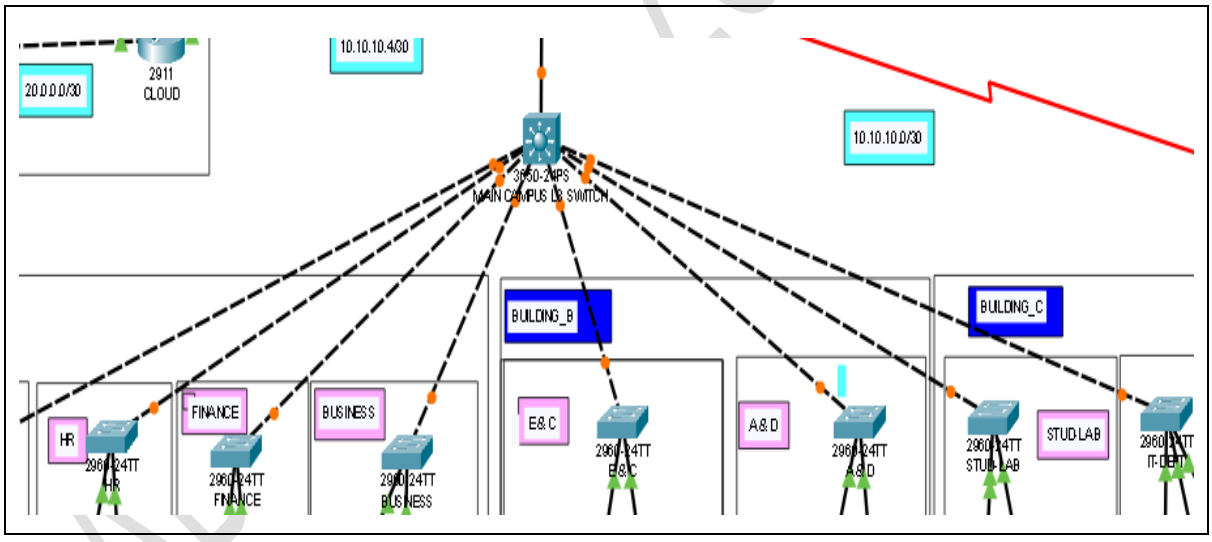


Now we saw that Distribution layer Switch will turned ON in a while as shown in the below screenshot;



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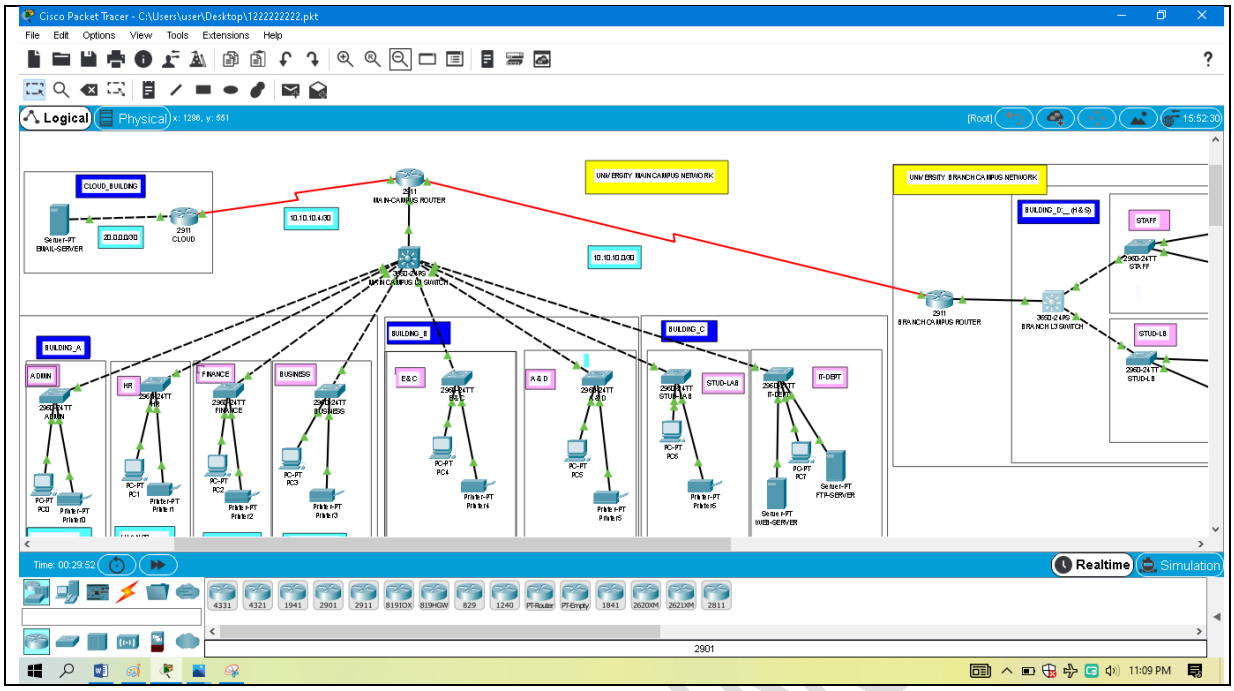
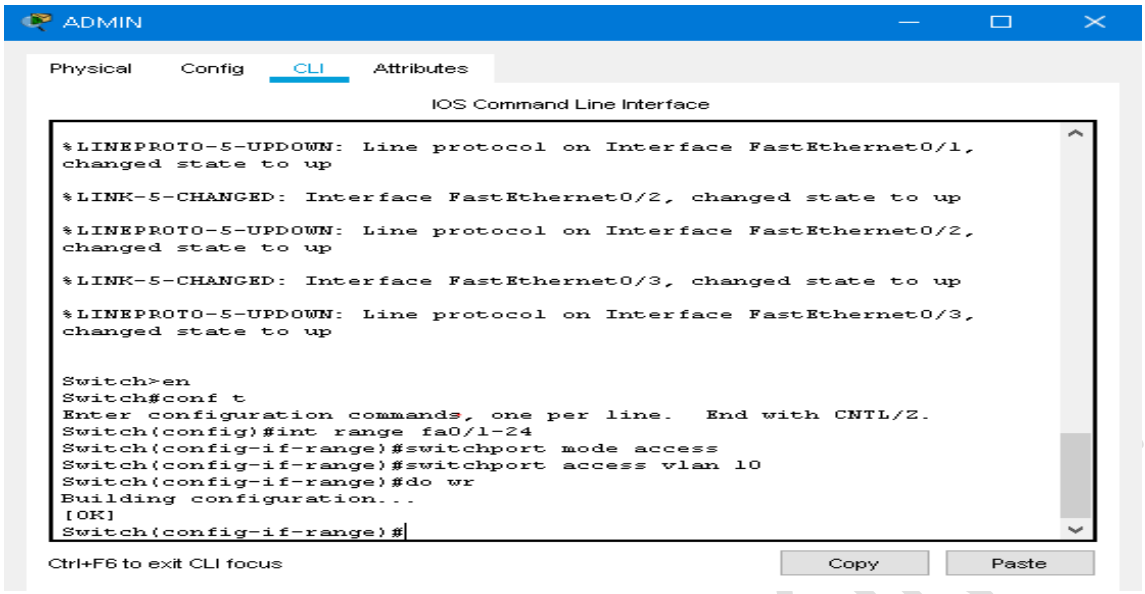


5. PROCEDURE FOR VLAN CONFIGURATION ON THE ACCESS & DISTRIBUTION LAYER SWITCHES:

- **Config For Access Layer Switch:**

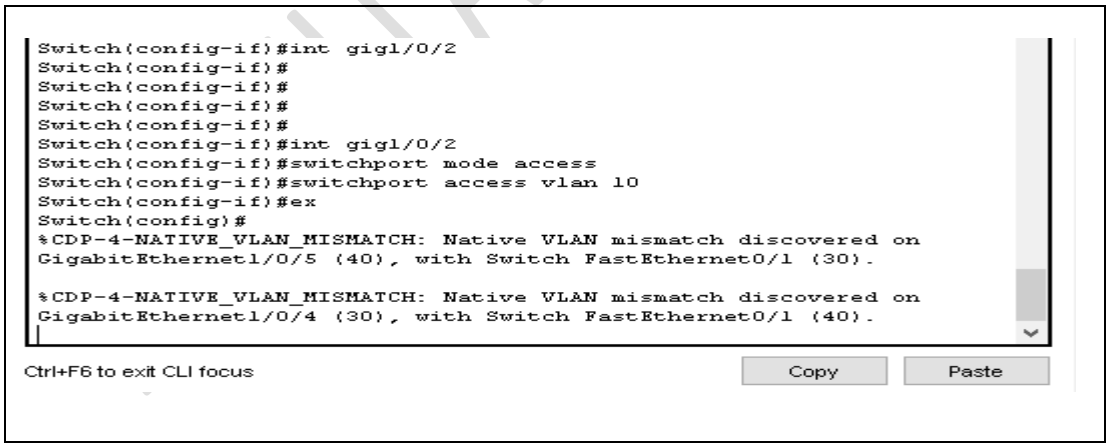
To configure VLAN's to the Access layer switch we have to type commands in the CLI of that Switch to configure its all interfaces to that specific VLAN as shown below.



As we saw in the above screenshot we had configured VLAN's for the ADMIN-DEPARTMENT(Switch) successfully. In the same way we have to do configuration for all the Access layer Switches of all the departments.

- **Config for Distribution Layer Switch:**

Now to configure Vlan's for distribution layer Switches we have to open the CLI of that Switch and type the command as shown below;



In the above pic we saw that the **Configuration of interface_gig1/0/2** is only for *admin department(having VLAN_10).*

Now we have to do the same for all of the interfaces of the Distribution layer Switch.

6. Procedure For Configuring The One Interface Of The L3 Switch To The Router's Interface:

Procedure For Configuring The One Interface Of The L3 Switch To The Router's interface we have to type the command in the below screenshot;

```
Switch(config-if)#
Switch(config-if)#int gigl/0/l
Switch(config-if)#switchport trunk encapsulation
% Incomplete command.
Switch(config-if)#switchport trunk encapsulation dotlq
Switch(config-if)#switch mode trunk
Switch(config-if)#ex
```

➔ By doing so, we had done the distribution layer configuration.

7. Procedure For Assigning IP Addresses To All The Interfaces Of The Routers & Also Configuring Inter-VLAN Routing:

- 1st we are going to assign IP addresses to the interfaces of the Router, so for this we have to go to the Router's CLI and type the command to configure IP to that particular interface as shown below;

```
Router>
Router>
Router>
Router>
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int se0/1/1
Router(config-if)#ip address 10.10.10.1 255.255.255.252
Router(config-if)#ex
Router(config)#int se0/1/0
Router(config-if)#ip address 10.10.10.5 255.255.255.252
Router(config-if)#ex
Router(config)#do wr
Building configuration...
[OK]
Router(config)#
```

Now we have to do the same for all of its interfaces that are directly connected to other Routers.

- Configuring inter-VLAN Routing for all the Vlan's connected to that particular interfaces;

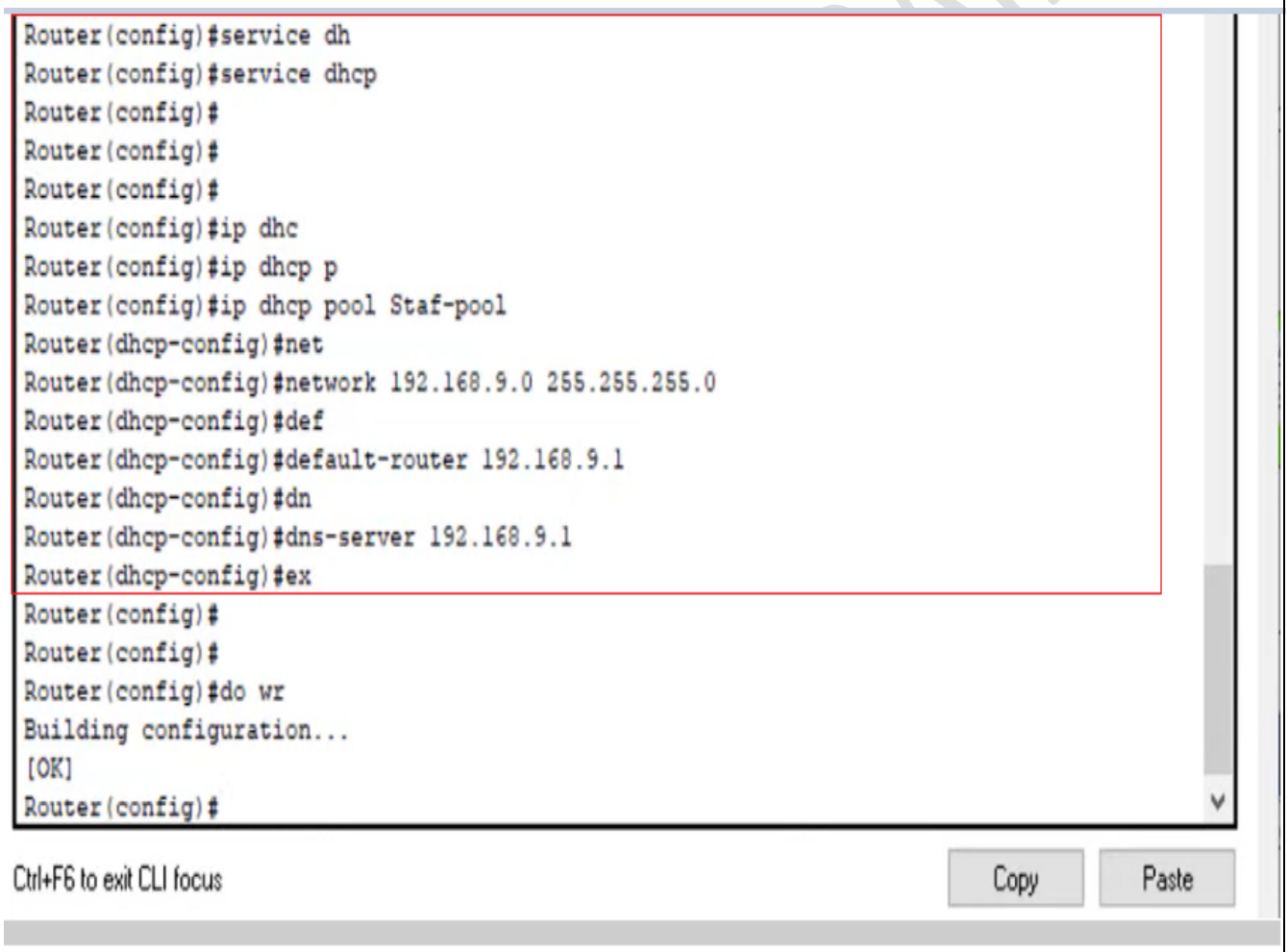
```
Router(config)#
Router(config)#int gig0/0.90
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.90, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.90, changed state to
up

Router(config-subif)#
Router(config-subif)#enc
Router(config-subif)#encapsulation d
Router(config-subif)#encapsulation dot1Q 90
Router(config-subif)#ip add
Router(config-subif)#ip address 192.168.9.1 255.255.255.0
Router(config-subif)#ex
Router(config)#
```

We have to do inter-Vlan Routing for all those interfaces which are connected to the VLAN's through Switches.

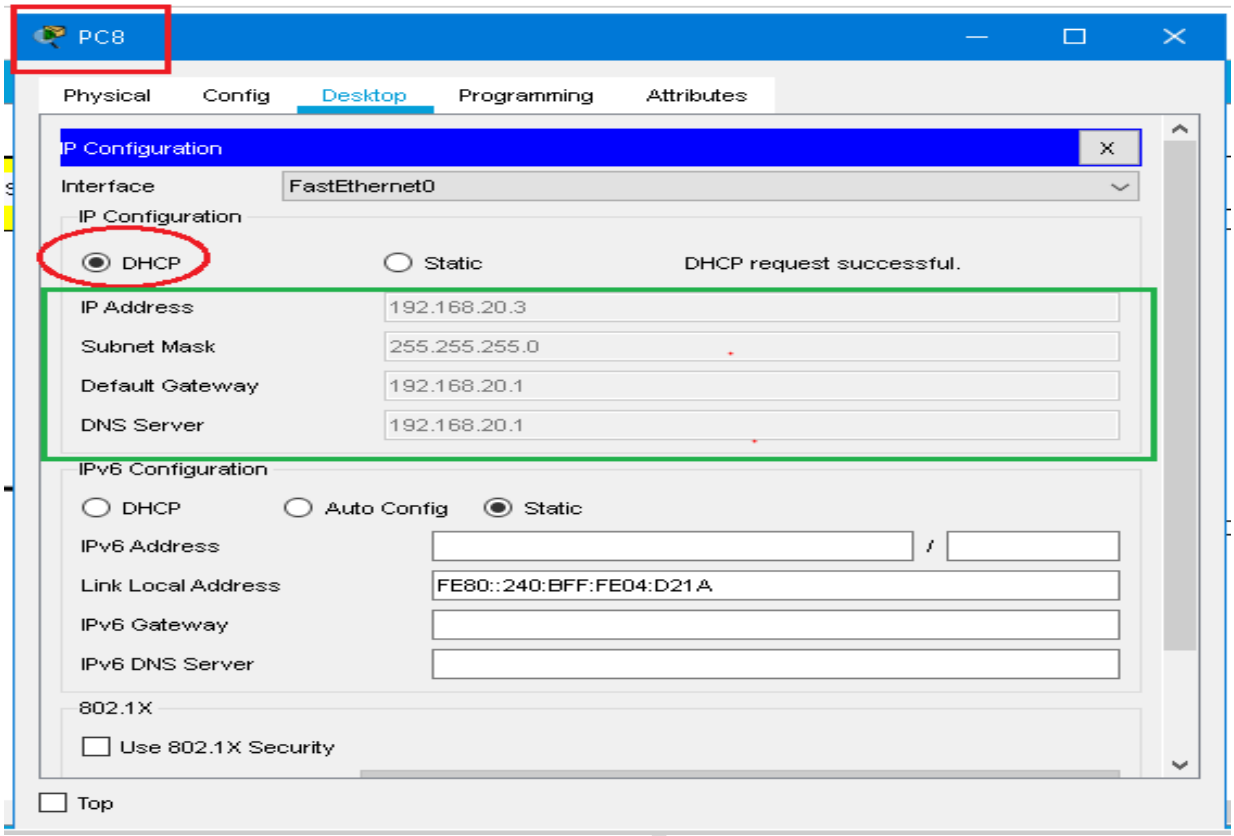
8. Procedure for Configuring DHCP Server (Router as the DHCP Server):

Now we have to configure DHCP_Server to the Router, to use Router as DHCP-Server.

By doing so we have to go to the CLI of the router and type command For DHCP-Server to be configured as shown below;



Do the same DHCP Configuration for all the departments.



9. Procedure for Configuring RIP version-2 as the routing protocol:

Now we have to configure the RIP Version-2 as the Routing Protocol in all Routers, as we have to communicate/share Data across all the Routers.(It means that all the branch campuses will be connected to each other→ as it is our main Goal).

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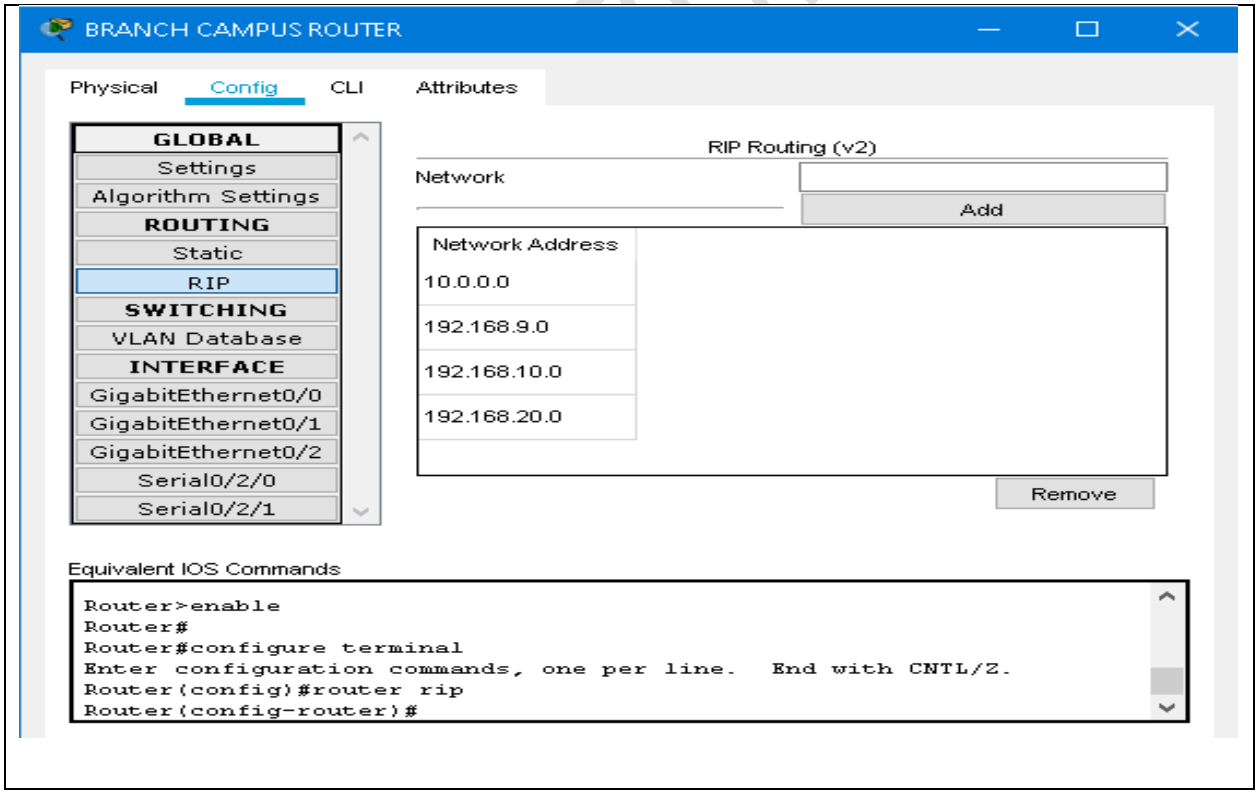
For doing so we have to go to the CLI of the Router and type command to configure RIPv2 as shown below;

```
Router(config)#router rip
Router(config-router)#v
Router(config-router)#version 2
Router(config-router)#networ
Router(config-router)#network 10.10.10.0
Router(config-router)#network 10.10.10.4
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)#network 192.168.4.0
Router(config-router)#network 192.168.5.0
Router(config-router)#network 192.168.6.0
Router(config-router)#network 192.168.7.0
Router(config-router)#network 192.168.8.0
Router(config-router)#ex
```



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10. Testing and Verifying Network Communication:

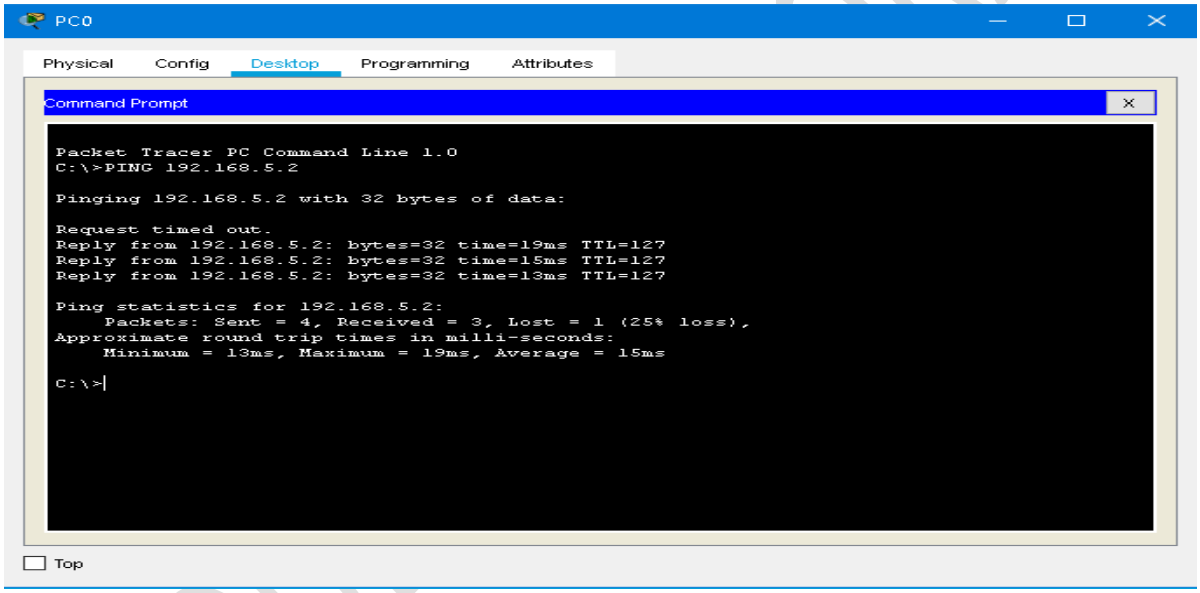
Now we have to test the connections in both Realtime mode and Simulation mode.

- **Realtime Mode:**

In this mode we will use ping command to Testing/Verifying the Network Communication/config.

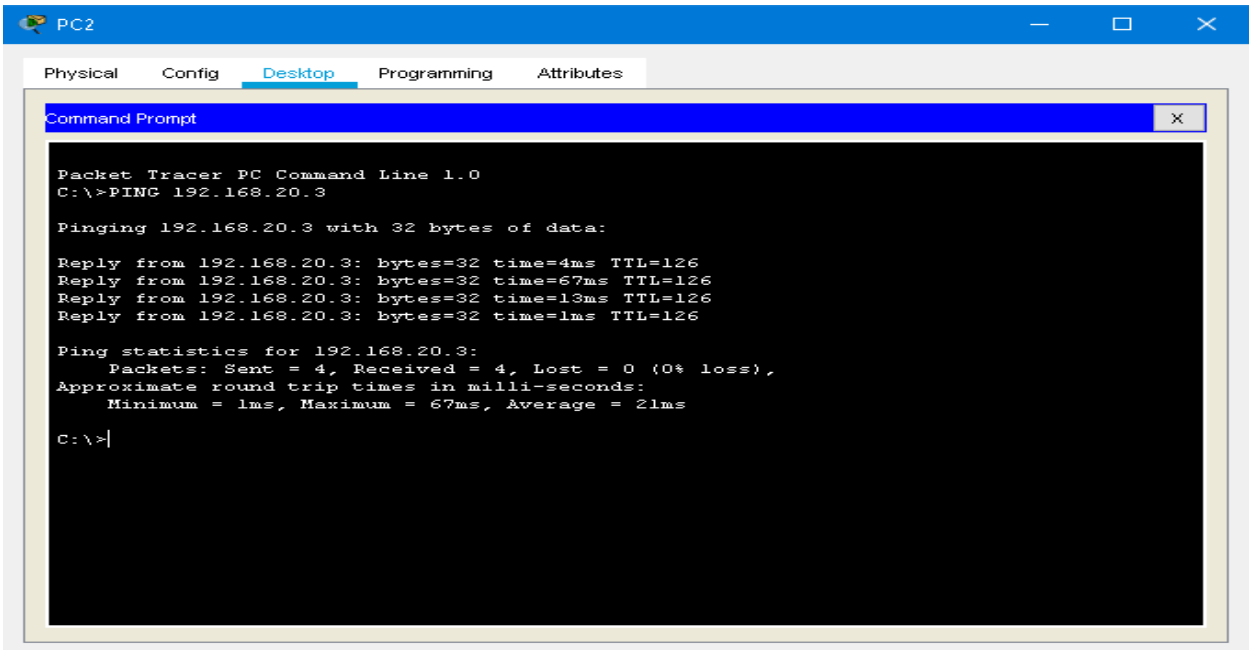
- **TESTING INSIDE A ROUTER (UNIVERSITY MAIN CAMPUS):**

Pinging from PC-0 to PC-5 as shown below;



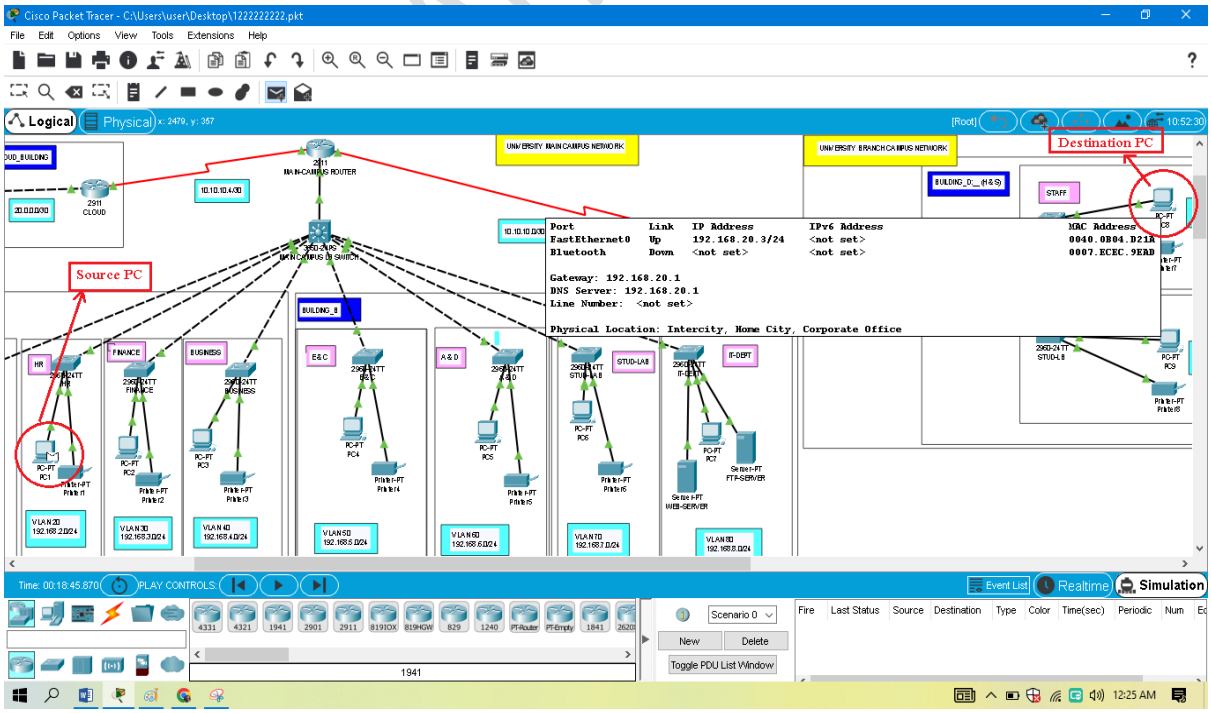
- **TESTING NETWORK CONFIGURATION ACROSS ROUTERS:**

Pinging from Main Campus PC-2 to Branch Campus PC-8 as shown below;



- **Simulation Mode:**

In this mode we have to first select the Simulation Mode and select Simple PDU packet, Drag it and paste on the Source PC first then paste on other PC as to kept that PC as destination as shown in the below Screenshots.



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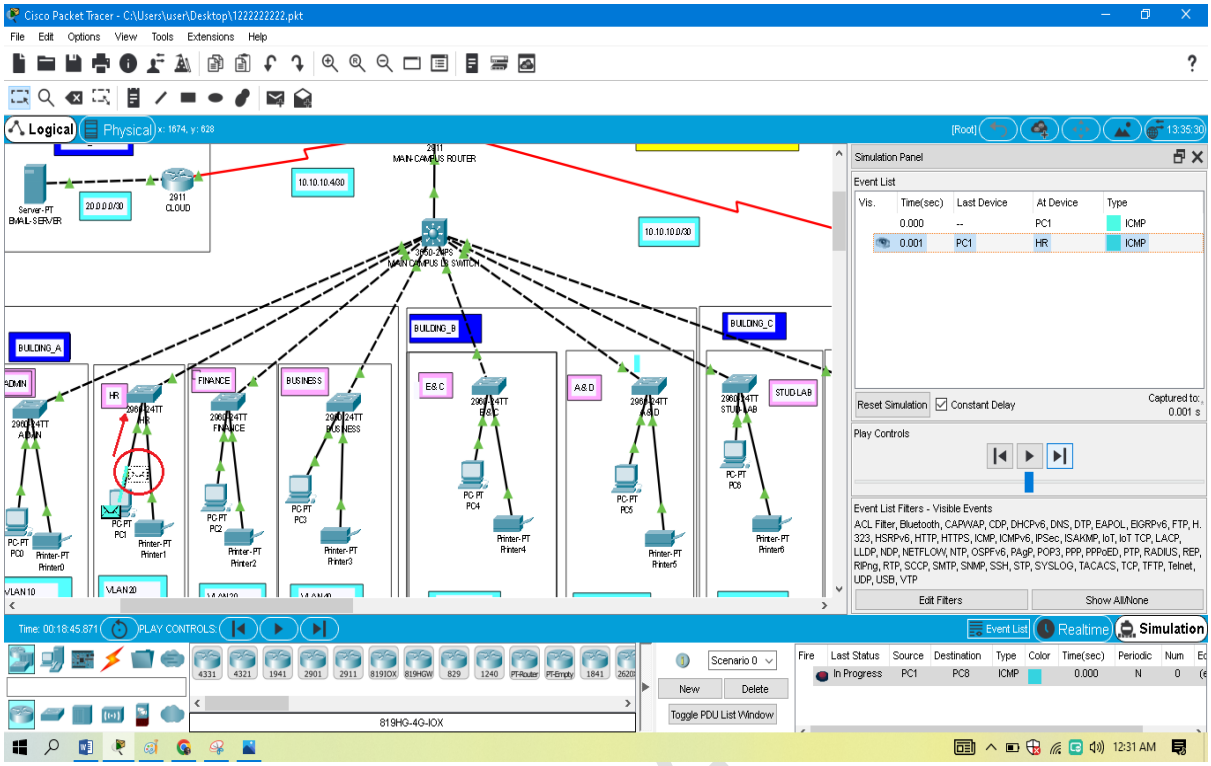

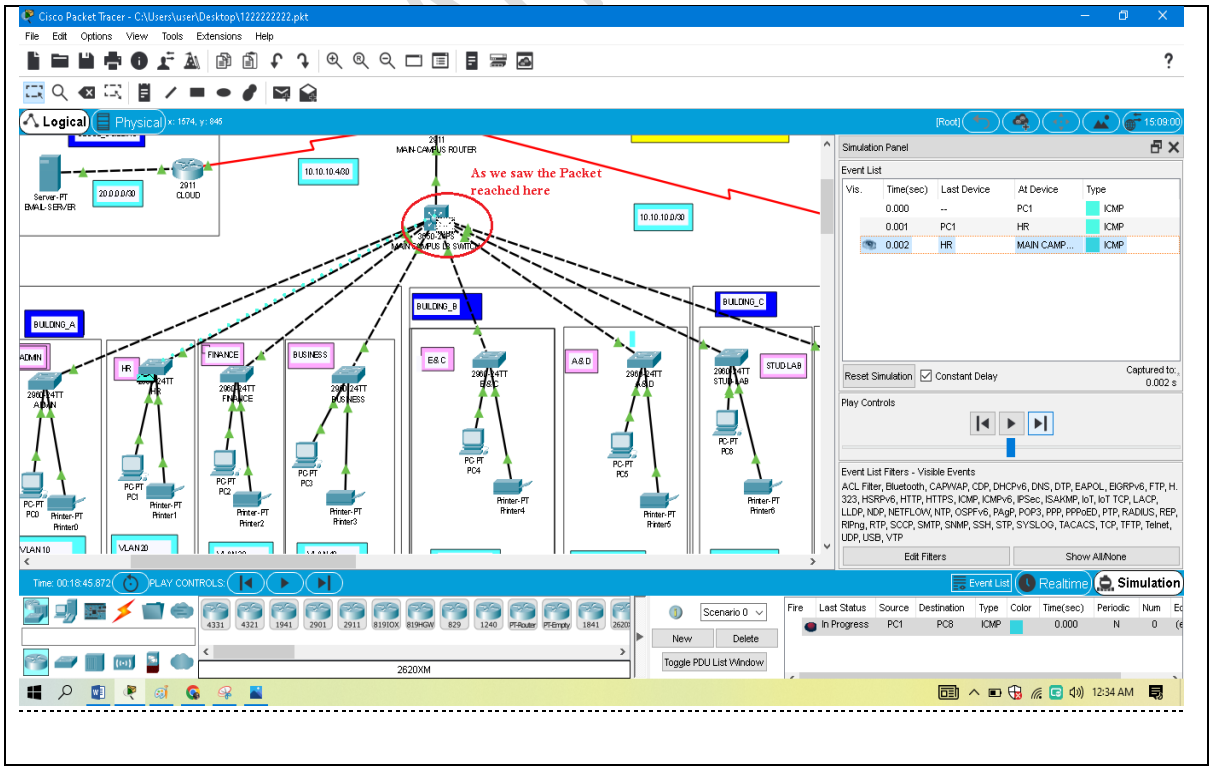

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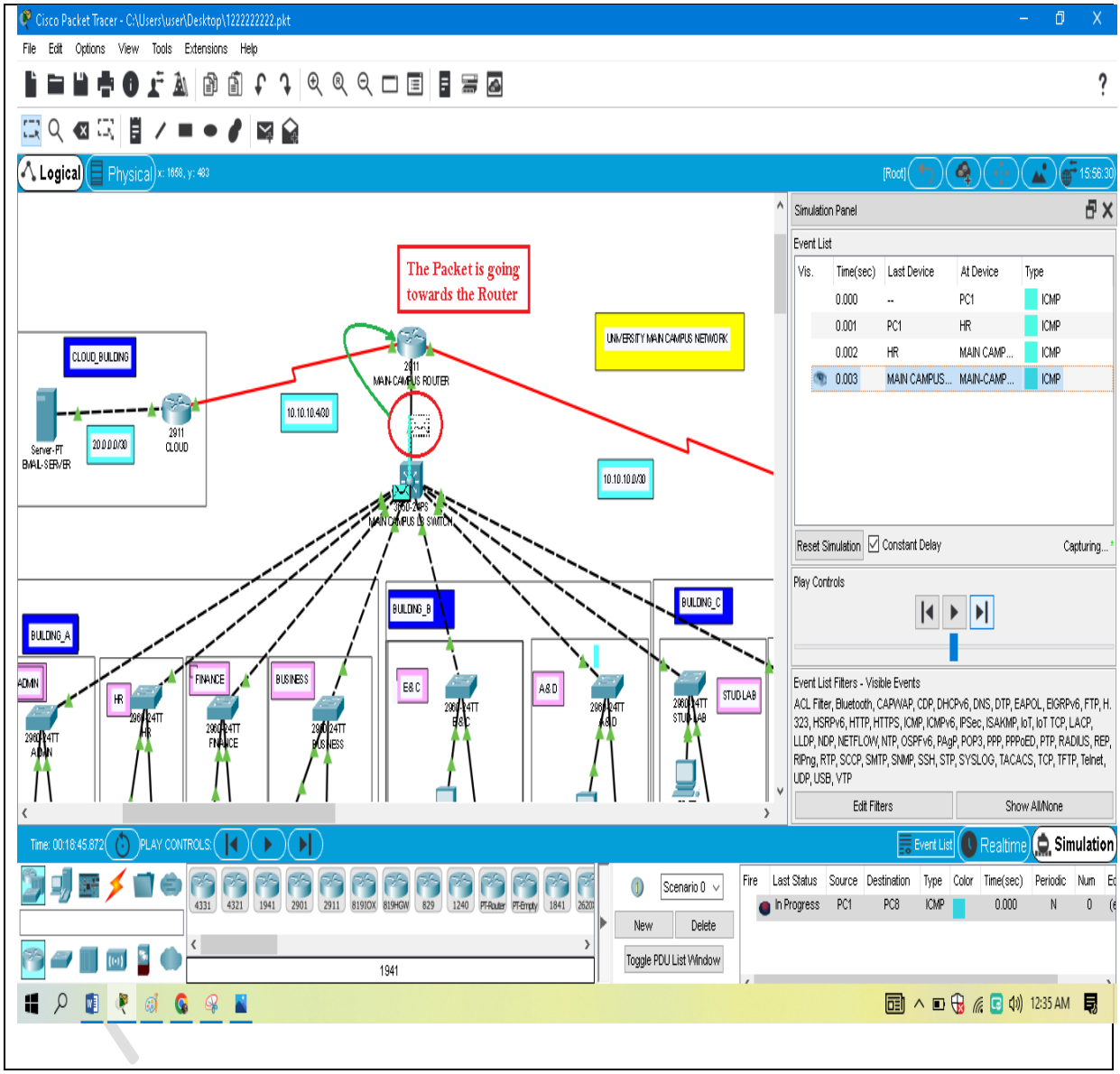

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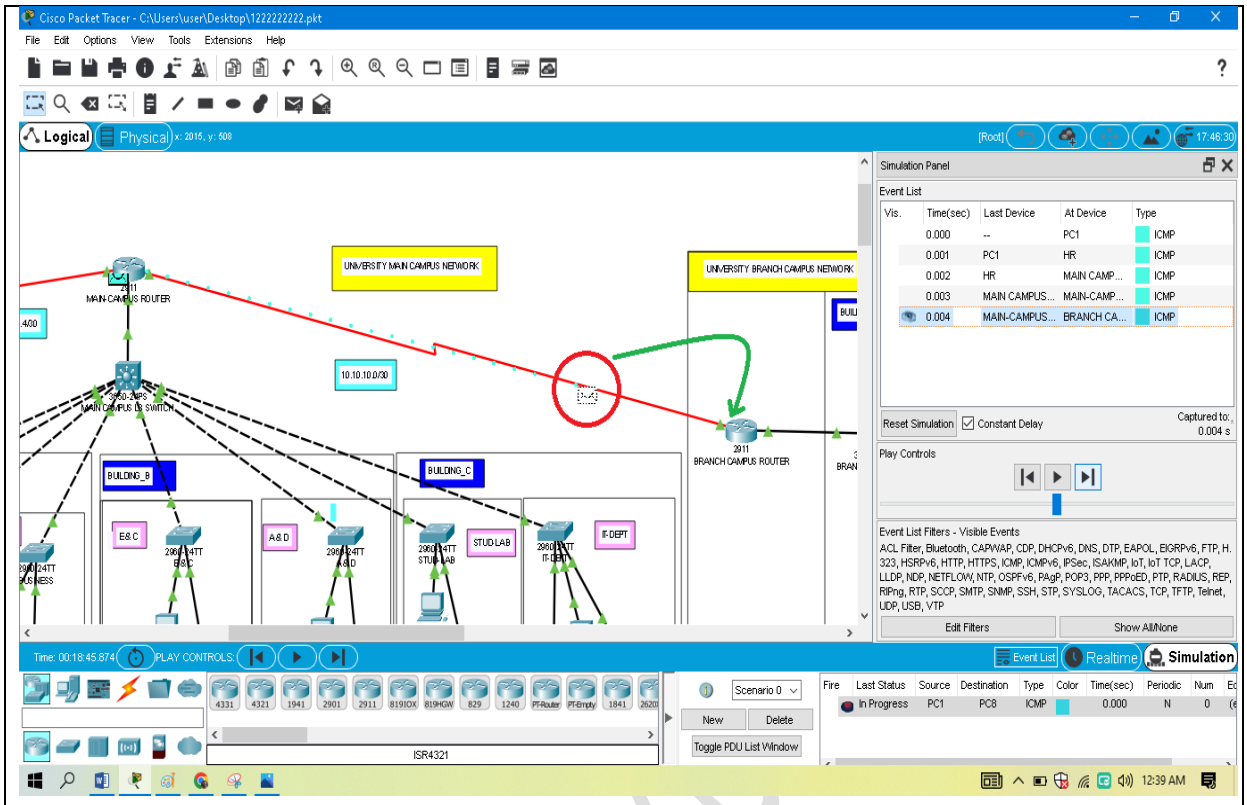

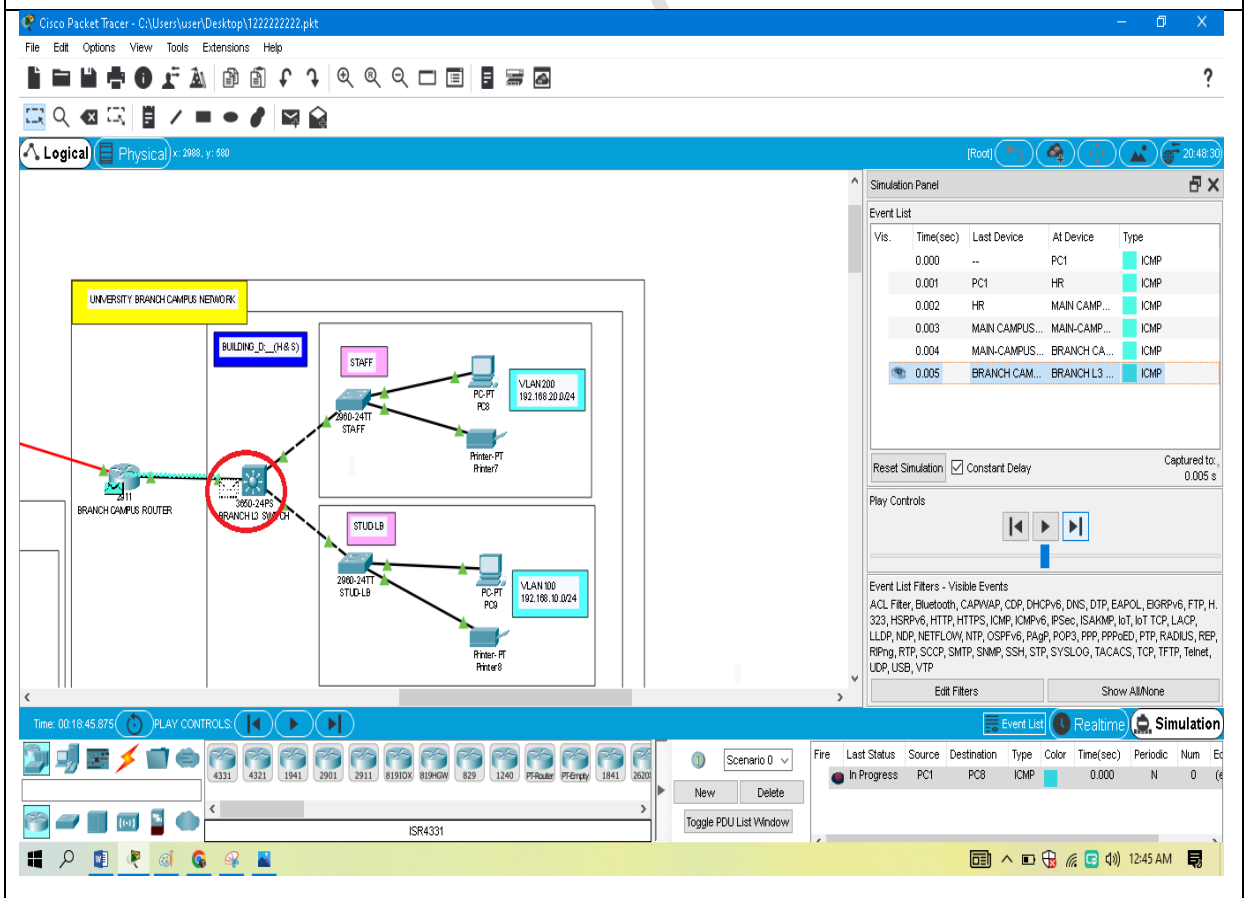

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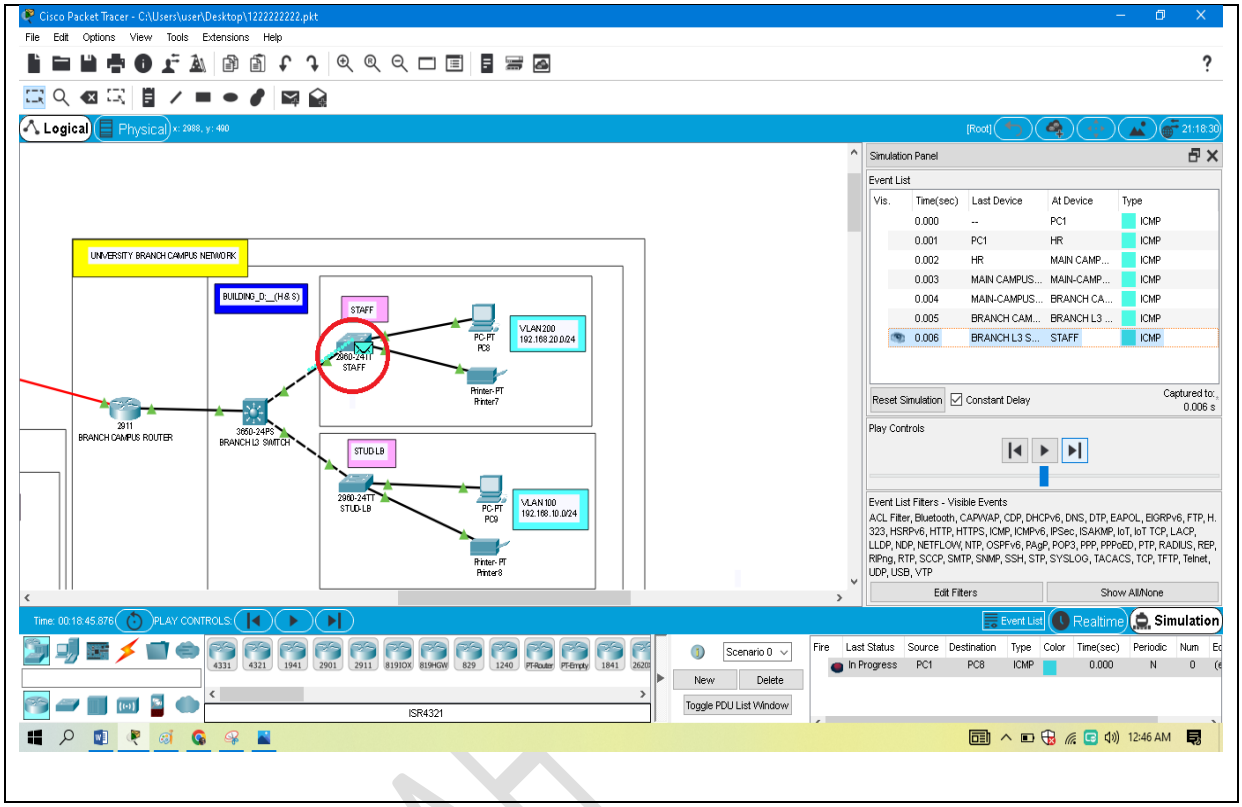

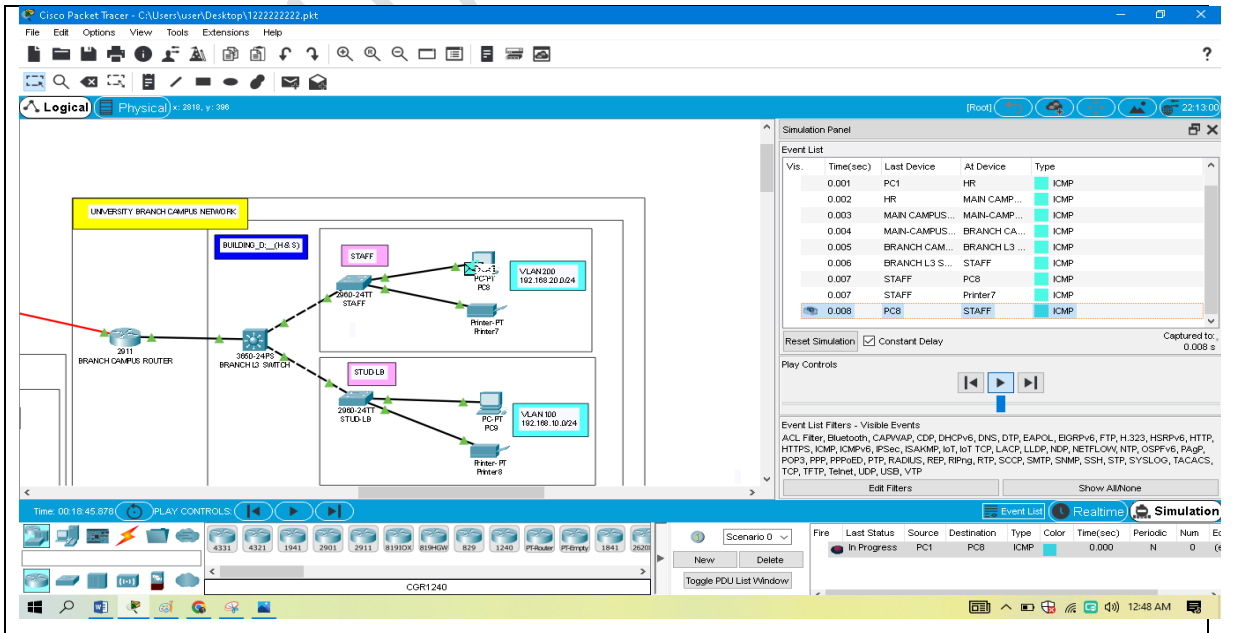

As in the Above Screenshots we saw that the Packet is Successfully reached to the destination PC from the Source PC, Now in the same way the Packet will be going back to the Soucre PC(Acknowledgment).