EAST WEST UNIVERSITY

Department of Electronics and Telecommunication Engineering

Spring 2021

PROJECT

Network System on a Small Residential Area

Course Code : ICE302/ETE302

Course Title : Computer Communications & Networks

Section No 01

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Date: 25-04-2021

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1) Background

The communication brings people together and closer to each other. It bonds the gap between individuals and groups through flow of information. Network system is a blessing to commutation. By establishing network system, we can bring people and groups together. In this project we will simulate network system for a residential area with five 5-storey buildings. We will implement a network system basically LAN (Local Area Network) to make communication easier and reliable for residential area in this project. This project will give us an experience of establishing a network system virtually which will help us to establish the network system in real life also. In this project the buildings have many facilities such as IP-Phones, Wi-Fi, PC, TV, Smartphone, Tablet, thus this project will also help us to gather knowledge of various devices and services.

2) Introduction

In this project we are implementing a small residential area network system. LAN covers a relatively small geographic area with a high speed data network. It will connect personal computers, IP-Phones, Servers and other devices. Our network will offer many advantages, including shared access to devices and applications, file exchanges between connected users, and communication via electronic mail and other applications.

This project is designed as a residential area with five 5-storey buildings. Each building has 10 apartments two per floor having a PC, TV, IP phone. There is a basement which contains a security checkup room, garage room each having a PC and IP Phone, and manager room having a PC, IP Phone and TV. There is a meeting room on the room floor with TV, IP Phone and Wi-Fi facility. The rooftop is an indoor playground having a TV set, IP phone and Wi-Fi facility. There will be a server room in the 3rd building of the area contains a PC, IP Phone, TV and a Server.

Server:

Server is a computer program or device that provides functionality for other programs or devices, called “clients”.

DHCP Server:

Dynamic Host Configuring Protocol is a network server that automatically provides and assigns IP addresses, default gateways, and other network parameters to client devices.

DNS Server:

Domain Name System is a system that translate domain names to numeric IP addresses, leading them to correct websites when the domain names are typed in the URL bar of the clients’ browsers.

Email Server:

Email server is a computer system that sends and receives emails using standard email protocols.

3) Tools

Cisco Packet Tracer

A visual simulation tool to create network topologies, and computer networks.

4) Equipment and Quantity

Name and total numbers of equipment to implement the project for five 5-storey buildings is mentioned below:

Equipment	Quantity
PC-PT	66
IP Phone-7960	76
TV-PT	66
Cloud-PT-Empty	10
AccessPoint -PT	10

Smartphone -PT	5
TabletPC-PT	5
Switch-2960-24TT	15
Router-2811	5
Server-PT	1
Copper Crossover Cables	Copper crossover cables to connect switch to switch, switch to Cloud.
Copper Straight Cables	Copper straight cables to connect PC to switch, switch to IP Phone, Server to switch, router to switch, AccessPoint to switch.
Coaxial Cables	Coaxial cables to connect Cloud-PT to TV-PT.

5) LAN Connection Design in The Residential Area

In this project we have simply designed the network system for the residential area. To keep neat and understandable we have colored each building differently. We have used yellow color for 1st building, red color for 2nd building, violet color for 3rd building, blue color for 4th building and maroon color for 5th building.

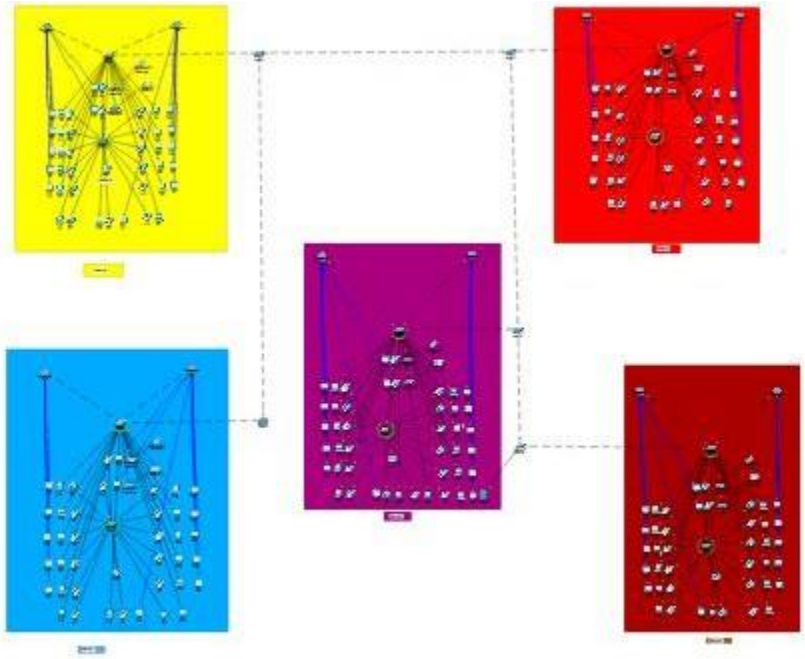

Fig1: Network Design of five buildings in the Residential Area

6) LAN connection in a 5-storey building

We will describe network connection only for the 1st building thoroughly because other buildings have the same network connections.

In the 1st building all 15 IP-Phones are connected to Switch0 2960-24TT. Router7-2811 is configured for IP-Phones and connected to Switch0 2960-24TT. All 13 TVs are connected to Cloud0 and Cloud1. Smartphone0, Tablet PC0 has wireless connection with the AccessPoint1 and AccessPoint0. All of the 13 PC-PTs, 2 AccessPoint-PTs, and 2 Cloud-PT-Empties are connected to Switch5 2960-24TT.

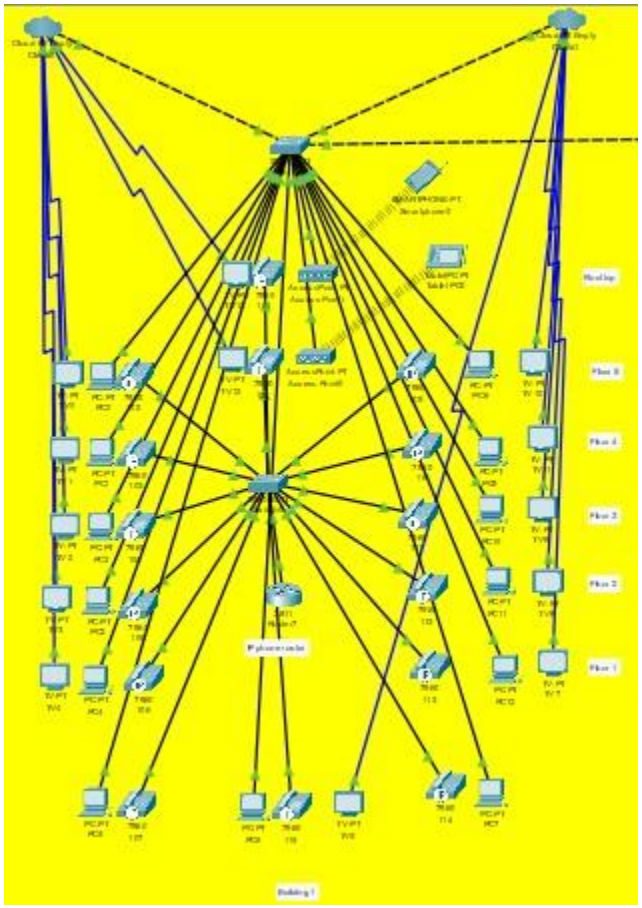

Fig2: LAN connection in a 5-storey building

7) Network in each Floor and description

a) Basement

The basement contains a security checkup room, garage room each having a PC and IP Phone, and manager room having a PC, IP Phone and TV. The Router7 configured for IP-Phones, IP-Phones (107,114,115) are connected to Switch0. TV5 is connected to Cloud1. The Cloud1, PC5, PC6, and PC7 is connected to Switch5.

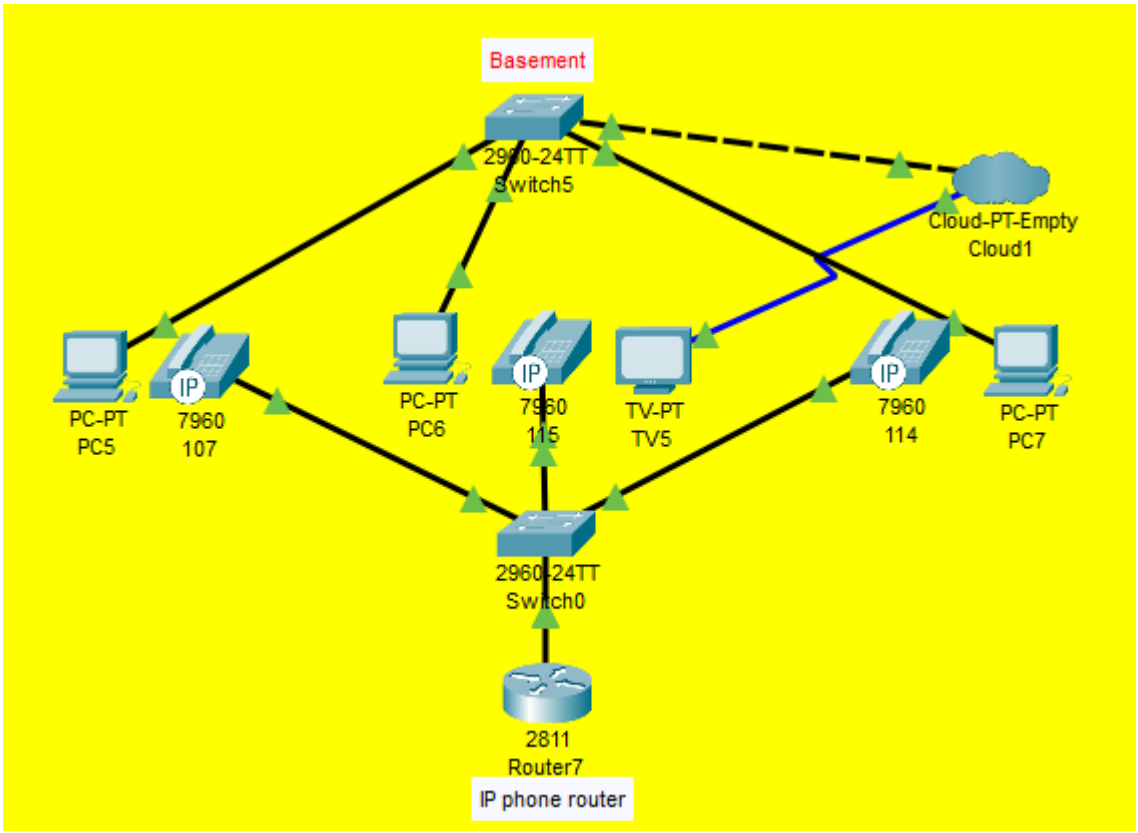

Fig3: Network connection in the basement

b) 1st floor

The 1st floor contains two apartments each having a PC and IP Phone, and TV set. The Router7 configured for IP-Phones, IP-Phones (106,113) are connected to Switch0. TV4 is connected to Cloud0 and TV7 is connected to Cloud1. The Cloud1, Cloud0, PC4, and PC12 is connected to Switch5.

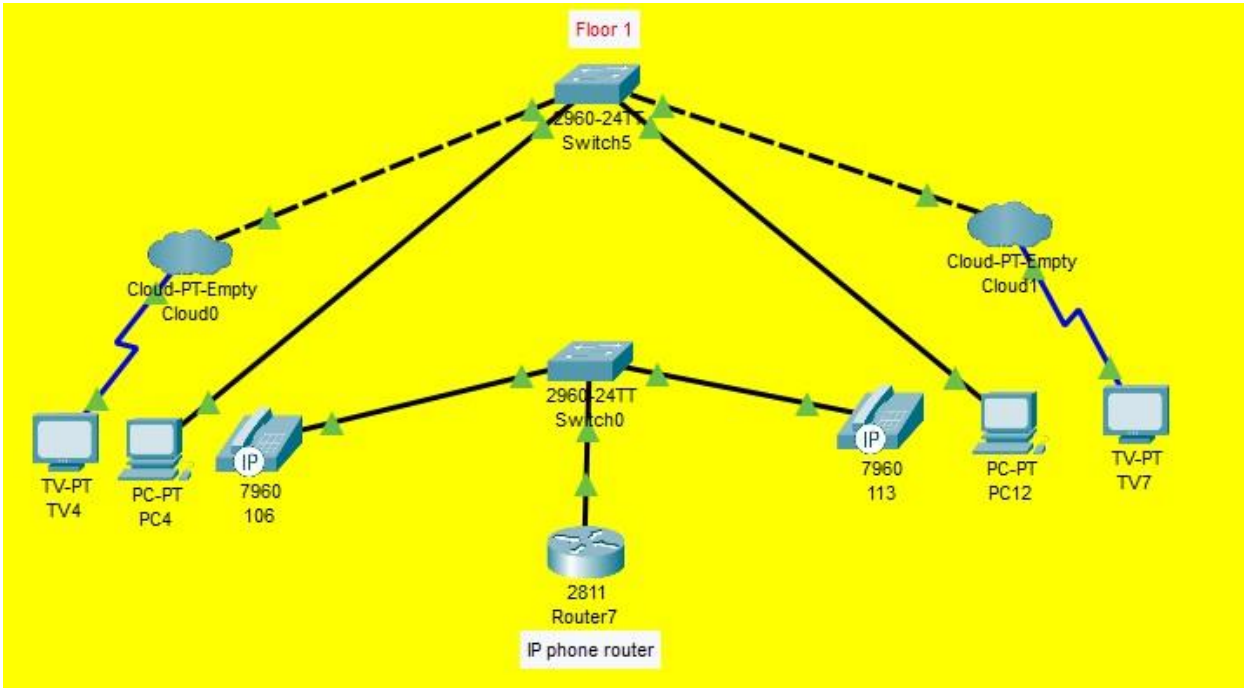

Fig4: Network connection in Floor 1

c) 2nd floor

The 2nd floor contains two apartments each having a PC and IP Phone, and TV set. The Router7 configured for IP-Phones, IP-Phones (105,112) are connected to Switch0. TV3 is connected to Cloud0 and TV8 is connected to Cloud1. The Cloud1, Cloud0, PC3, and PC11 is connected to Switch5.

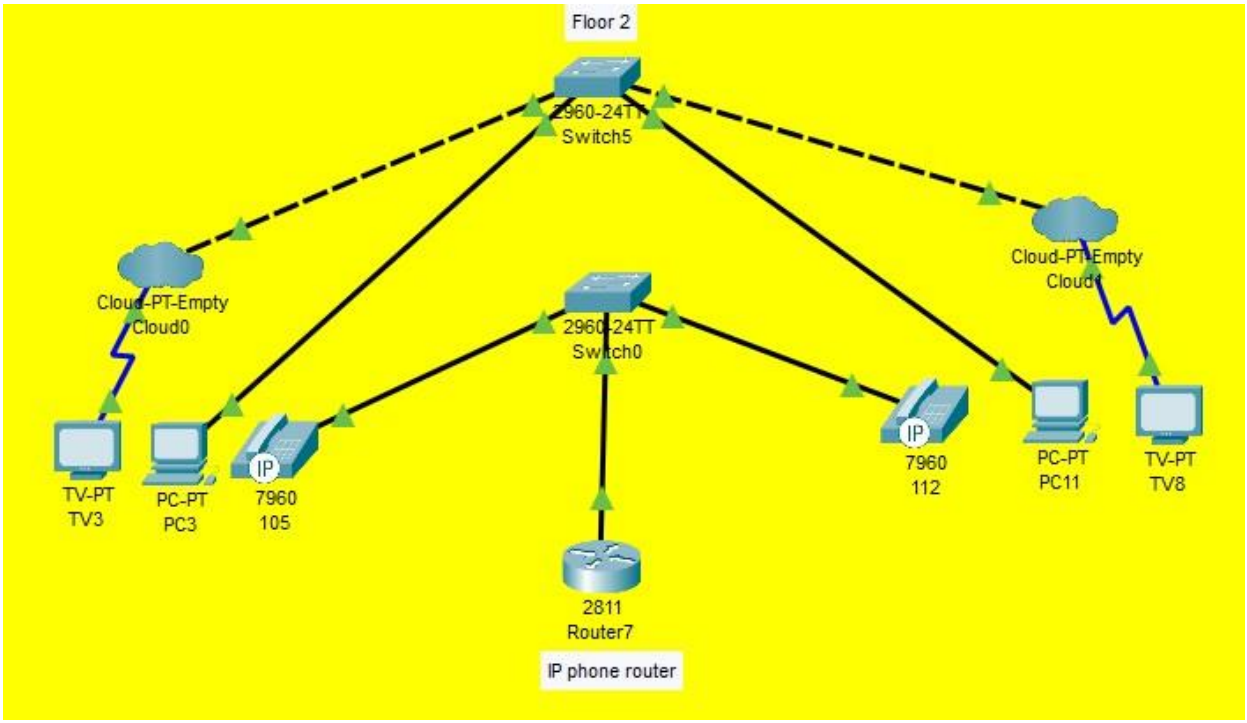

Fig5: Network connection in Floor 2

d) 3rd floor

The 3rd floor contains two apartments each having a PC and IP Phone, and TV set. The Router7 configured for IP-Phones, IP-Phones (104,111) are connected to

Switch0. TV2 is connected to Cloud0 and TV9 is connected to Cloud1. The Cloud1, Cloud0, PC2, and PC10 is connected to Switch5.

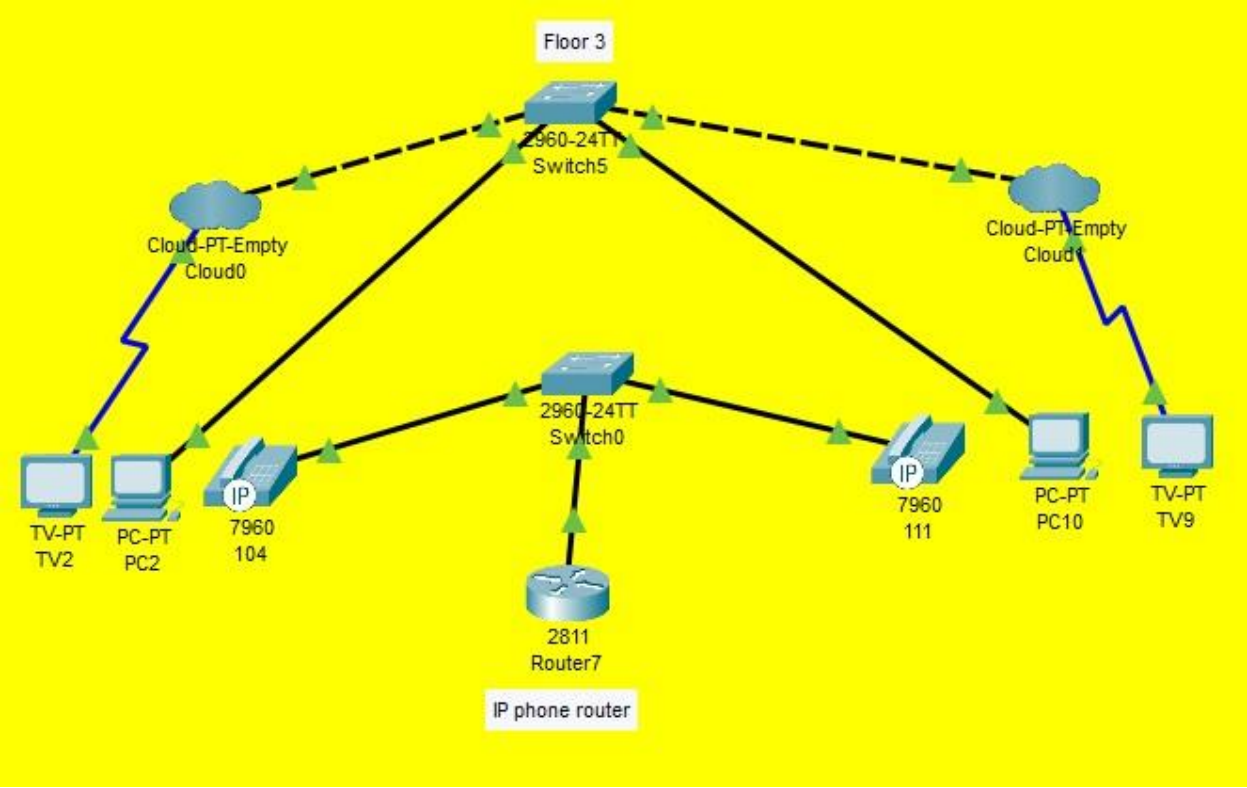

Fig6: Network connection in Floor 3

e) 4th floor

The 4th floor contains two apartments each having a PC and IP Phone, and TV set. The Router7 configured for IP-Phones, IP-Phones (103,110) are and connected to Switch0. TV1 is connected to Cloud0 and TV11 is connected to Cloud1. The Cloud1, Cloud0 and PC1, PC9 is connected to Switch5.

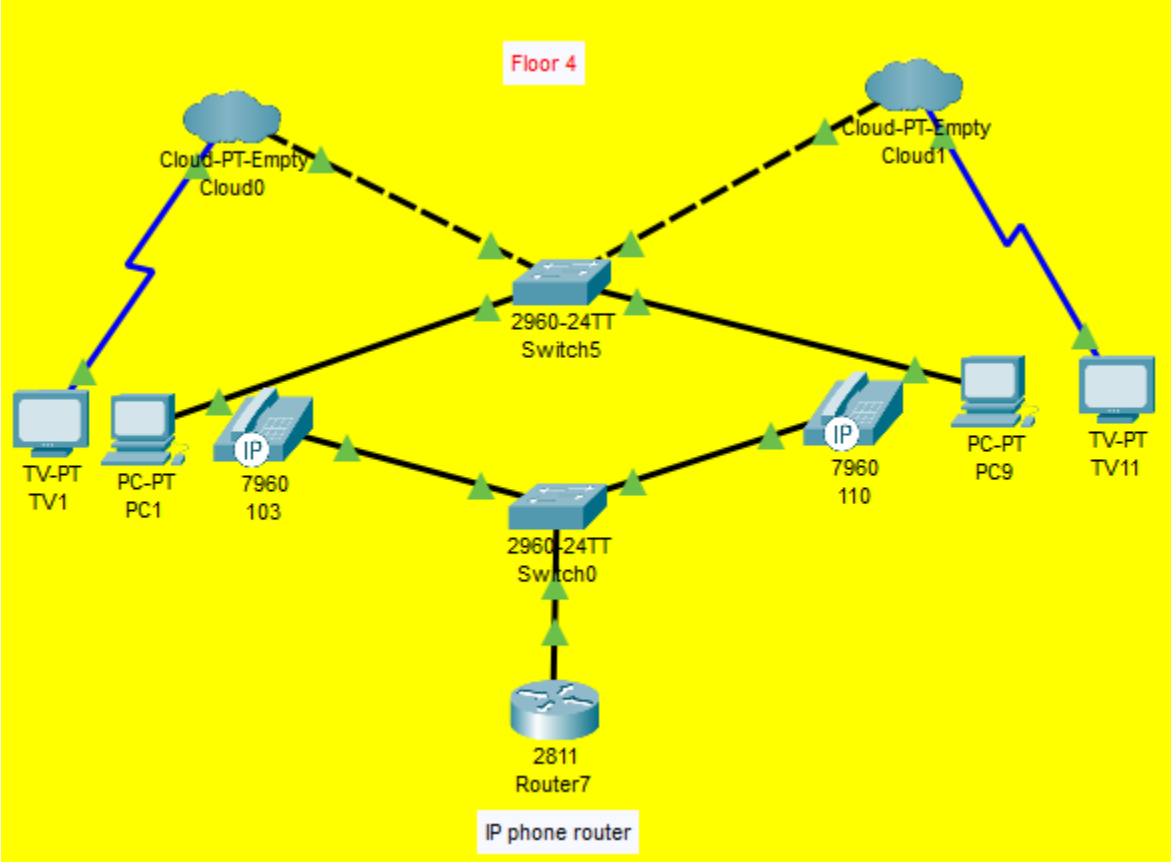

Fig7: Network connection in Floor 4

f) 5th floor

The 5th floor contains two apartments each having a PC, TV, IP Phone, and meeting room having a TV, IP Phone and Wi-Fi facility. The Router7 configured for IP-Phones, IP-Phones (102,108,109) are connected to Switch0. TV0 and TV12 is connected to Cloud0 and TV10 is connected to Cloud1. Tablet PC0 has a wireless connection to AccessPoint0. The Cloud1, Cloud2, AccessPoint0, PC0, and PC8 is connected to Switch5.

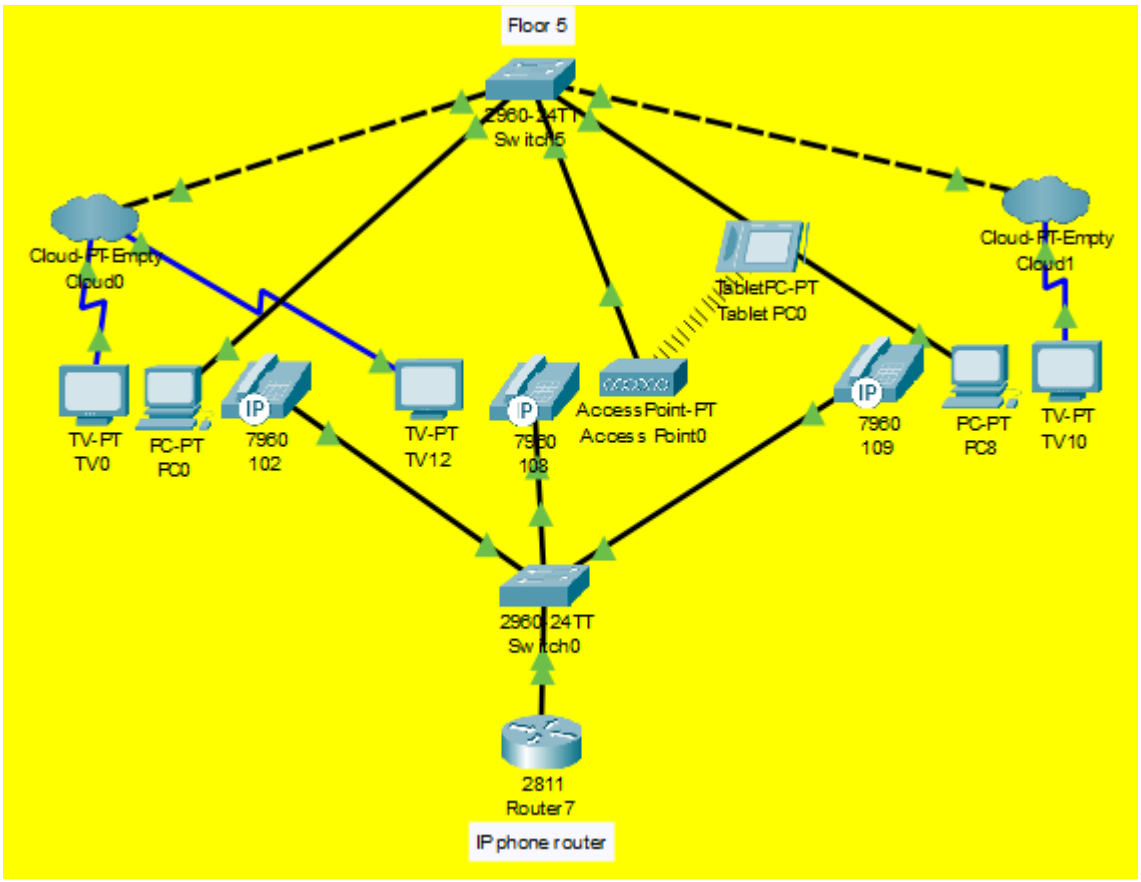

Fig8: Network connection in Floor 5

g) Roof top

The rooftop is designed as an indoor playground having a TV set, IP phone and Wi-Fi facility. The Router7 configured for IP-Phone 101, and IP-Phone101 is connected to Switch0. TV13 is connected to Cloud0. Smartphone0 has a wireless connection to AccessPoint1. The Cloud0, and AccessPoint1 is connected to Switch5.

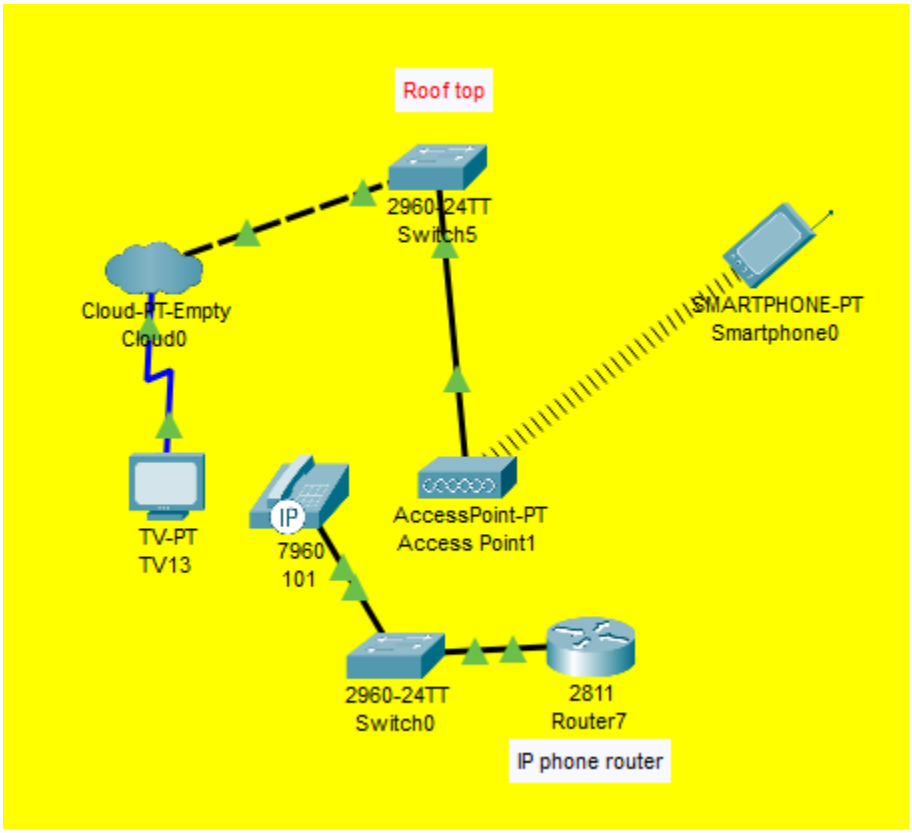

Fig9: Network connection in Roof top

8) 3rd building's basement with server

Only one server is used in this project. In the basement of the 3rd building there is server room contains server of the area, also has an IP phone, a PC and a cloud TV set. The basement contains a security checkup room, garage room each having a PC and IP Phone, and manager room having a PC, IP Phone and TV. The Router2 configured for IP-Phones, IP-Phones (306,316,315,314) are connected to Switch2. TV52 is connected to Cloud4 and TV66 is connected to Cloud5. The Cloud4,

Cloud5, PC (31,32,33,39) is connected to Switch8. The Server-PT is connected to a Switch14.

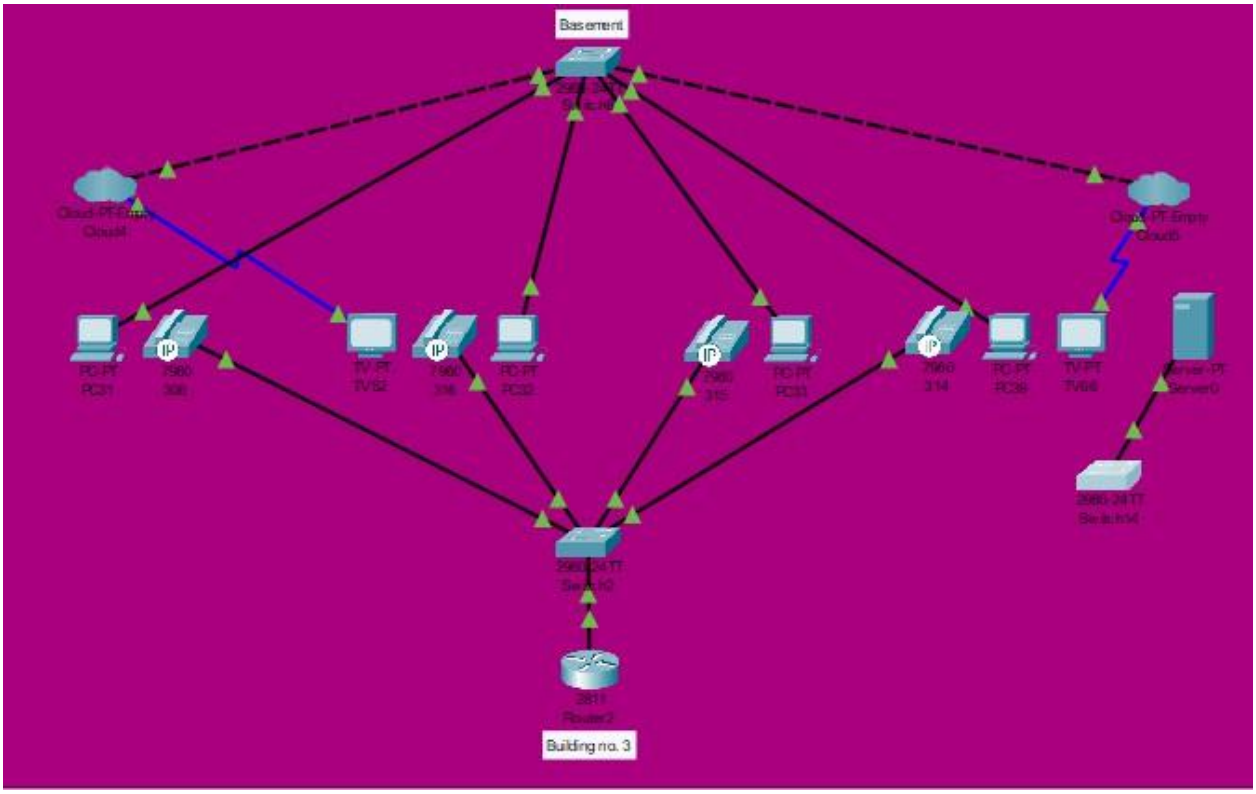

Fig10: Network connection in the basement of 3rd building

9) Connections

We have connected the switches of each building with another switch and interconnected all the 5 switches of five buildings with one server.

The Switch5 from 1st building is connected to Switch11.

The Switch6 from 2nd building is connected to Switch12.

The Switch8 from 3rd building is connected to Switch13.

The Switch9 from 4th building is connected to Switch10.

The Switch7 from 5th building is connected to Switch14

Switch10 is connected to switch11, switch 11 is connected to switch 12, switch12 is connected to switch 13, switch13 is connected to switch 14 and switch 14 is connected to the server0.

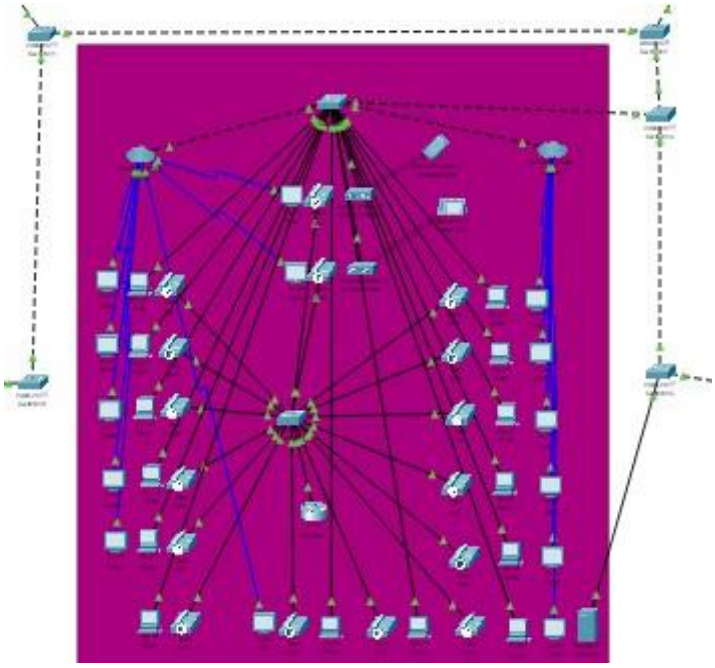

Fig11: Network connection in the Area

10) Configurations

a) Server IP configuration

We have set the Server IP Address “192.168.1.1”. And the Subnet Mask is “255.255.255.0”.

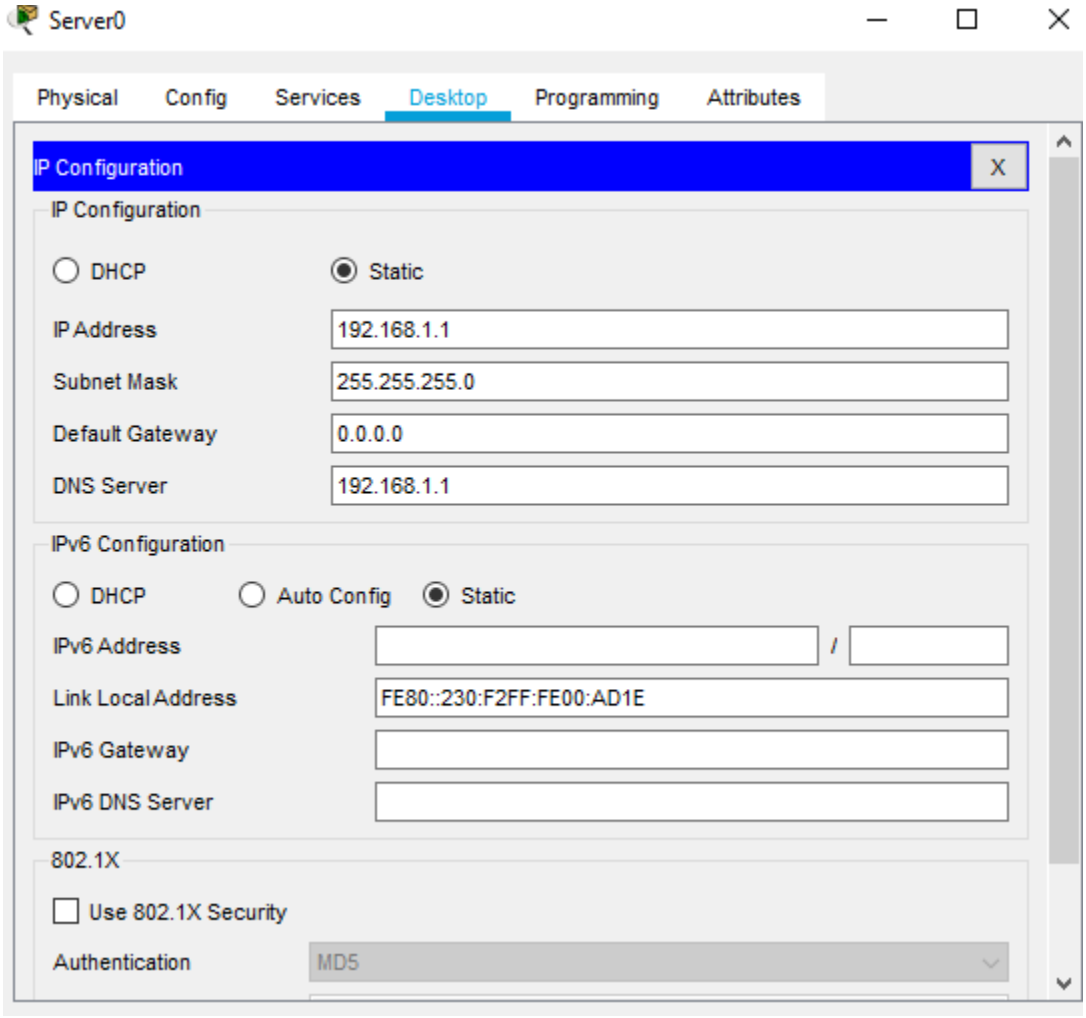

Fig12: Server IP Configuration

b) **DHCP Server**

First, we have turned “ON” the DHCP service in Server0 and named the Pool Name. We have set the Start IP Address “192.168.1.0” and the Subnet Mask is “255.255.255.0”. Then we have added and saved the service.

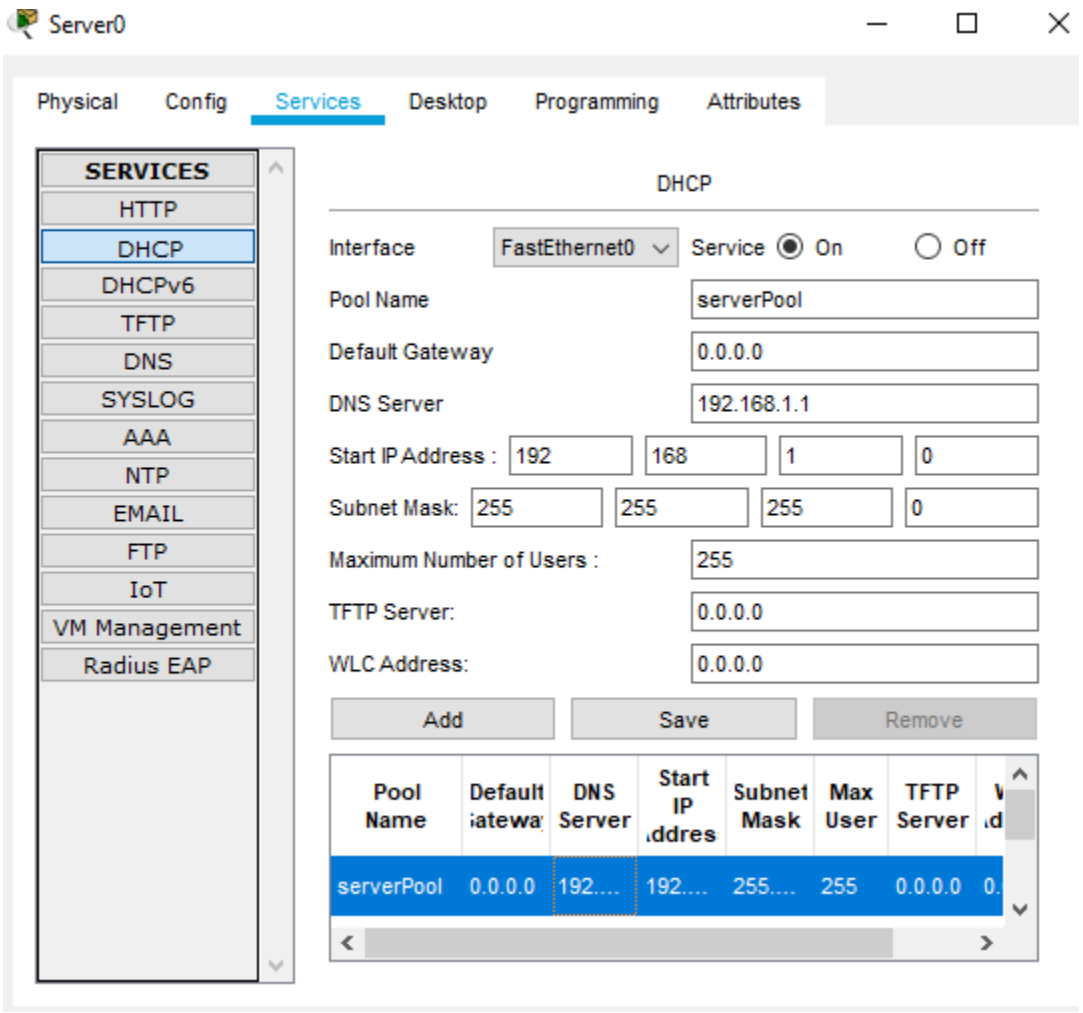

Fig13: DHCP Server Configuration

c) **DNS Server**

We have chosen the DNS from the services section of the Server0 and turned it "ON". We have put www.google.com in the Name box and set the IP address of the server which is "192.168.1.1" in the Address for DNS. Then we have added and saved the record.

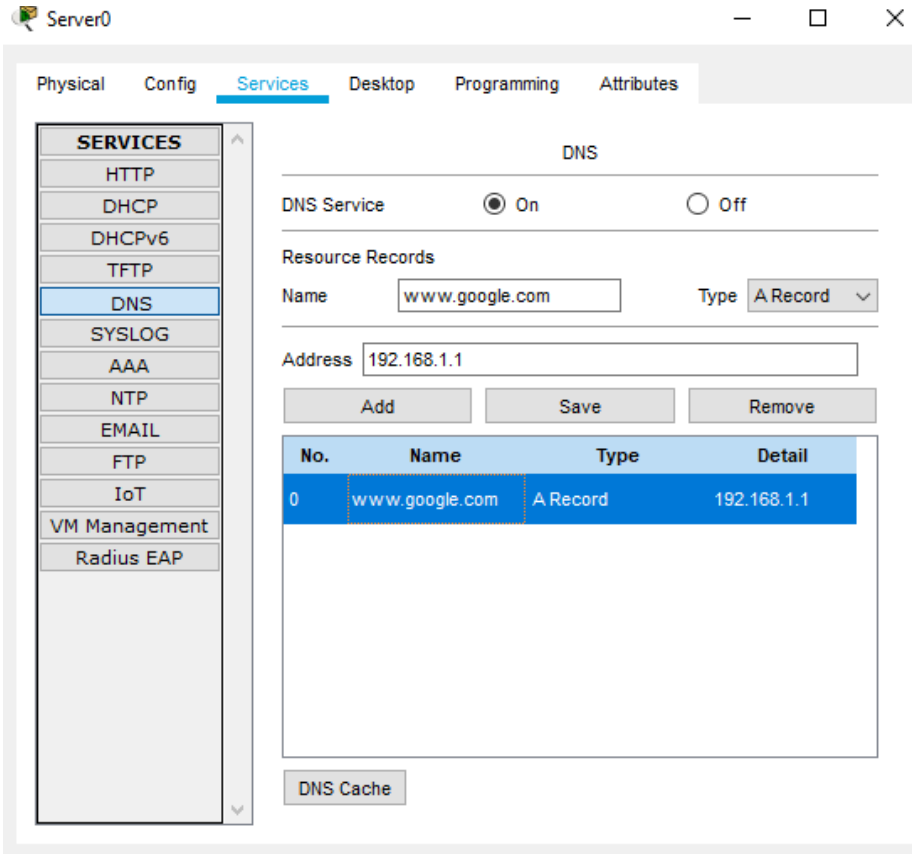

Fig14: DNS Server Configuration

d) **Email configuration**

We have selected Email service and set the Domain Name. We setup the user and password for all the PCs, Tablets, Smartphones. and added in the server.

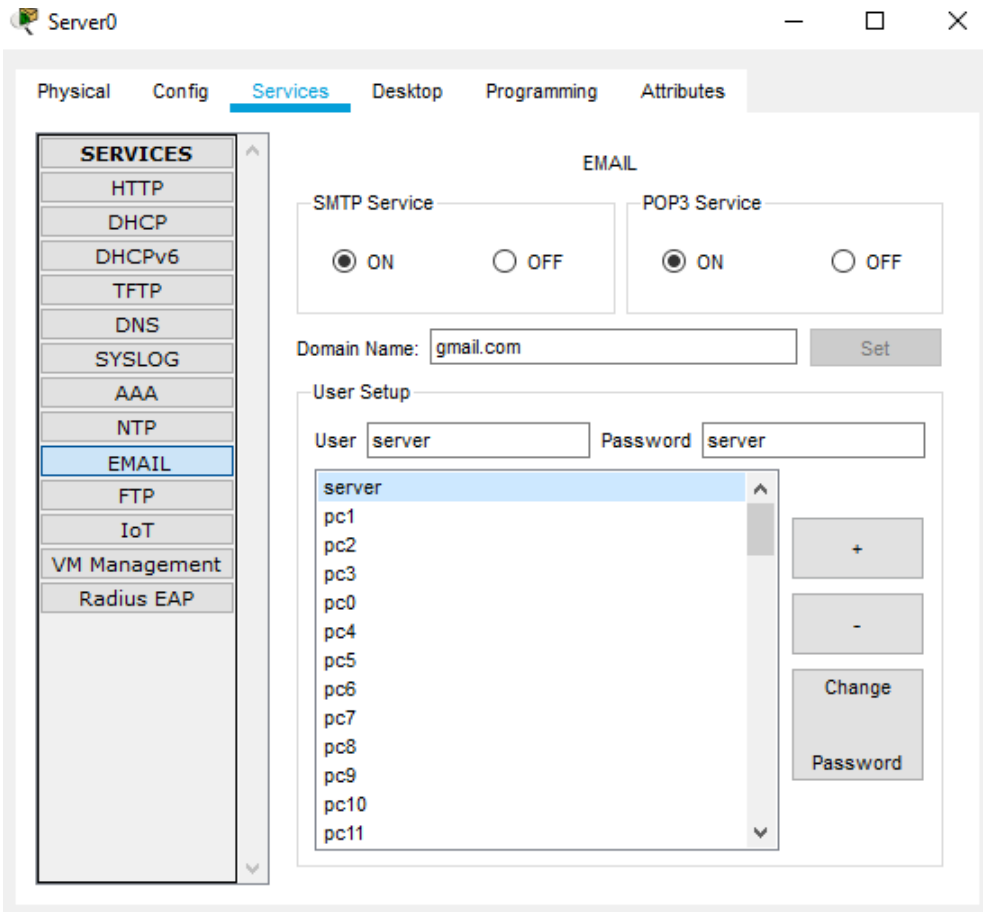

Fig15: Email Server Configuration

We have set the name and Email address in User Information and IP address of the server in the Server Information.

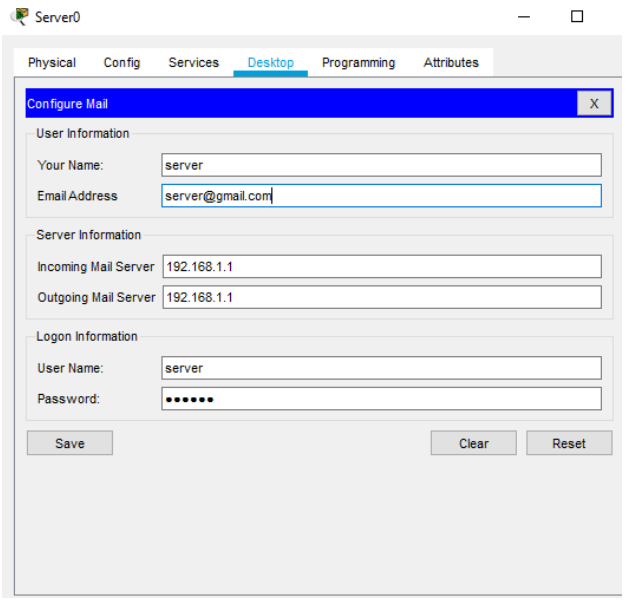

Fig16: Email Server Information Configuration

9) **PC configuration**

We have selected DHCP then IP address, DNS, subnet mask assigned automatically.

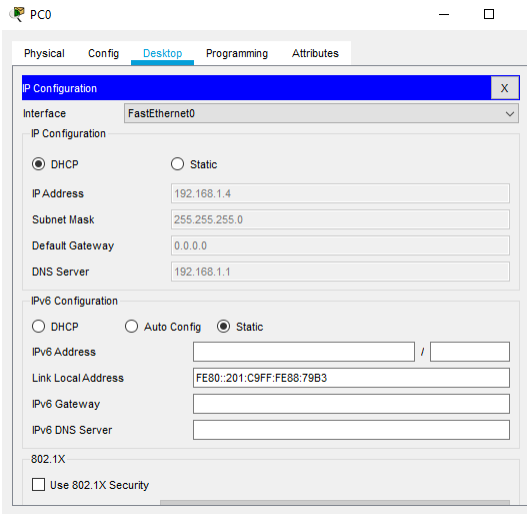

Fig17: PC configuration

10) IP phone configuration

a) Power on

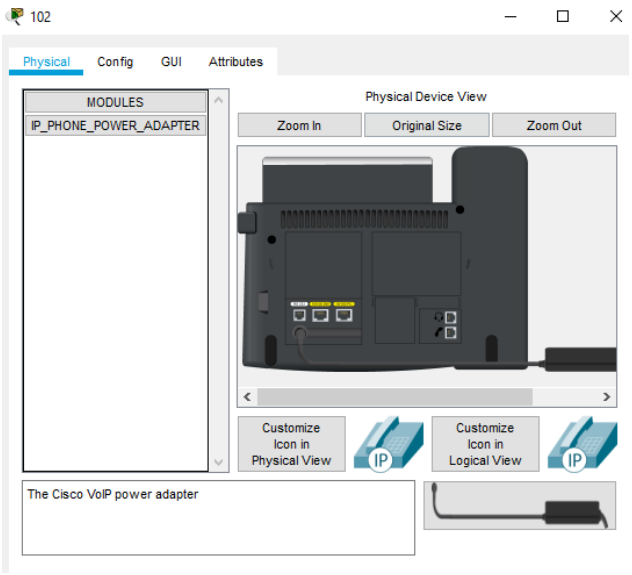

Fig18: power “ON” in the IP-Phone

b) Router configuration

Here, we configured all the IP-Phones of the 1st building in the Router.

--- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: no

Press RETURN to get started!

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip dhcp pool NilimaTech
Router(dhcp-config)#network  192.168.5.0  255.255.255.0
Router(dhcp-config)#default-router  192.168.5.1
Router(dhcp-config)#option 150 ip 192.168.5.1
Router(dhcp-config)#ex
Router(config)#ip dhcp excluded-address 192.168.5.1
Router(config)#int fa0/0
Router(config-if)#ip add 192.168.5.1 255.255.255.0
Router(config-if)#no sh

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

Router(config-if)#ex
Router(config)#
Router(config)#telephony-service
Router(config-telephony)#max-ephones  20
Router(config-telephony)#max-dn  20
Router(config-telephony)#ip source-address 192.168.5.1 port 2000
Router(config-telephony)#auto assign 1 to 20
Router(config-telephony)#ex
Router(config)#

Router(config)#ephone-dn  1
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 1.1, changed state to up

Router(config-ephone-dn)#num  101
```

```
Router(config-ephone-dn)#ex
Router(config)#ephone-dn 2
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 2.1, changed state to up

Router(config-ephone-dn)#num 102
Router(config-ephone-dn)#ex
Router(config)#ephone-dn 3
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 3.1, changed state to up

Router(config-ephone-dn)#num 103
Router(config-ephone-dn)#ex
Router(config)#ephone-dn 4
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 4.1, changed state to up

Router(config-ephone-dn)#num 104
Router(config-ephone-dn)#ex
Router(config)#ephone-dn 5
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 5.1, changed state to up

Router(config-ephone-dn)#num 105
Router(config-ephone-dn)#ex
Router(config)#ephone-dn 6
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 6.1, changed state to up

Router(config-ephone-dn)#num 106
Router(config-ephone-dn)#ex
Router(config)#ephone-dn 7
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 7.1, changed state to up

Router(config-ephone-dn)#num 107
Router(config-ephone-dn)#ex
Router(config)#ephone-dn 8
Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 8.1, changed state to up
```

Router(config-ephone-dn)#num 108

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 9

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 9.1, changed state to up

Router(config-ephone-dn)#num 109

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 10

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 10.1, changed state to up

Router(config-ephone-dn)#num 110

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 11

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 11.1, changed state to up

Router(config-ephone-dn)#num 111

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 12

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 12.1, changed state to up

Router(config-ephone-dn)#num 112

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 13

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 13.1, changed state to up

Router(config-ephone-dn)#num 113

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 14

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 14.1, changed state to up

Router(config-ephone-dn)#num 114

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 15

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 15.1, changed state to up

Router(config-ephone-dn)#num 115

Router(config-ephone-dn)#ex

Router(config)#ephone-dn 16

Router(config-ephone-dn)#%LINK-3-UPDOWN: Interface ephone_dsp DN 16.1, changed state to up

Router(config-ephone-dn)#num 116

Router(config-ephone-dn)#ex

Router(config)#

c) Switch configuration

We have configured the Switch-2960-24TT for IP-Phone which is connected to the IP-Phone Router-2811.

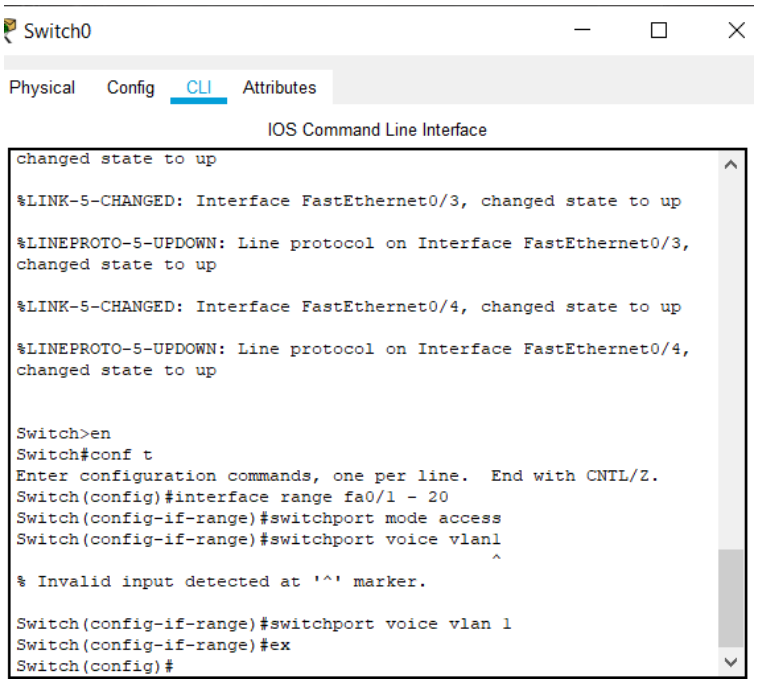

Fig19: Switch configuration for IP-Phone

11) Cloud configuration

a) TV connection

We have selected the Cloud-PT-Empty to connect the Cloud TV set. The PT-CLOUD-NM-1CX card features a single coaxial connector, which is used for a cable modem service connection. The PT-CLOUD-NM-1CE features a single Ethernet port that can connect a LAN backbone. We have to turn off the power before adding the module.

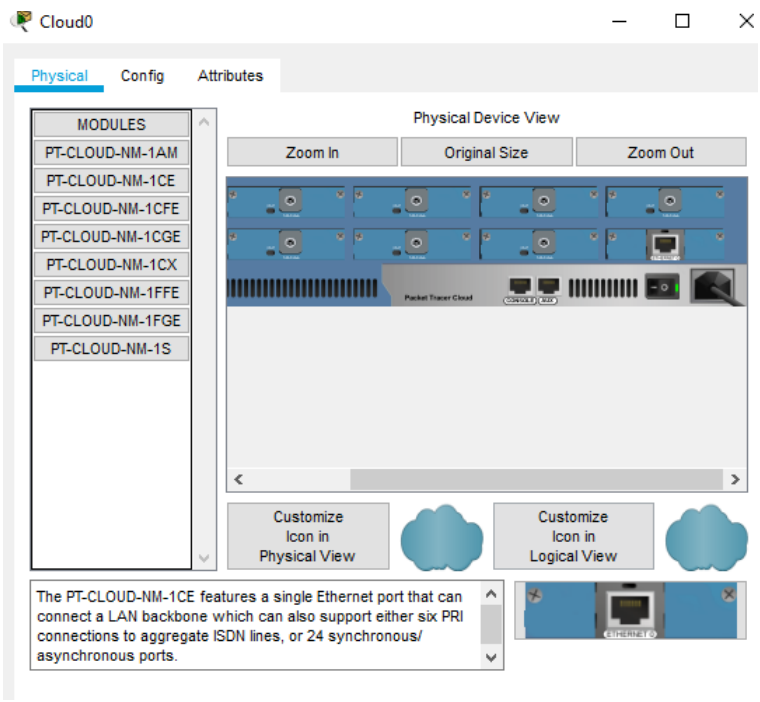

Fig20: Cloud-PT module adding

We have set the TV settings and added few images which we would like to display on the TV set.

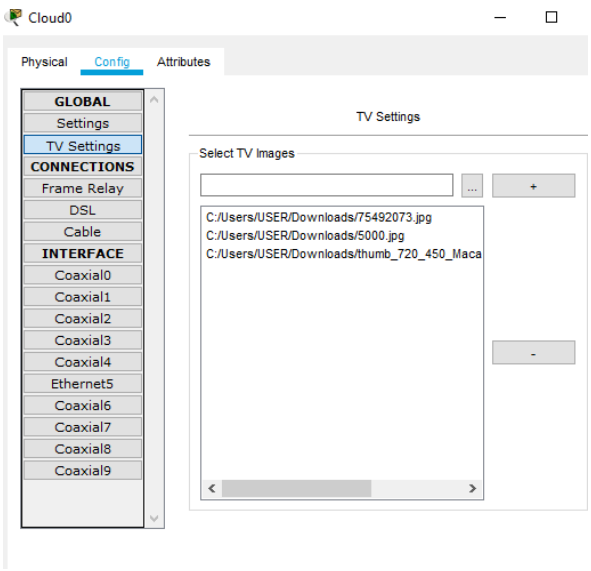

Fig21: Cloud-PT TV settings

b) TV display

Now we can see the images on the TV screen.

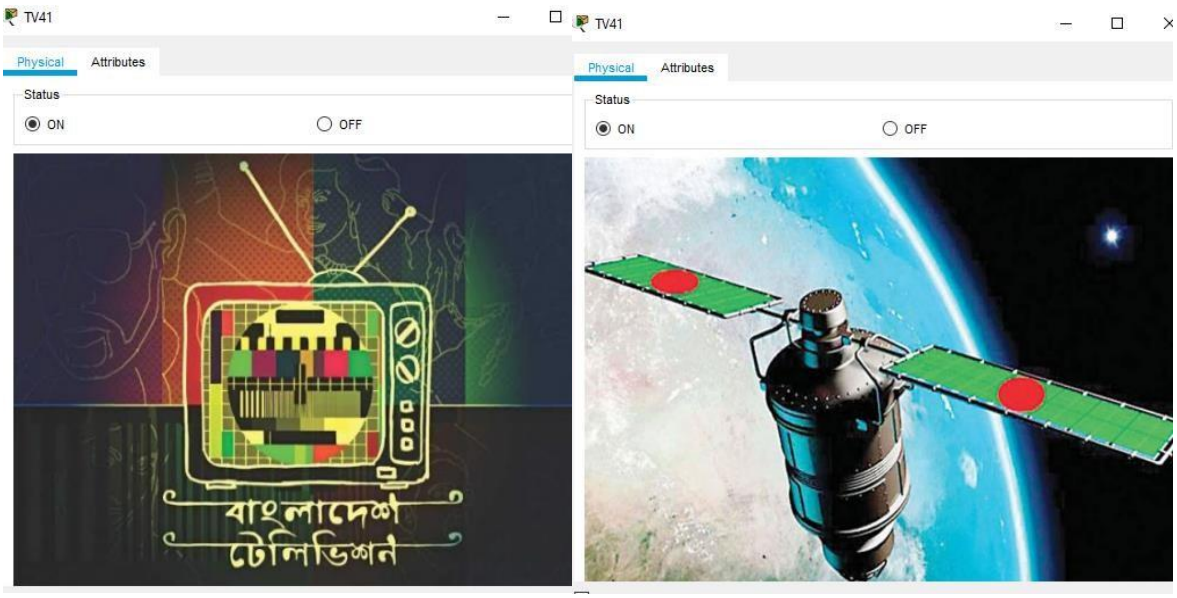

Fig22: Cloud TV Channel display

12) Wi-Fi facility

a) AccessPoint configuration

In port 1 we have selected WEP and set the WEP key of 10 digits. Both ID and Password has to be different for different AccessPoint devices.

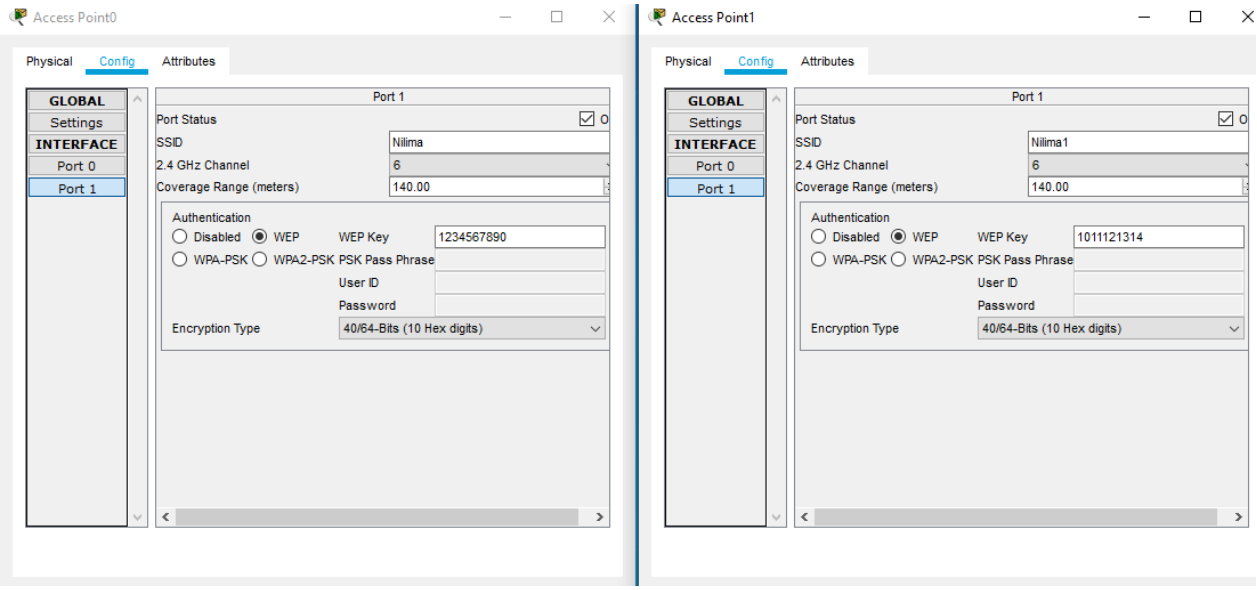

Fig23: Access points configuration

b) End device configuration

The devices which are connected wireless to the AccessPoint, have been configured with the same user ID and Password used in the connected AccessPoint devices.

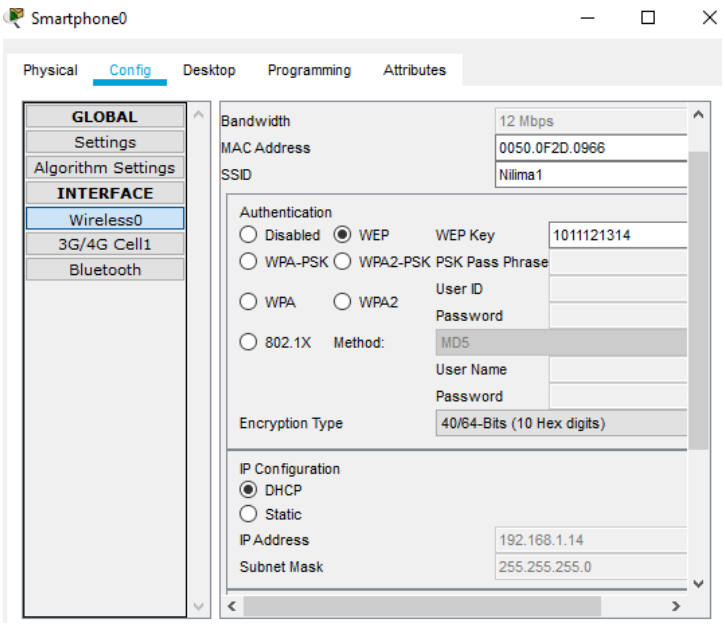

Fig24: Smartphone configuration

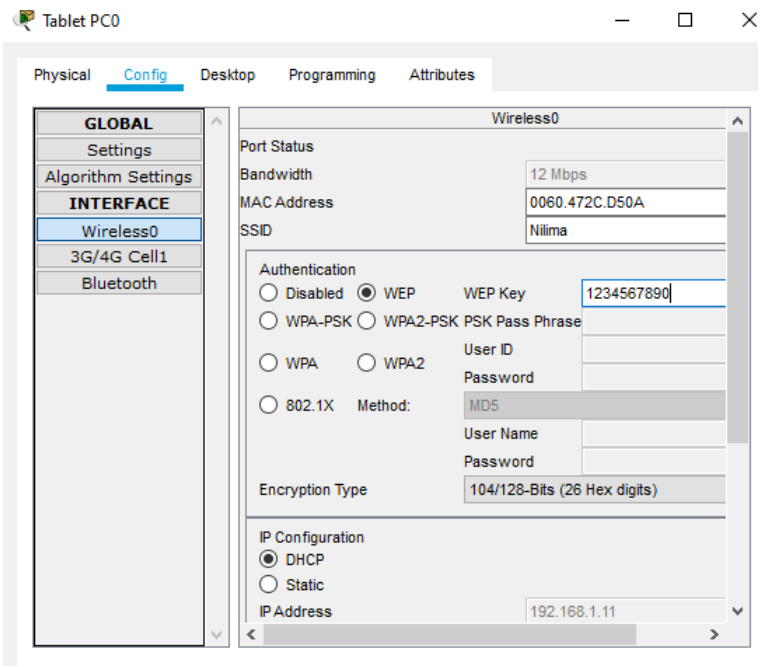

Fig25: Tablet PC configuration

14) Communication

People of this Residential area can communicate with their neighbors through the network we established.

We have checked all the connections properly and further tested whether we are able to communicate via email from one End device to another, call from one IP-Phone to another IP-Phone, and ping one PC from another PC. We also checked the TV display.

a) PC ping command

All the PC-PTs can successfully ping other PCs. Here, we are only showing the ping command for PC4 of 1st building and PC51 of 4th building.

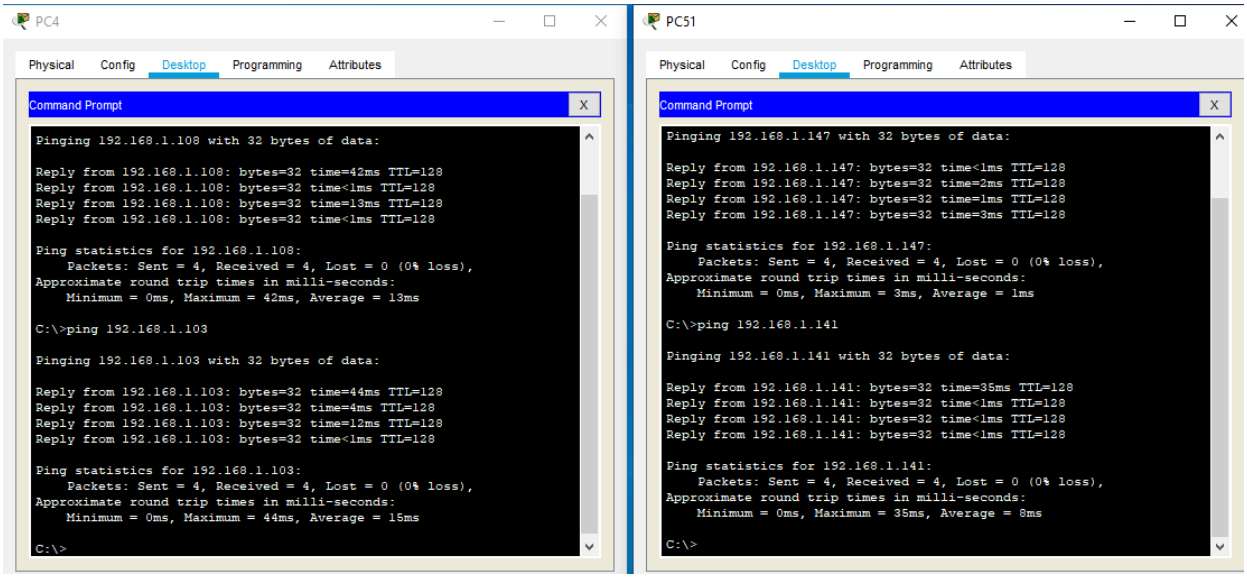

Fig26: PC-PT ping command

b) PC to PC email

We can send and receive emails from one devices to another.

Here, we can see a PC of 1st building successfully sent email to a PC of 4th building.

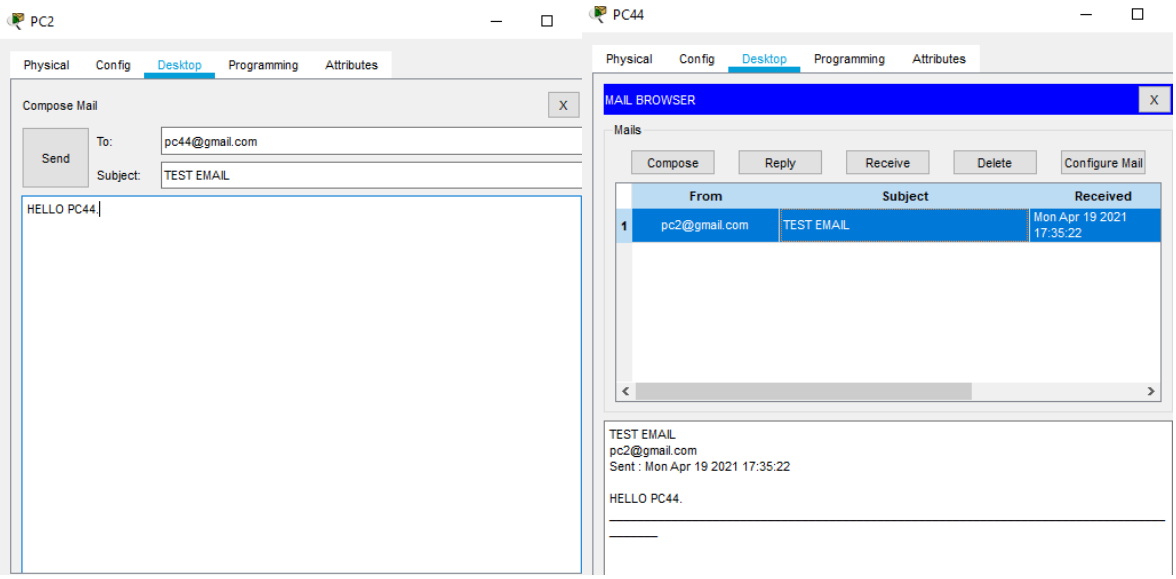

Fig27: email sent and received from one PC to another PC

c) PC to Server email

Here, we can see a PC of 1st building successfully sent email to the Server placed in the 3rd building.

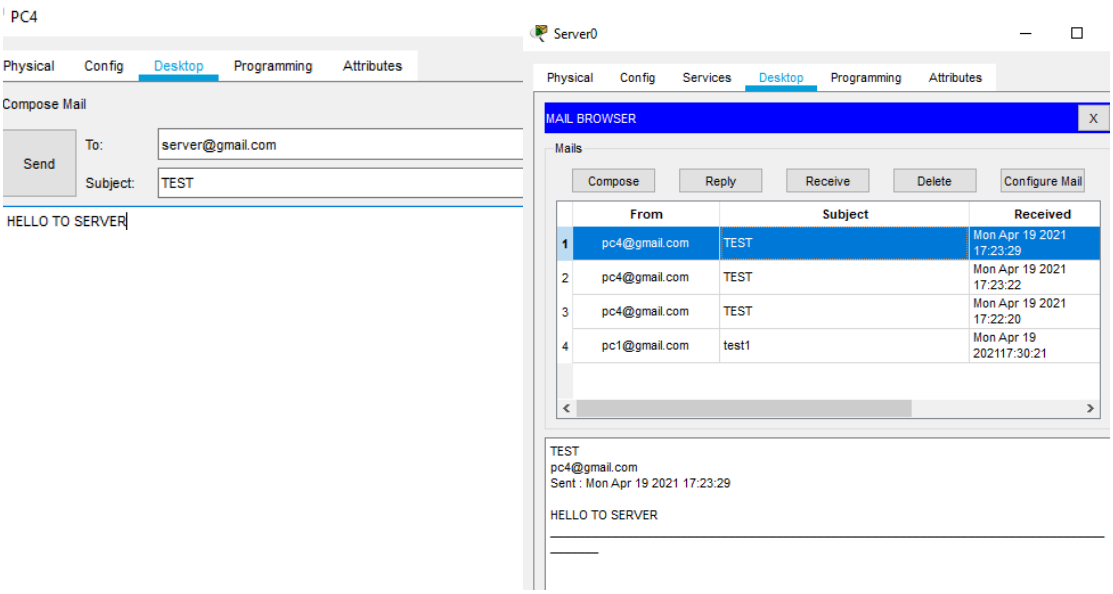

Fig28: email from PC-PT to Server

d) IP phone to IP phone

All the IP-Phones of the building can communicate with each other.

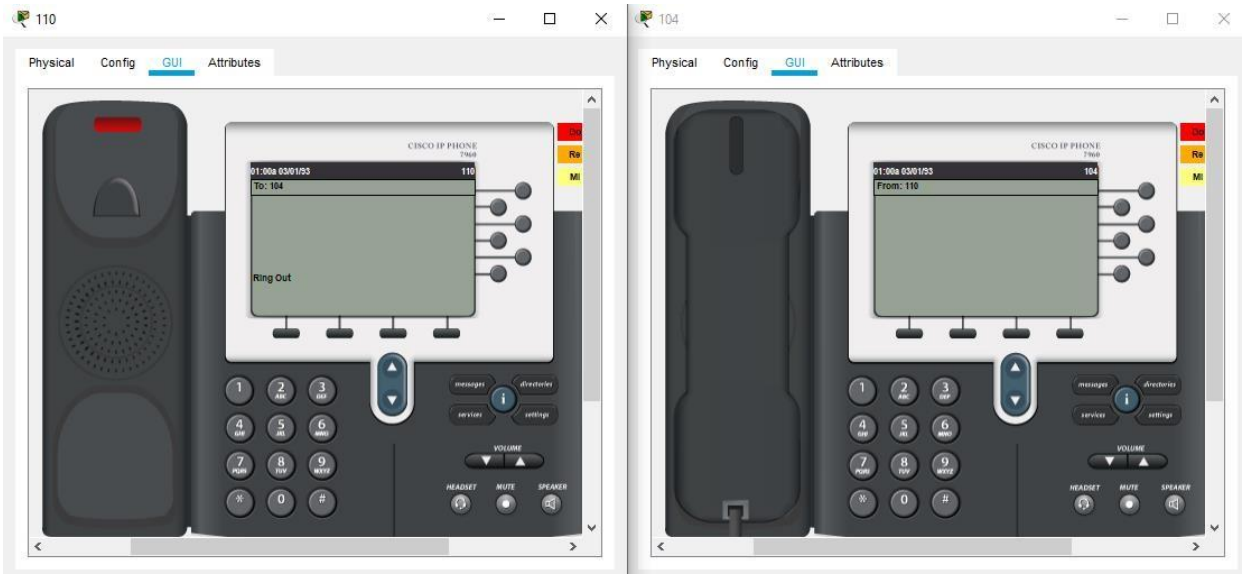

Fig29: IP phone to IP phone calling in the 1st building

e) Cloud TV

If we turn on the TV, we can see the images on TV screen.

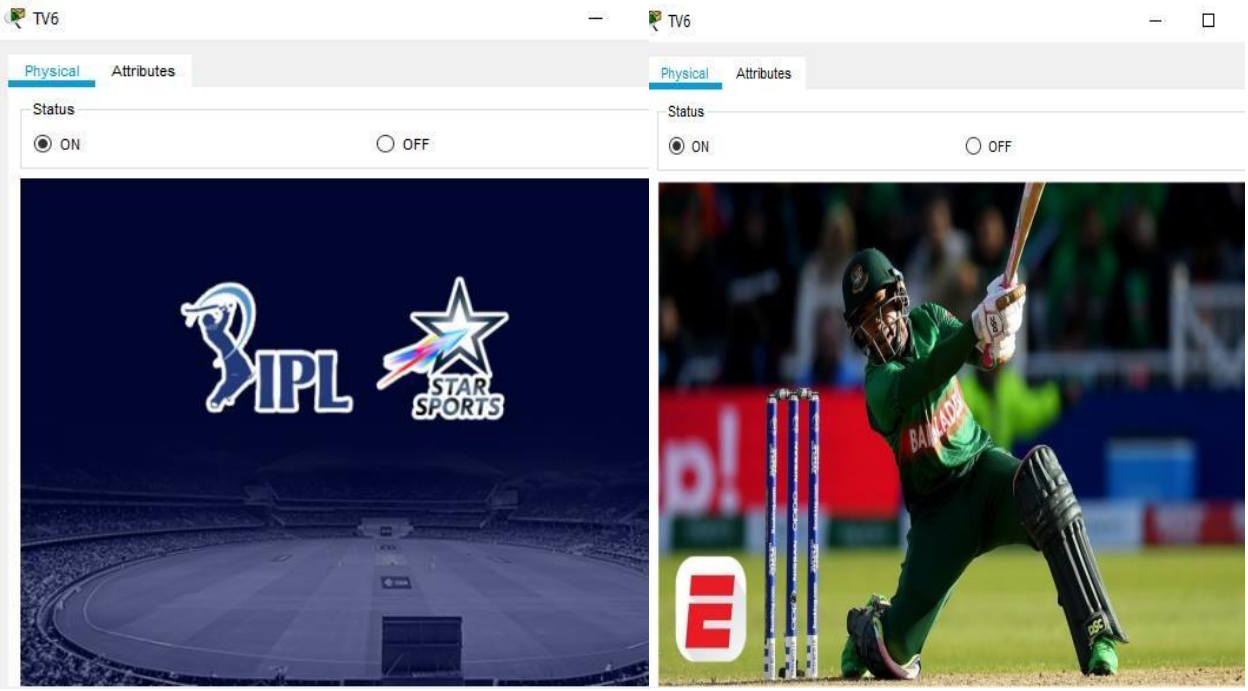

Fig30: TV-PT Screen

f) Wi-Fi connected devices

Smartphones and Tablets are connected to Wi-Fi AccessPoint device. So we can use web browser to search websites.

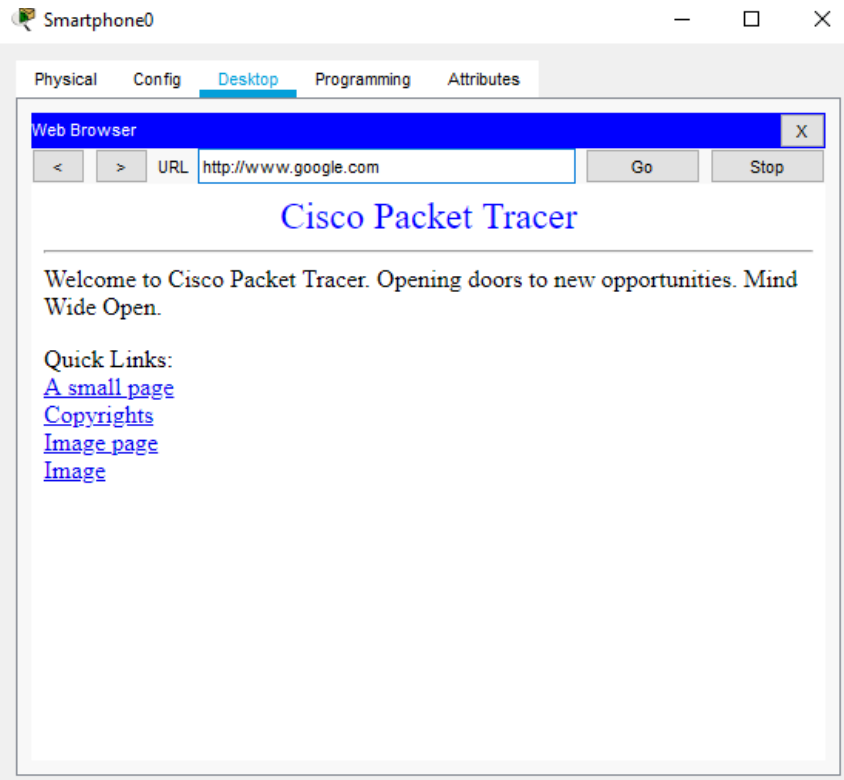

Fig31: Wi-Fi connected smartphone web browsing

15) **Advantages**

In this project we have built a network system for the residential area having five-5storey buildings, fundamentally a LAN has been established. As the user numbers are minimal, LAN provides very fast connectivity with users. Web browsing, files, mails, information can be shared very quickly. All the users work is stored in a central place. Emails can be sent to people working at other computers on the network which will save both paper and time. All the client users are controlled by

the server thus server can control over users' access rights. Data is stored in the server computer so it is easy to manage data and data is secure too. Instead of using home routers we have used AccessPoint-PT in our network system because it will cover a large area, handle more connections, and users can freely roam from one room to another without experiencing network interruptions. When people move through the building their devices shift from one Access point to the next without dropping the connection and they won't even realize they are switching between networks.

16) **Limitations**

The Server administration can see and check personal data files of the users. If the Server hard disk is not secured, unauthorized users can access important data of the users. Our established LAN system can cover a small area similar to a group of buildings. If a virus gets into the Server PC, it can easily spread throughout the network. If the server fails, all shared files will be inaccessible to the network. IP-Phones of one building could not connect to the IP-phones of other buildings. IP phones connection was within the building because our IP-Phones work only in the router of the building. So another limitation is that people can't communicate

through IP-Phones from one building to another building. They can only communicate within the building.

17) Future work

We can improve the future work for our network system.

The Server hard disk should be more secured and password system can be made to stop unauthorized users access important data of the clients. If the server fails, all shared files will be inaccessible to the network so we should use more than one server to solve this problem. If we setup server properly, patch it regularly, and maintain good security practice, we will not need anti-virus. In our DHCP and DNS network system there are so many users interacting with the server in that case we should user anti-virus in the Server to protect it from virus attack. IP-Phones of one building could not connect to the IP-phones of other buildings so we can overcome this problem in future and communicate through IP-Phones from one building to another building.

18) Cost

The initial setup cost of implementing this network is high because a special software is required to make a server. In this project there are so many devices and cables thus it will cost more. Communication devices like switches, routers, Ethernet cables are costly. Routers are costlier than switches. As we have kept our network design simple and budget friendly so we have used switches instead of using so many routers to minimize the number of routers as much as possible. Switches have been used for a limited budget to experience high performance at a lower cost.

The cost of wireless access point is more than a wireless router because it covers a large area but in this project the price is worth for its reliable and consistent internet access.

19) Conclusion

We have designed our project simply to make it understandable. We haven't used so many routers to avoid complexity. Configuring routers would also take a lot of time to connect all the IP-phones because of the shortage of time we used switches instead. It is a simulation based project but we learnt all the methods and systems to establish a network thus it will easier for us to implement this project in real life also.

We faced so many complications and overcome the problems so we can solve complications in network systems in real life too.

Communication has been easier between neighbors through this established network thus it will create a bond between peoples and groups. The Honorable teacher has taught and helped us to do this project. This project has included many facilities and devices which make us to learn about all these connection systems. This project will be very helpful in our future also. Through this project we have learnt about the network system that are working to give us communication facilities in our daily life.

20) **Reference**

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3. https://computernetworktopology.com/local-area-network/