Computer Networks Project

Project Topic

Campus Network Design, Implementation & Simulation

Prepared By

Nimra Noor

Contact Information: nimranoor584@gmail.com

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1. Abstract

In recent years, computer networks have evolved beyond being just a collection of networked gadgets. Networking is the process of connecting computers, printers, routers, and other devices over a channel in order to share information/resources. It is a highly useful instrument in the day-to-day functioning of the company. Data communication and networking research has resulted in new technologies whose objective is to communicate data such as text, audio, video, and so on. Recently, no decent business can function successfully and efficiently without a solid computer network or the internet. In this project, I have provided a computer network strategy, design, and simulation for universities in developing countries. All possible blocks for one university can be seen in prototype of this project. The aim of project is to design a network with high-quality security by giving user and privilege mode password to routers. All devices are configured by putting IP addresses whereas servers in academic block are DNS, DHCP and WEB servers. Additionally, wireless devices are also used in some blocks of campus by giving WEP key. I have designed a special telephone room using DHCP pool in campus. I used EIGRP and RIP protocols to make connect all devices in campus. My aim is to received more than 80% of data supplied successfully.

2. Campus Design

I have designed a campus which is shown in Figure 1. This campus has following blocks/sections:

- Reception
- Staff
- Sports Golf
- Cafeteria
- Library
- MBA Department (Non-Technical Department)
- BTECH Departments
- Vice Chancellor Room
- Office
  - Academic Section
  - Account Section
- Hostel
  - Boys Hostel
  - Girls Hostel
- Telephone Room

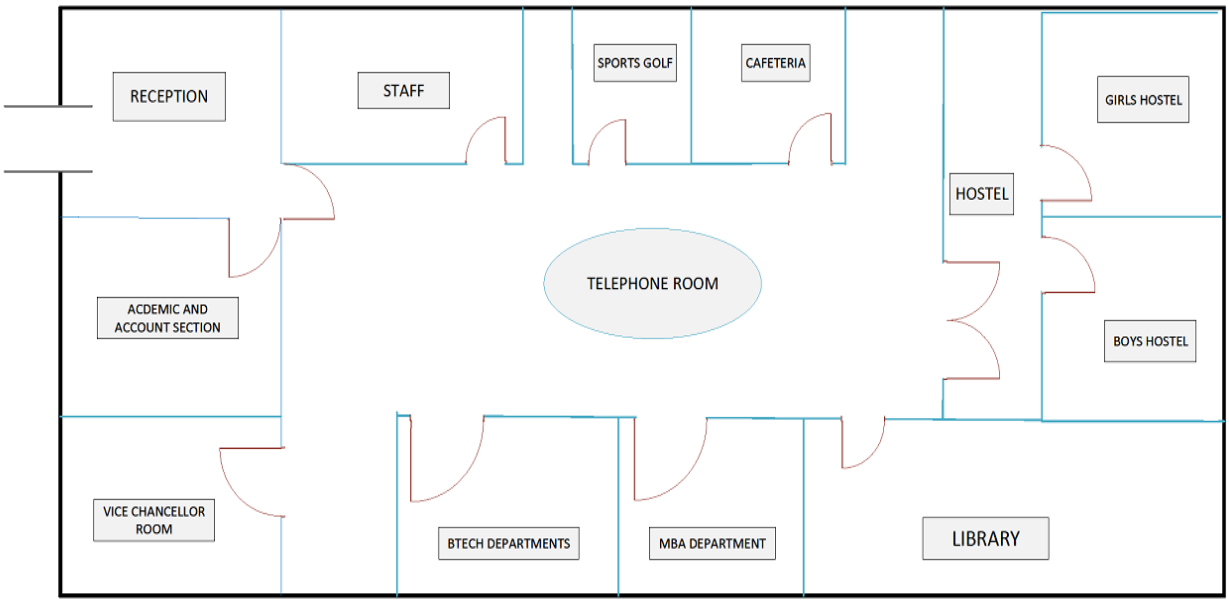


Figure 1. Block Diagram

3. Project Implementation and Results

3.1 Campus Blocks Implementation

In first step I have made all departments separately and give IP addresses to each device or host which is shown in network diagram below:

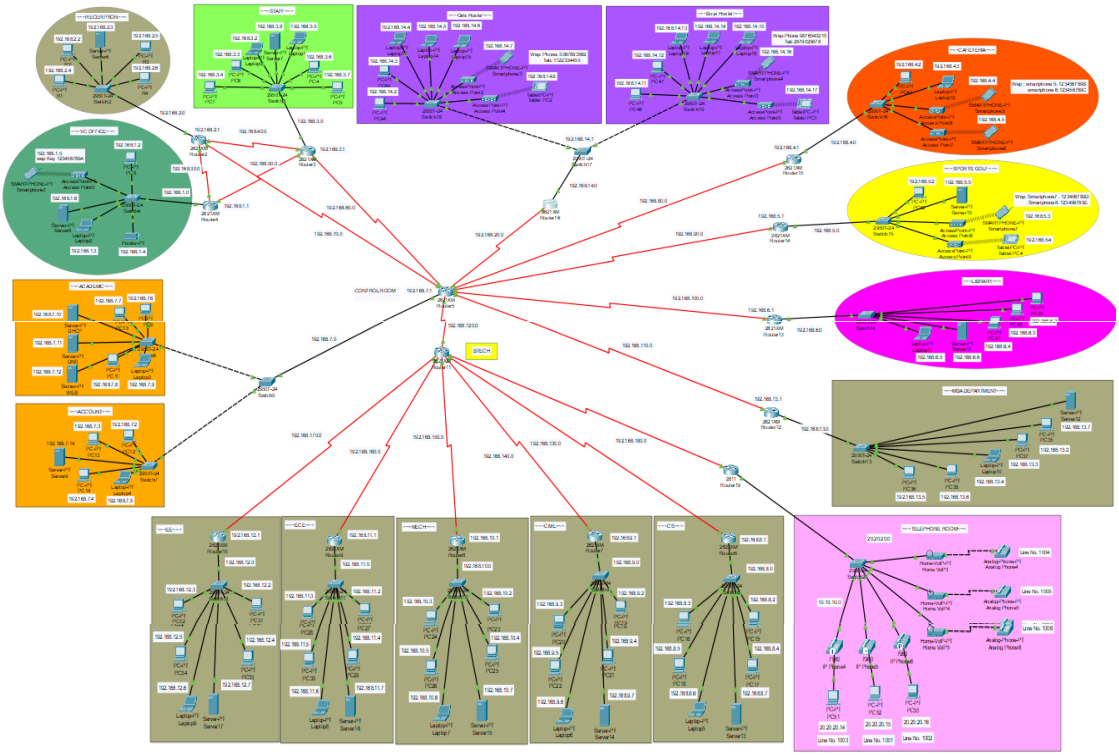
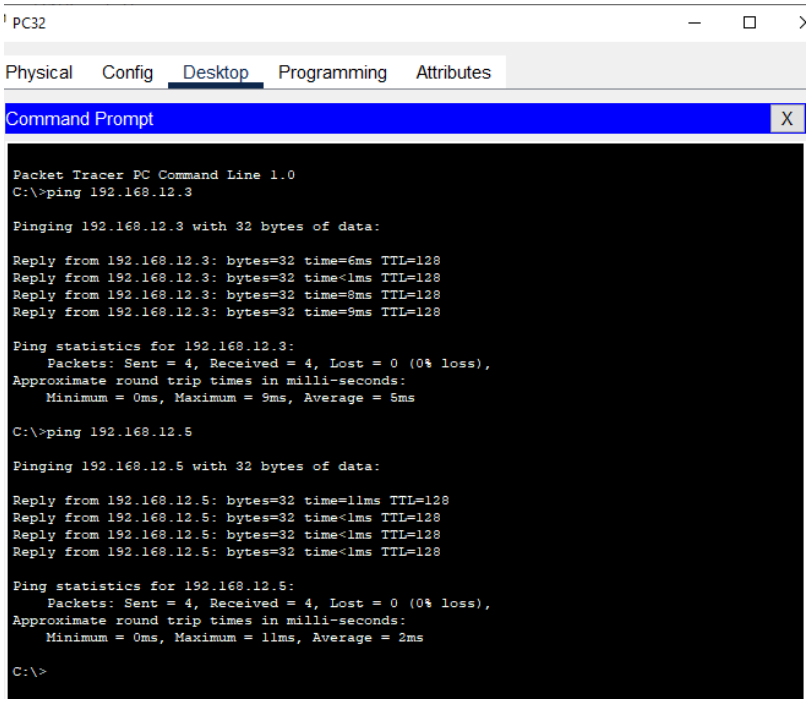


Figure 2. Designed Topology

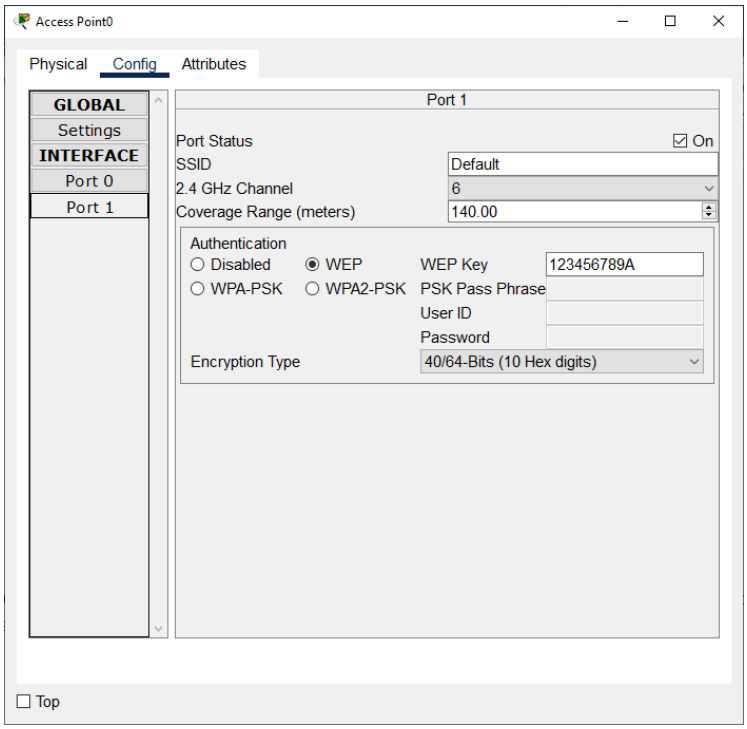
After this the **communication inside each block is successful** as shown below:



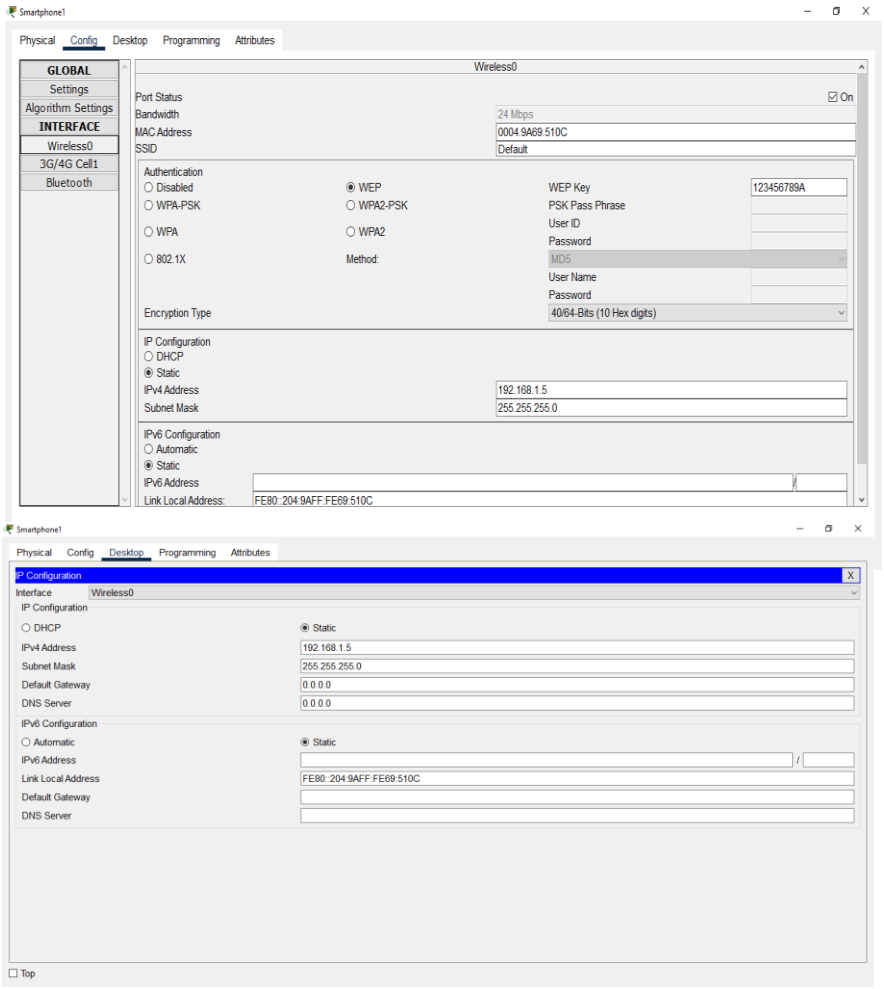
3.2 Wireless Devices Configuration

I have used wireless devices in this network by using Access Point-PT, Smartphones and tablets. To wirelessly communicate I have set WEP keys in both Access Point-PT and wireless device then set IP address for wireless device as shown below:

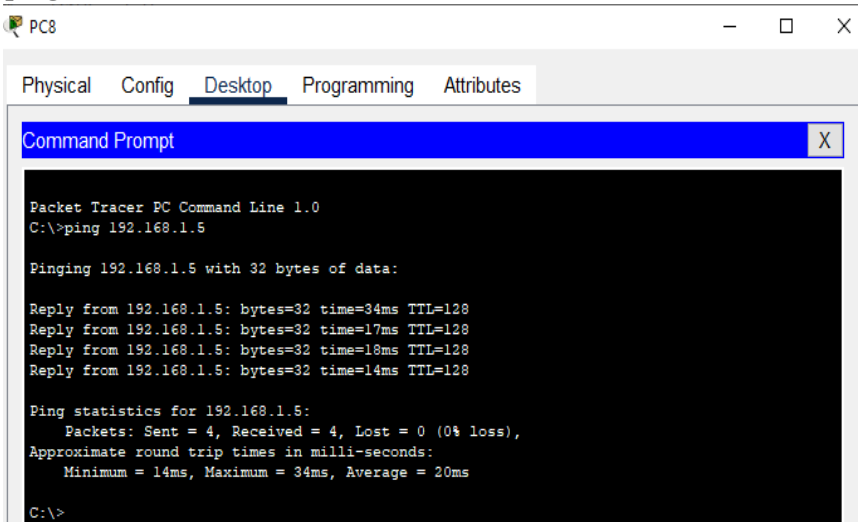
Access Point configuration is:



Smartphone configuration is:



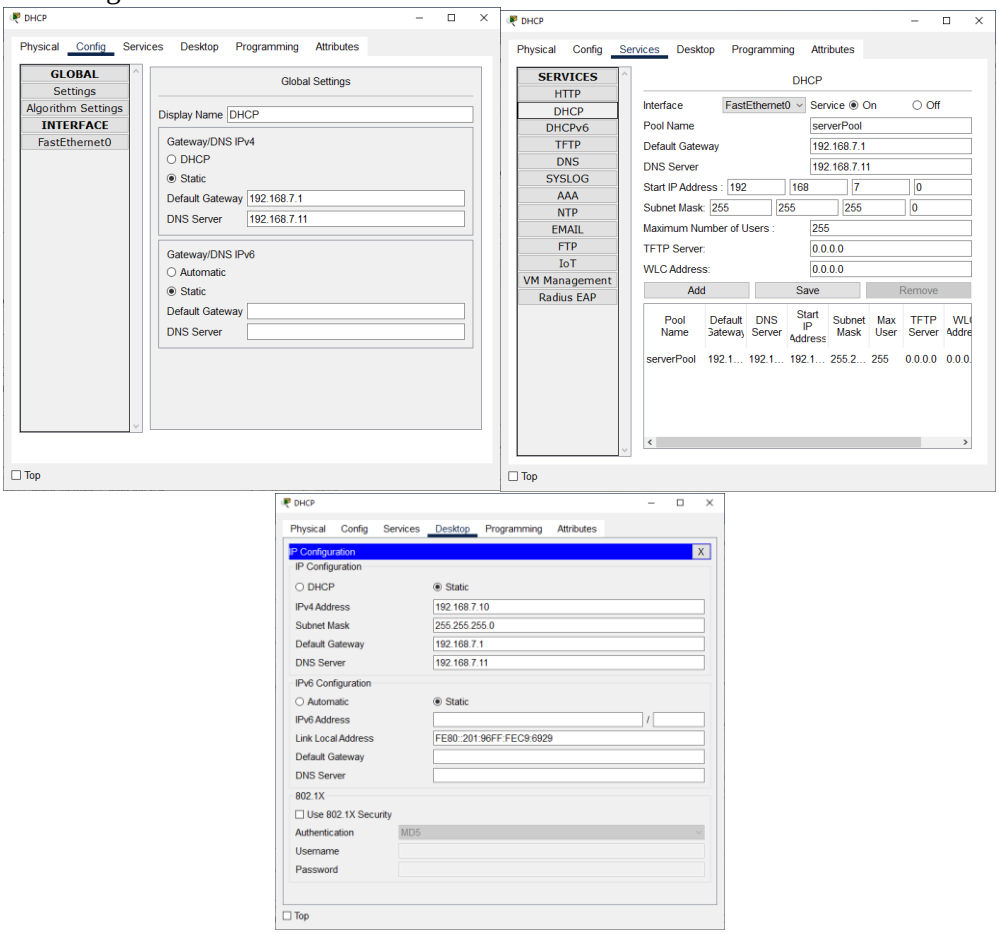
As a result, now **ping with wireless device is successful** as shown below:



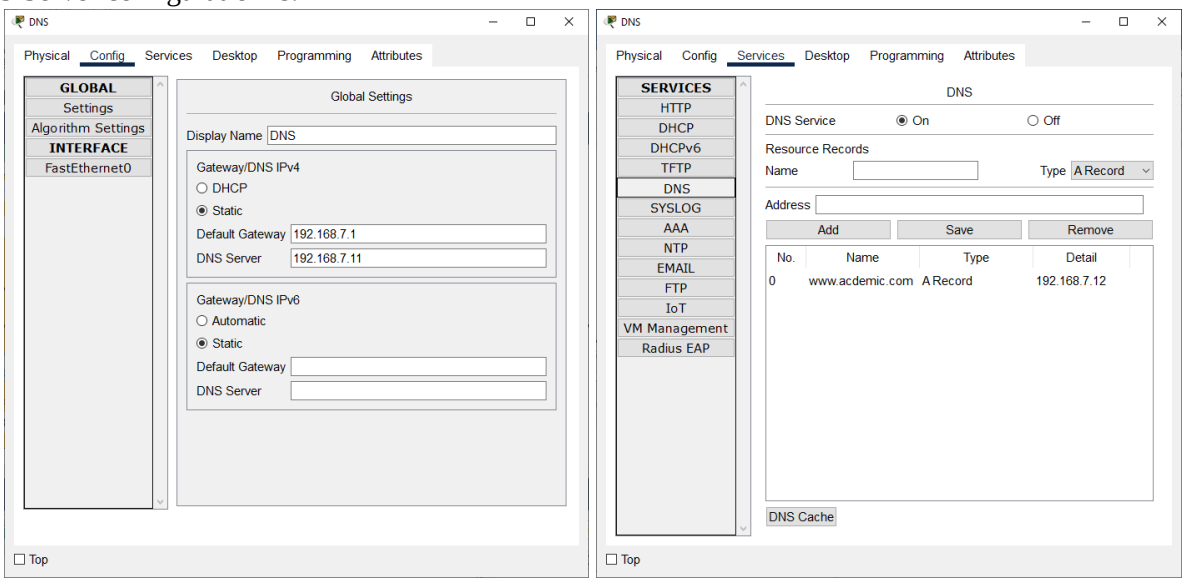
3.3 Servers for Academic Section Settings

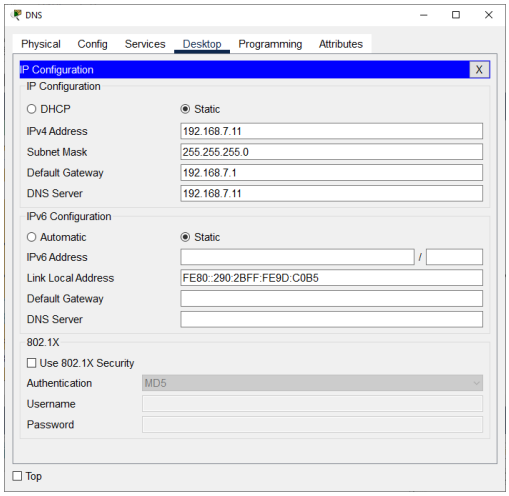
I have used three servers DHCP, DNS and Web in academic block. Their configurations are given below:

DHCP Server configuration is:

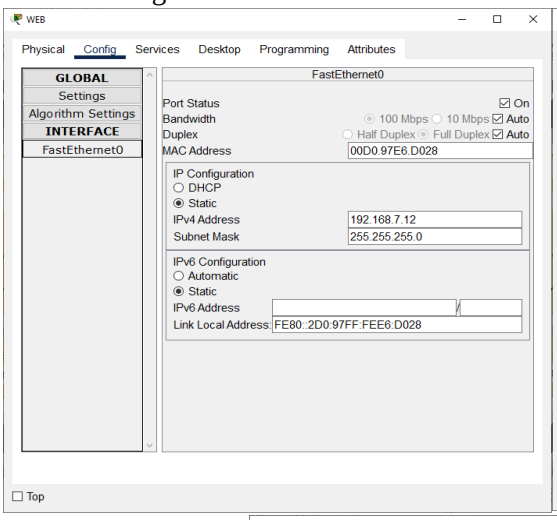


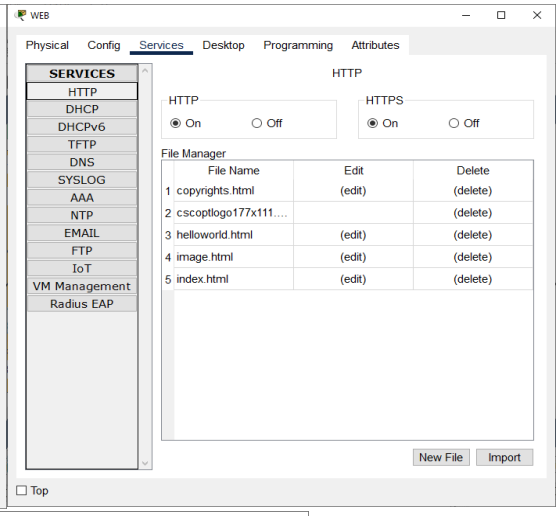
DNS Server configuration is:

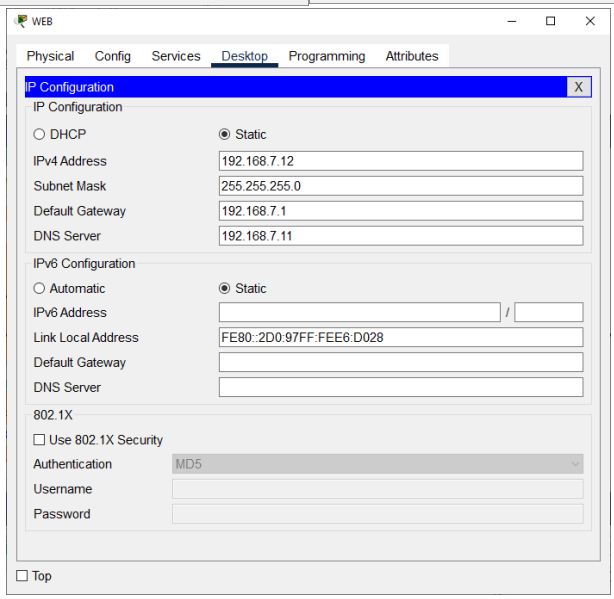




WEB Server Configuration is:





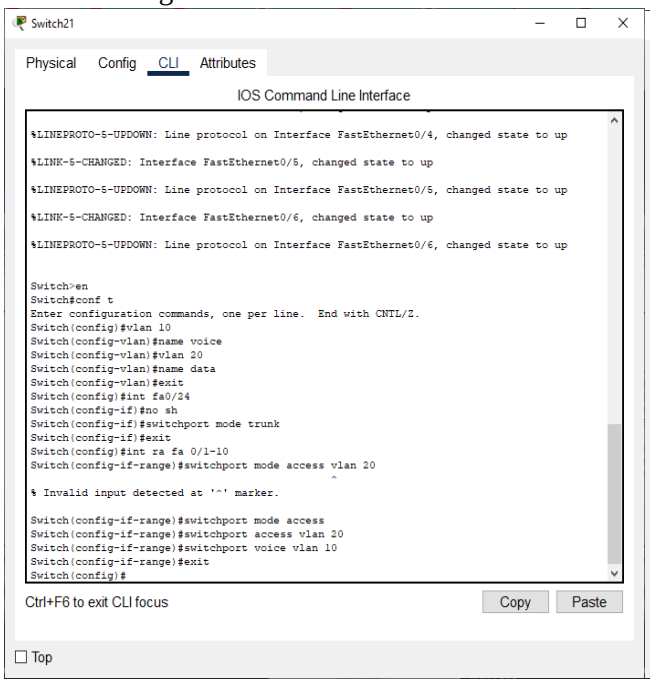


Their results are shown in simulation.

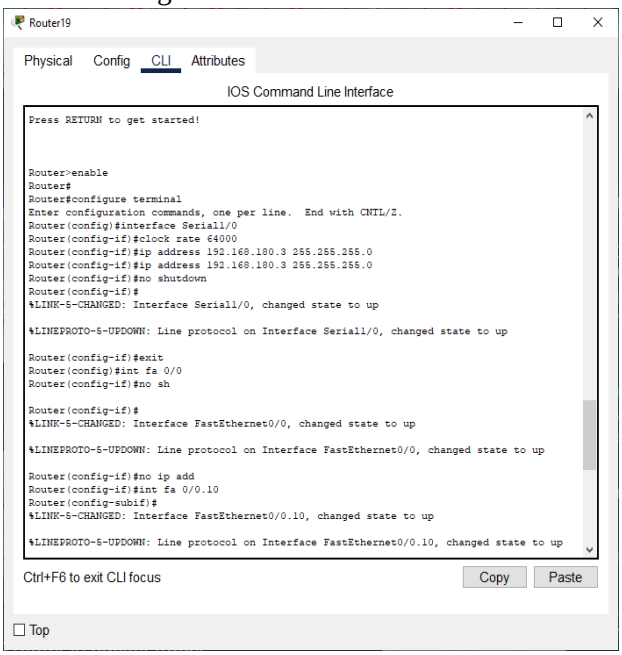
3.4 Home-VOIP and IP Phone Settings

I have made a telephone room in this campus in which I have used three Home-VOIPs and three IP Phones.

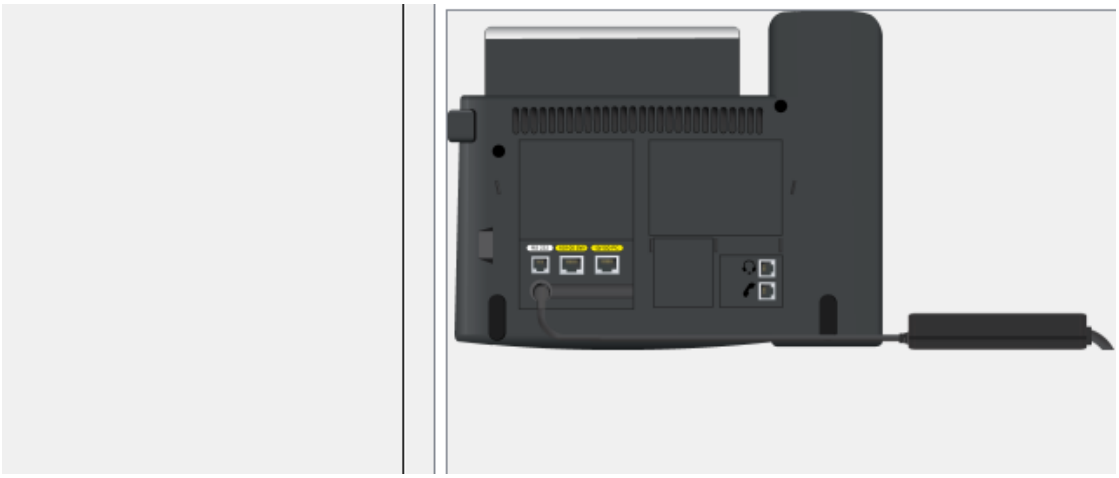
Switch Configuration is:



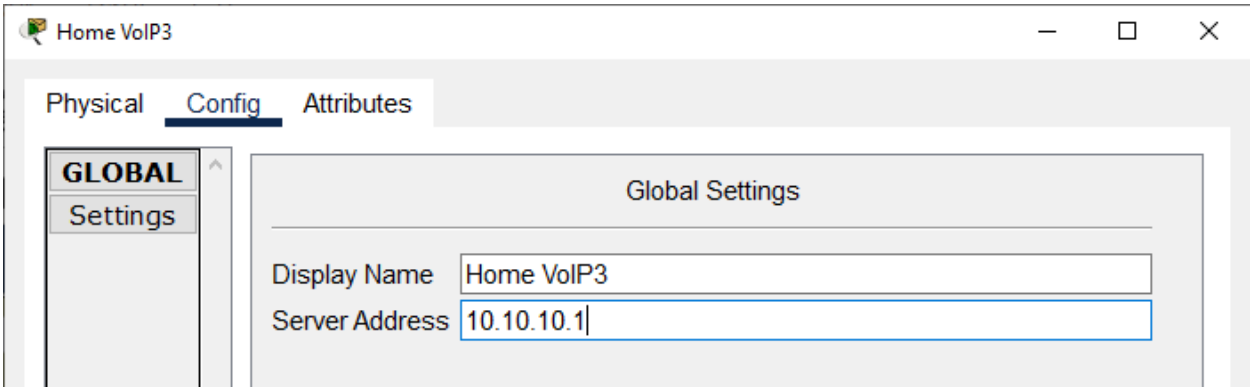
Router Configuration is:



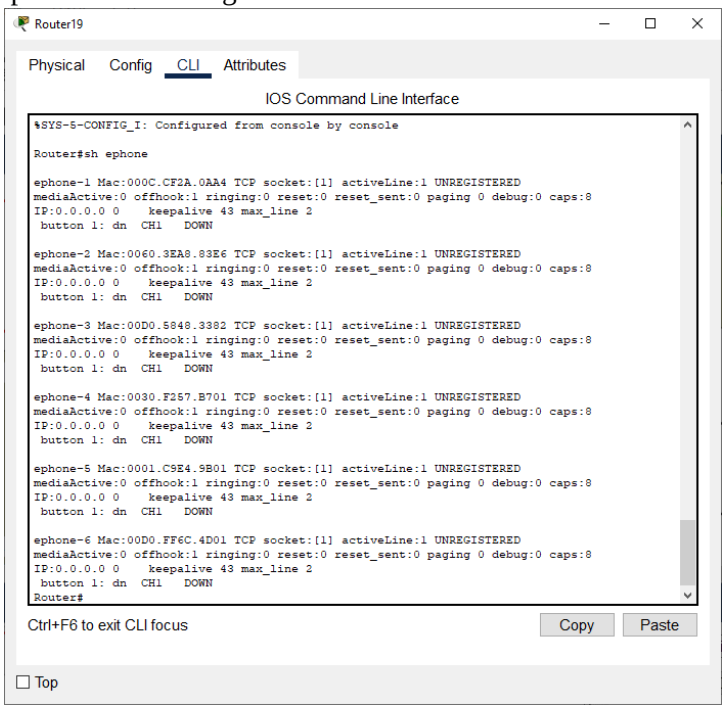
Set adapter of IP-Phone:

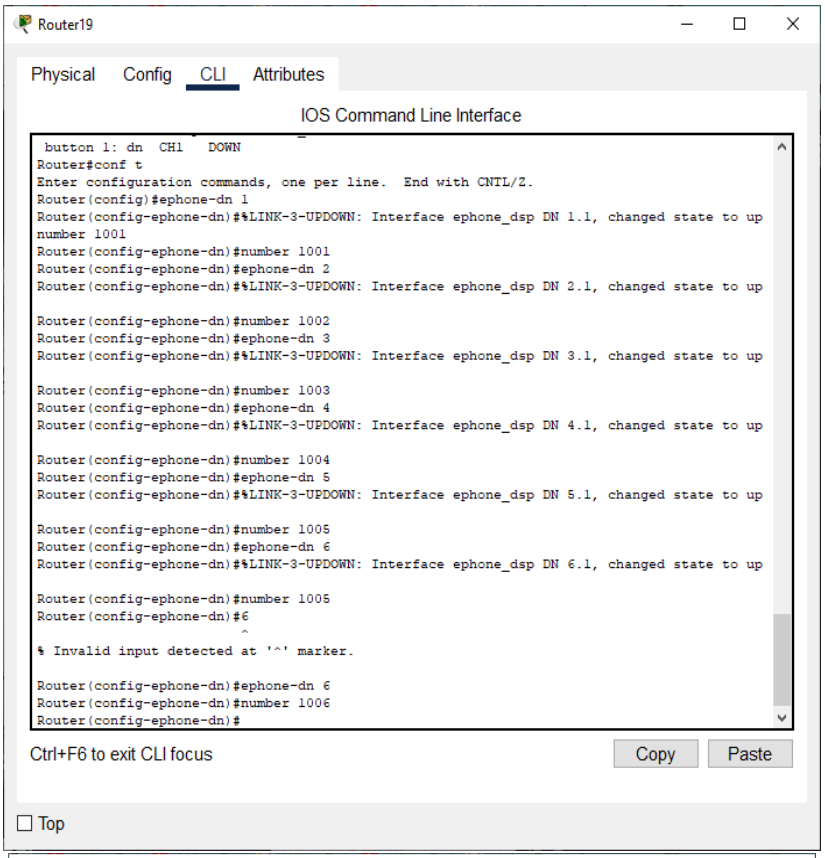


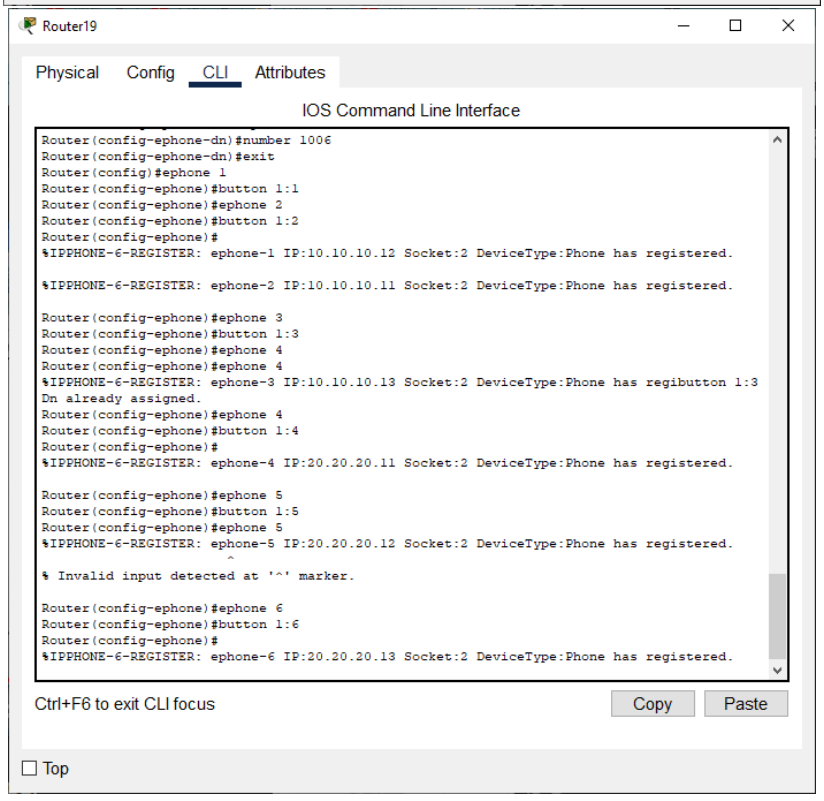
Set server address for Home VOIP



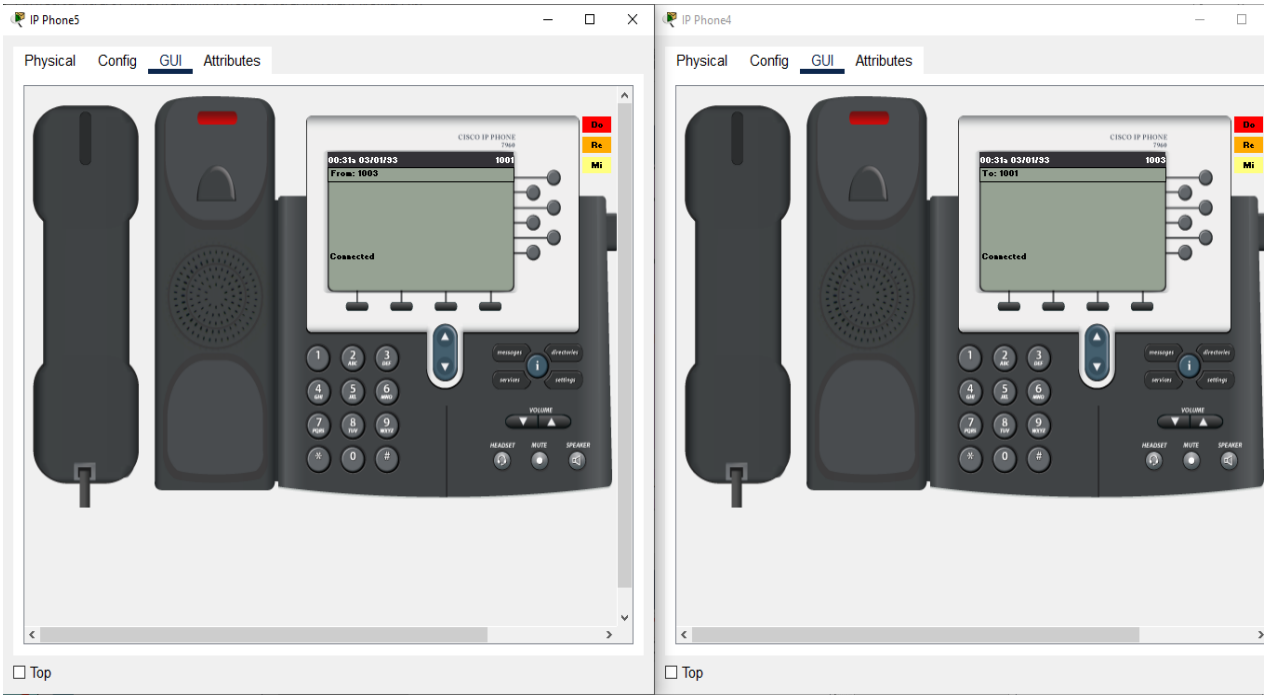
Set line numbers to all phones after seeing their MAC addresses




Router19
Physical
Config
CLI
Attributes
IOS Command Line Interface
button 1: dn CH1 DOWN
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ephone-dn 1
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 1.1, changed state to up
number 1001
Router(config-ephone-dn)#number 1001
Router(config-ephone-dn)#ephone-dn 2
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 2.1, changed state to up
Router(config-ephone-dn)#number 1002
Router(config-ephone-dn)#ephone-dn 3
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 3.1, changed state to up
Router(config-ephone-dn)#number 1003
Router(config-ephone-dn)#ephone-dn 4
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 4.1, changed state to up
Router(config-ephone-dn)#number 1004
Router(config-ephone-dn)#ephone-dn 5
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 5.1, changed state to up
Router(config-ephone-dn)#number 1005
Router(config-ephone-dn)#ephone-dn 6
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 6.1, changed state to up
Router(config-ephone-dn)#number 1005
Router(config-ephone-dn)#6
^
% Invalid input detected at '^' marker.
Router(config-ephone-dn)#ephone-dn 6
Router(config-ephone-dn)#number 1006
Router(config-ephone-dn)#
Ctrl+F6 to exit CLI focus
Copy
Paste
Top


Router19
Physical
Config
CLI
Attributes
IOS Command Line Interface
Router(config-ephone-dn)#number 1006
Router(config-ephone-dn)#exit
Router(config)#ephone 1
Router(config-ephone)#button 1:1
Router(config-ephone)#ephone 2
Router(config-ephone)#button 1:2
Router(config-ephone)#
%IPPHONE-6-REGISTER: ephone-1 IP:10.10.10.12 Socket:2 DeviceType:Phone has registered.
%IPPHONE-6-REGISTER: ephone-2 IP:10.10.10.11 Socket:2 DeviceType:Phone has registered.
Router(config-ephone)#ephone 3
Router(config-ephone)#button 1:3
Router(config-ephone)#ephone 4
Router(config-ephone)#ephone 4
%IPPHONE-6-REGISTER: ephone-3 IP:10.10.10.13 Socket:2 DeviceType:Phone has regibutton 1:3
Dn already assigned.
Router(config-ephone)#ephone 4
Router(config-ephone)#button 1:4
Router(config-ephone)#
%IPPHONE-6-REGISTER: ephone-4 IP:20.20.20.11 Socket:2 DeviceType:Phone has registered.
Router(config-ephone)#ephone 5
Router(config-ephone)#button 1:5
Router(config-ephone)#ephone 5
%IPPHONE-6-REGISTER: ephone-5 IP:20.20.20.12 Socket:2 DeviceType:Phone has registered.
^
% Invalid input detected at '^' marker.
Router(config-ephone)#ephone 6
Router(config-ephone)#button 1:6
Router(config-ephone)#
%IPPHONE-6-REGISTER: ephone-6 IP:20.20.20.13 Socket:2 DeviceType:Phone has registered.
Ctrl+F6 to exit CLI focus
Copy
Paste
Top

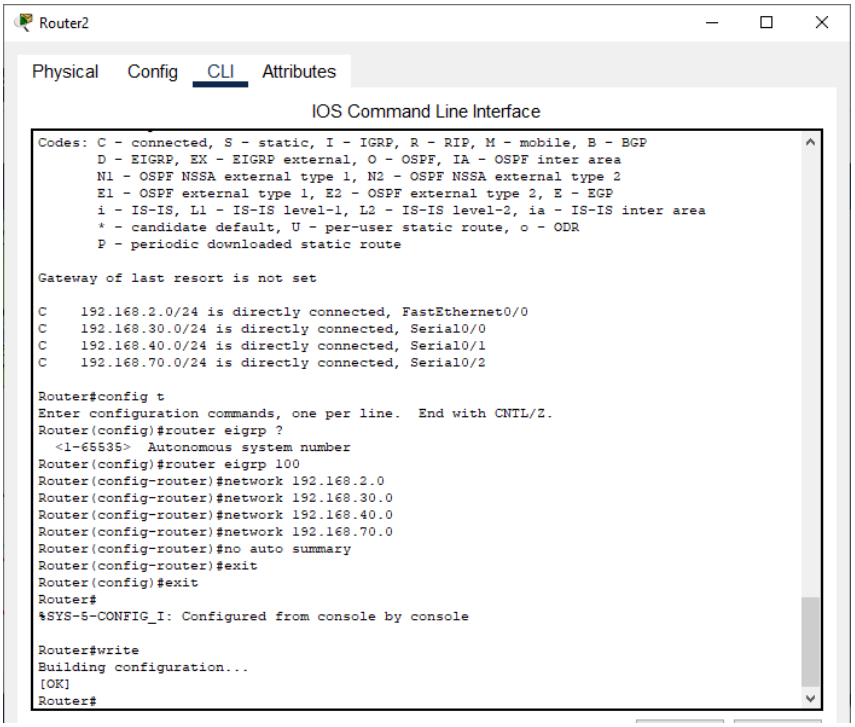
Connection is successful. Results are shown below:



3.5 Enhanced Interior Gateway Routing Protocol (EIGRP) Implementation

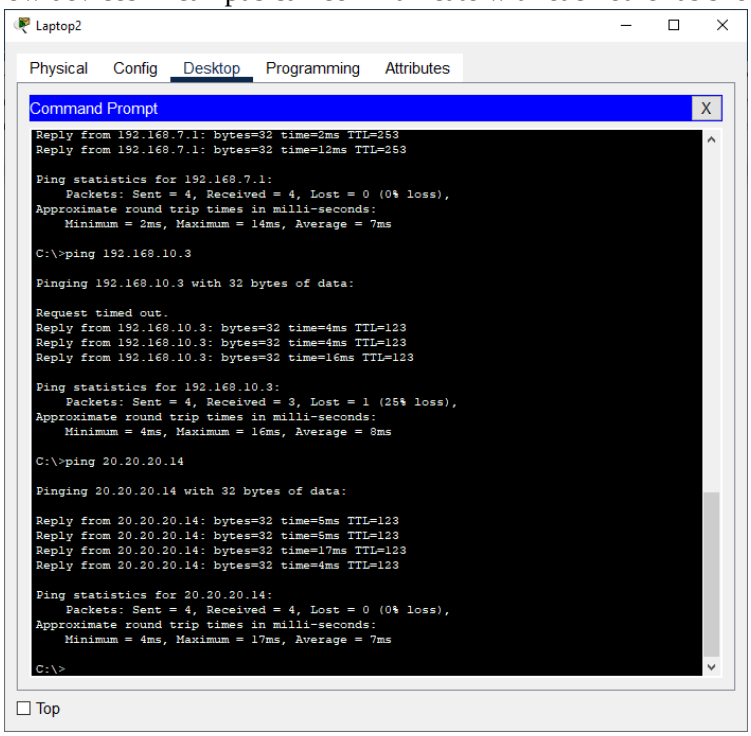
Implement EIGRP on all routers in network

For one router it is shown below:




```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.30.0/24 is directly connected, Serial0/0
C    192.168.40.0/24 is directly connected, Serial0/1
C    192.168.70.0/24 is directly connected, Serial0/2

Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router eigrp ?
  <1-65535>  Autonomous system number
Router(config)#router eigrp 100
Router(config-router)#network 192.168.2.0
Router(config-router)#network 192.168.30.0
Router(config-router)#network 192.168.40.0
Router(config-router)#network 192.168.70.0
Router(config-router)#no auto summary
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#write
Building configuration...
[OK]
Router#
```

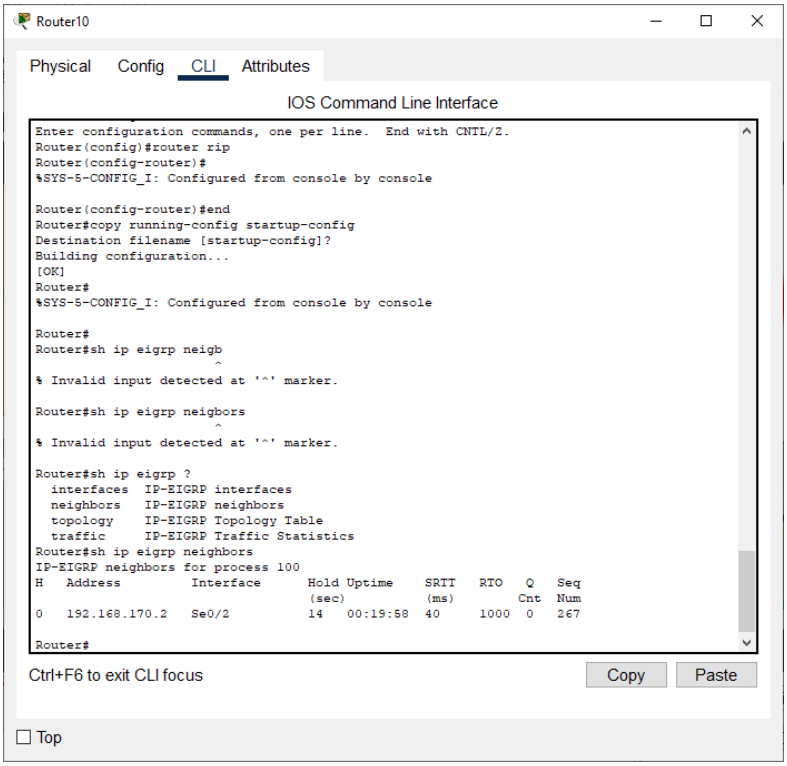
After implementing now devices in campus can communicate with each other as shown below:



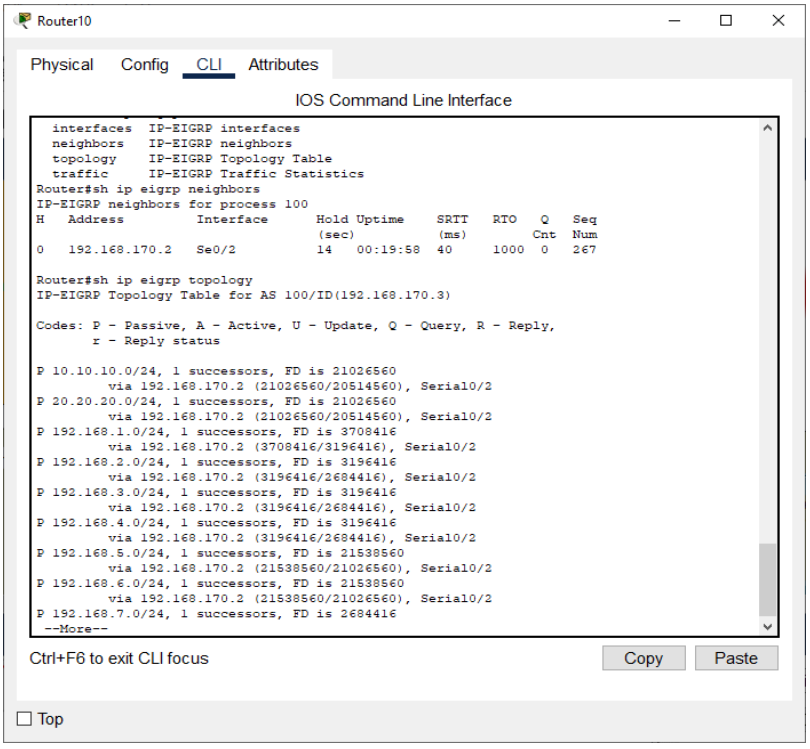
3.6 Enhanced Interior Gateway Routing Protocol (EIGRP) Tables

Three tables of EIGRP are shown below:

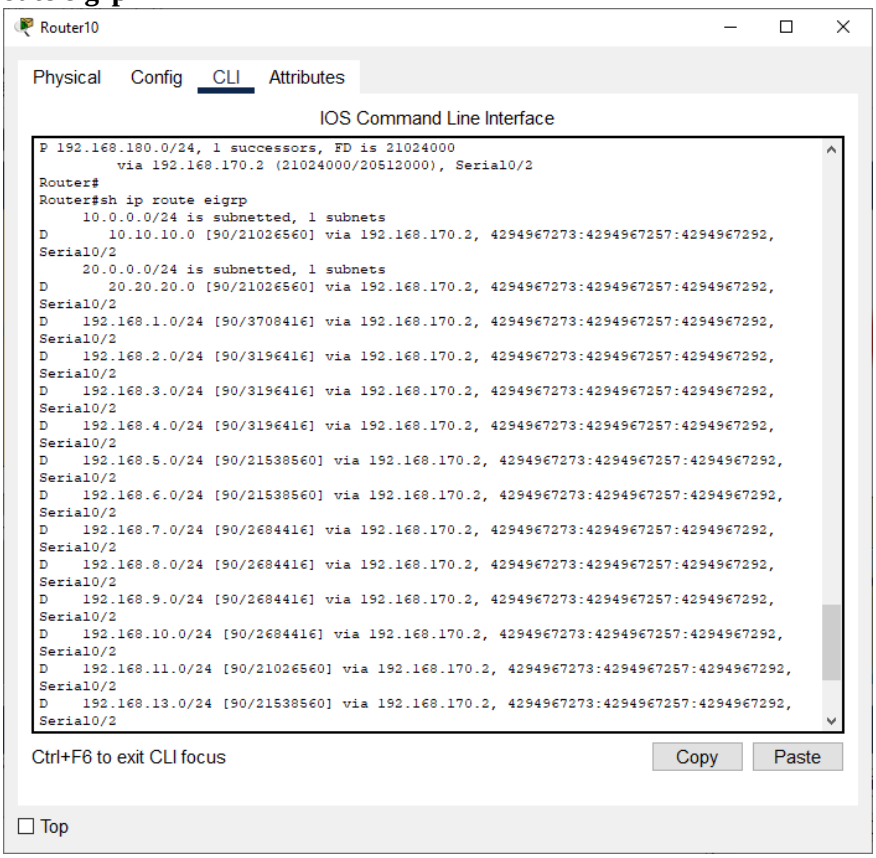
i. ip eigrp neighbors



ii. ip eigrp topology



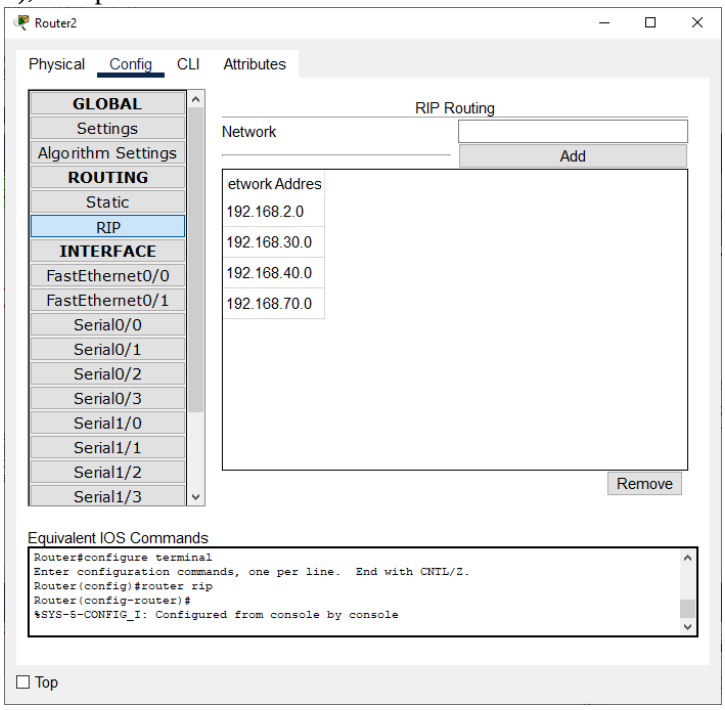
iii. show ip route eigrp



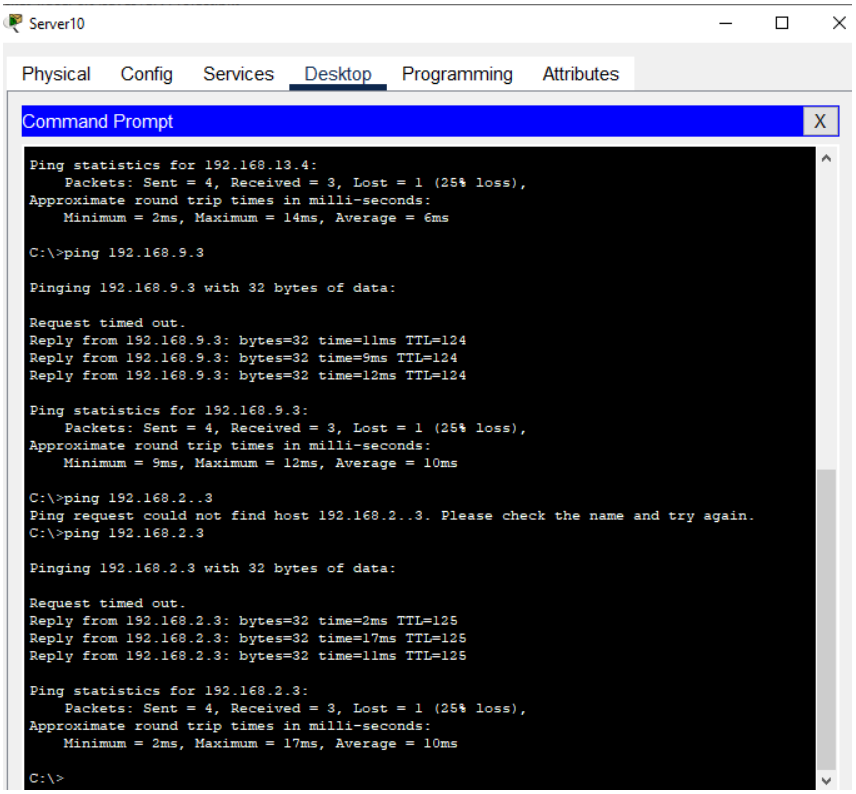
3.7 Routing Information Protocol (RIP) Implementation

In next step I Implemented RIP protocol on all routers in network.

For Router 2(Reception), RIP protocol is shown:



Results are shown below:



3.8 Security

At the end set privilege passwords for all blocks in campus and set user and privileged mode password for control room to secure it more.

For all routers CLI commands are:

```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#enable password staff123
Router(config)#enable secret staff123s
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

For control room's router CLI commands are:

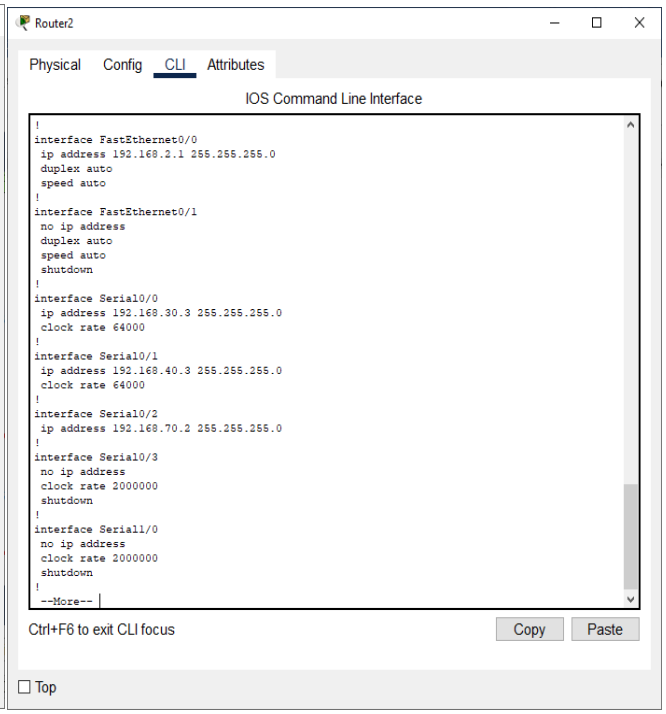
```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#line console 0
Router(config-line)#password control123
Router(config-line)#login
Router(config-line)#exit
Router(config)#line vty 0 15
Router(config-line)#password control123
Router(config-line)#login
Router(config-line)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#exit


User Access Verification

Password:

Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#enable secret controlpriv123
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#exit
```

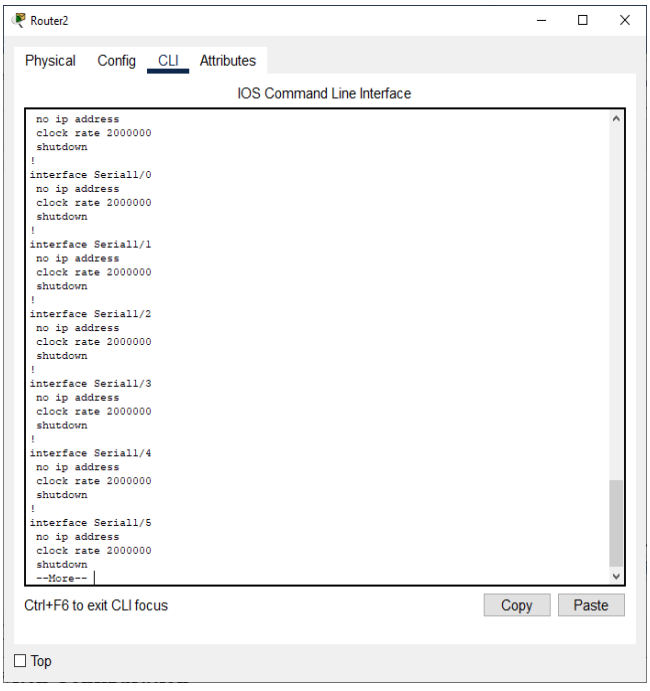
For all routers and switches passwords are assigned. Now when CLI mode of switch or router is accessible only for authorized people who know password as shown below:

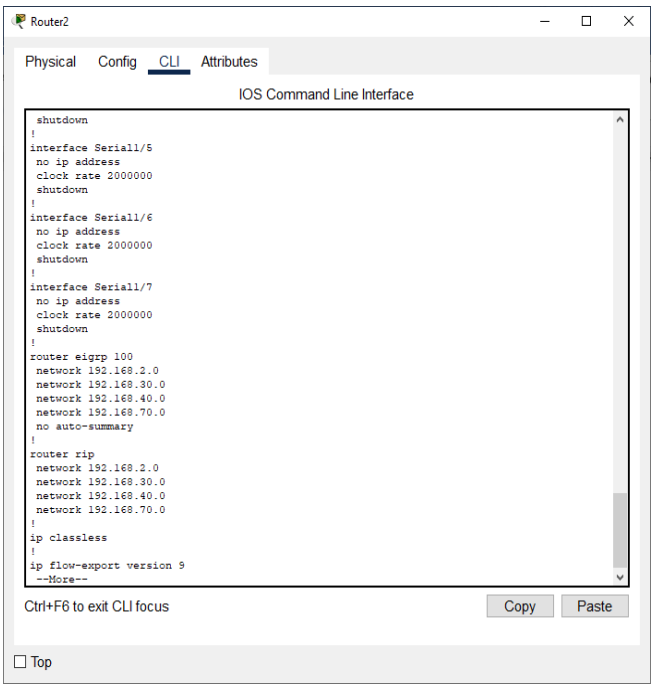
```
User Access Verification

Password:

Router>en
Password:
Password:
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
```

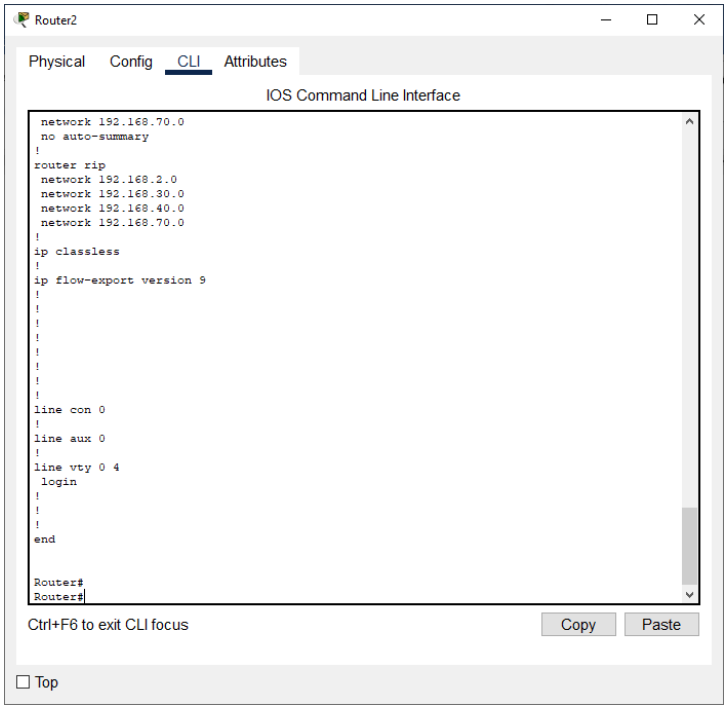
4. Simulations

4.1 Router Configuration

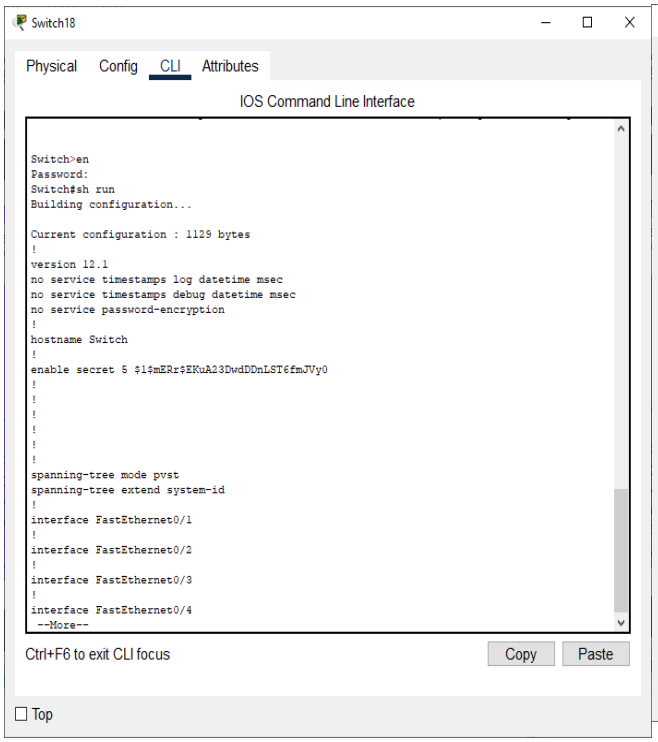


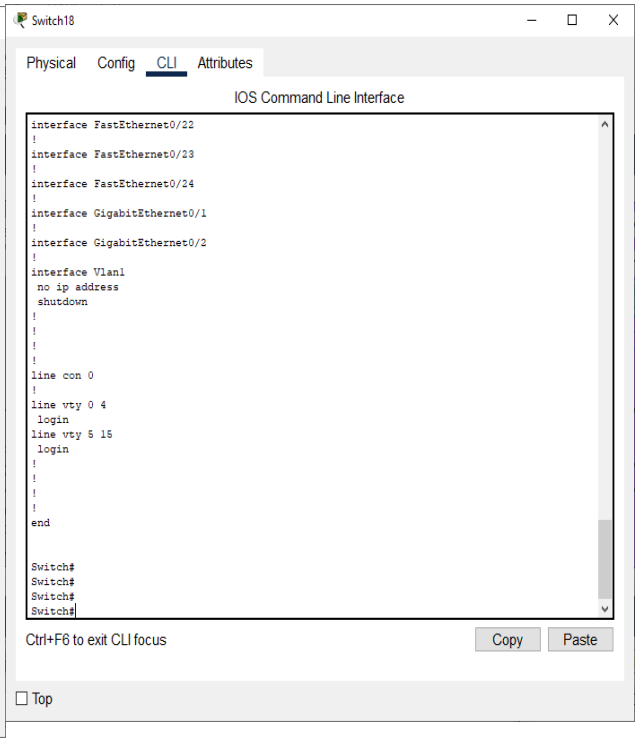




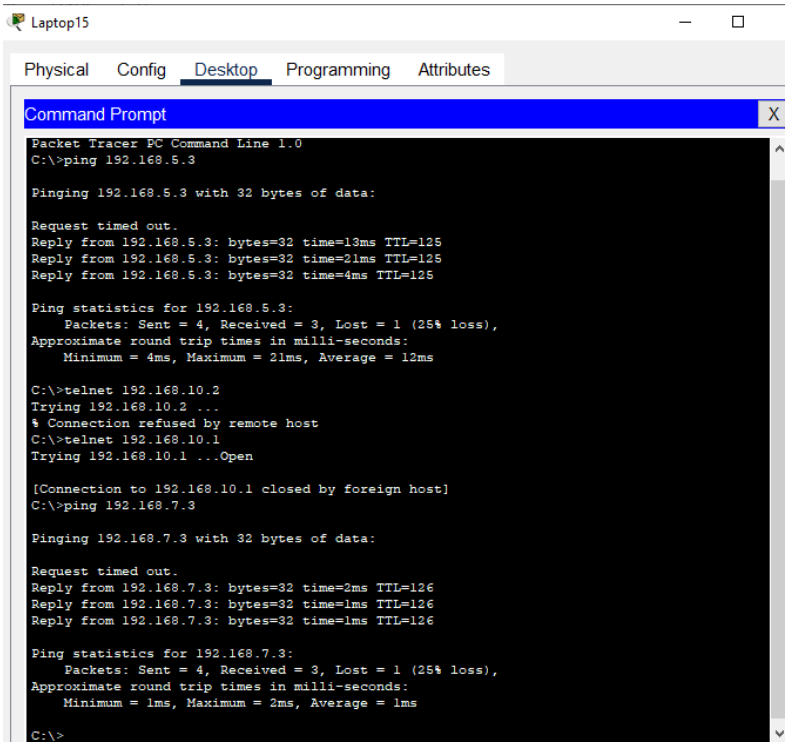


4.2 Switch Configuration



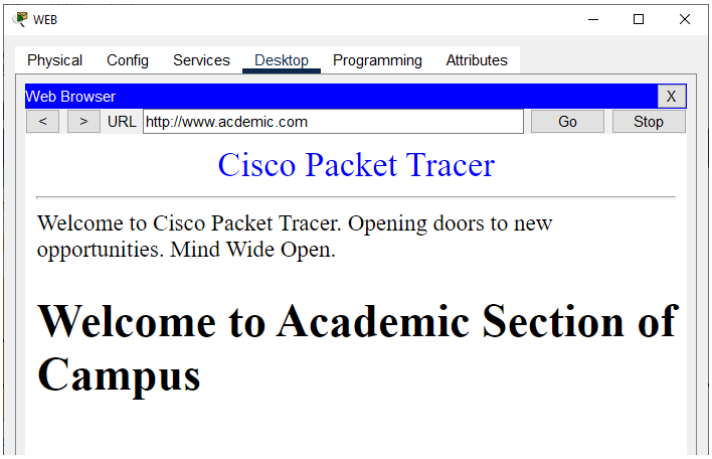


4.3 Communication Between Hosts Simulation

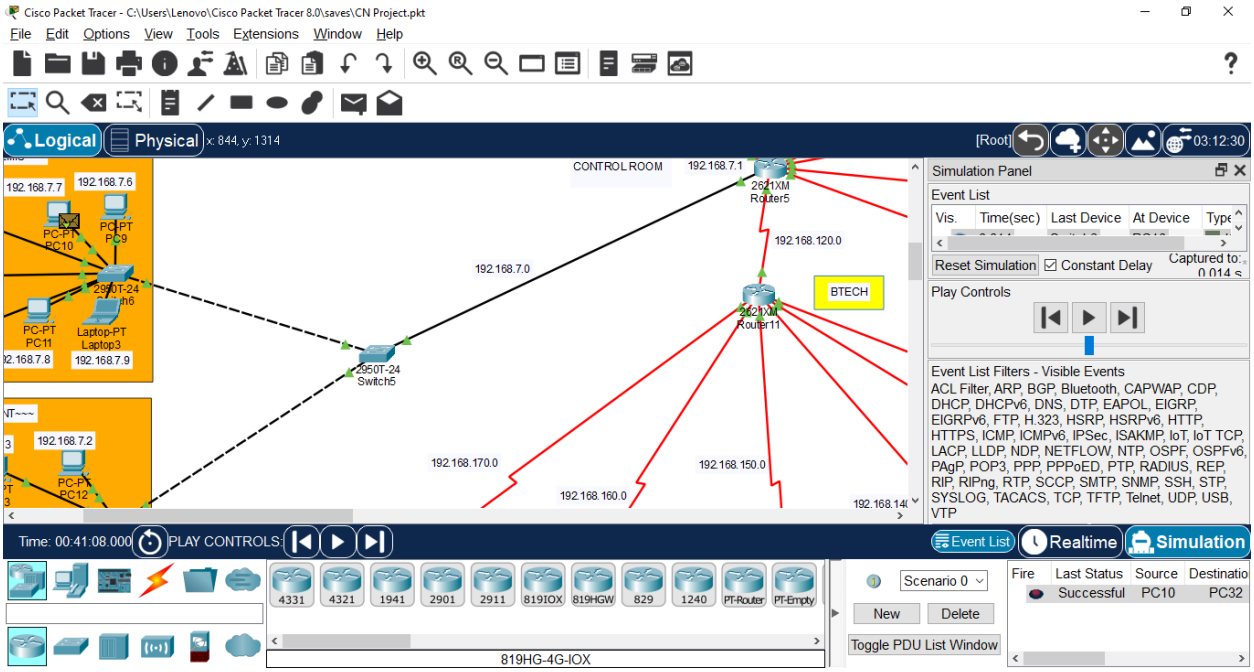


4.4 Analog Phone Simulation

4.5 Web Server Simulation



4.6 Network Simulation



5. Conclusions

This project has proven that a standard network system can be designed with less cost and more secure. This network design is composed of many blocks. There is a special Telephone Room in campus where VOIP phones and IP Phones are installed. I have used the cheapest devices in designing the network. This network is using EIGRP and RIP protocols. We used some important servers such as DNS and DHCP which help the network to perform their functions in a smooth way. On the simulated network, more than 85% of data supplied was successfully received, with just around 15% of lost as claimed in abstract. Lastly, this network design is not limited to only developing countries but developed countries that are trying to cut cost in any of their network design projects can also adopt the methods used in this project.

References

[1] AlSarhan, Rafid Salih Sarhan, "Computer Network Design for Universities in Developing Countries" (2016). Information Technology, Capstone Research Project Reports. 2. Available at: http://scholar.valpo.edu/itcrpr/2

[2] Huichao Ma,Guoliang Lv,Chunyu Wu, "Campus Network Planning and Design", Journal of Computer Hardware Engineering(2018), School of Computer and Information, Hefei University of Technology, Anhui, China