

INTERNET AND VOICE COMMUNICATION: LABORATORY REVIEW

**Prof. Jeevanesh J. Chavathe¹, Prof. Ashish S. Bhaisare²,
Prof. Madhuri P. Rodge³**

*^{1,2}Assistant Professor, ³Associate Professor, Dept. of Electronics & Telecom.,
Shivajirao S Jondhle College of Engg. & Technology, Asangaon, (India)*

ABSTRACT

This paper explores the laboratory experiments of new subject introduced to final year students of Mumbai University. Packet Tracer is helpful for students and instructors to create and simulate computer networks. Packet Tracer is a simulation based learning environment for networking novices. Also we explore some basic commands of Ubuntu Linux and ffmpeg related experiments.

Keywords: *packet tracer, networking devices, simulation software, CLI, Ubuntu Linux, ffmpeg.*

I. INTRODUCTION

Packet Tracer is visual simulation software developed by CISCO Systems to understand and learn concepts of computer networks. Student gains a lot of confidence by using virtual environment, so they are not facing difficulty in working with real-time environment. In Packet Tracer there is a facility of drag and drop various networking devices such as routers, switches, PCs etc. Students easily troubleshoot network failure problems in real-time. In this paper, student gains the knowledge of installation and configuration of DHCP, DNS, Email, FTP server and VOIP telephony with Packet Tracer. Ubuntu is a Linux operating system. It is available in 32-bit and 64-bit version. Student gains knowledge of basic commands used for create, delete, move, rename file / folder and find file / folder. And also commands related to ping and see the IP configuration of network. We are using Cisco Packet Tracer Student version: 6.1 and Ubuntu Linux 15.10. Both are free and easily available on the internet.

This paper is divided into 5 sections; Section 1 begins with an introduction of Packet Tracer and Ubuntu Linux and its experiments, Features of Packet Tracer covered in Section 2, Section 3 covers various features of Ubuntu Linux, Lab Experiments discusses in Section 4 and Sections 5 concludes teaching and students experience.

II. FEATURES OF PACKET TRACER

Packet Tracer helps the student to experiment with network behaviour and construct models. Packet Tracer is a simulation and visualization tool for teaching networking. It is an open-source software which can be downloaded free of cost from the internet.

Minimum System Requirements:

✓ CPU: Intel Pentium 4, 2.53 GHz or equivalent

- ✓ OS: Microsoft Windows XP or Ubuntu 12.04
- ✓ RAM: 512 MB Free
- ✓ Storage: 280 MB Free disk space

There are two types of workspaces: Logical and Physical workspace. Logical Work-space: It allows users to build logical network topologies and various devices can be dragged and dropped to logical workspace. Physical work-space: It allows a user to create a network, the way as it would look in real world, and has the capability of geographical representation, where different networking devices can be shown as connected at different locations of the city.

There are two type of modes Real-time mode and Simulation mode. Real-time mode: The devices in a network behave as real devices do and look similar to real devices. Simulation Mode: In this mode, a student can see and control time intervals, to learn how to troubleshoot network failures.

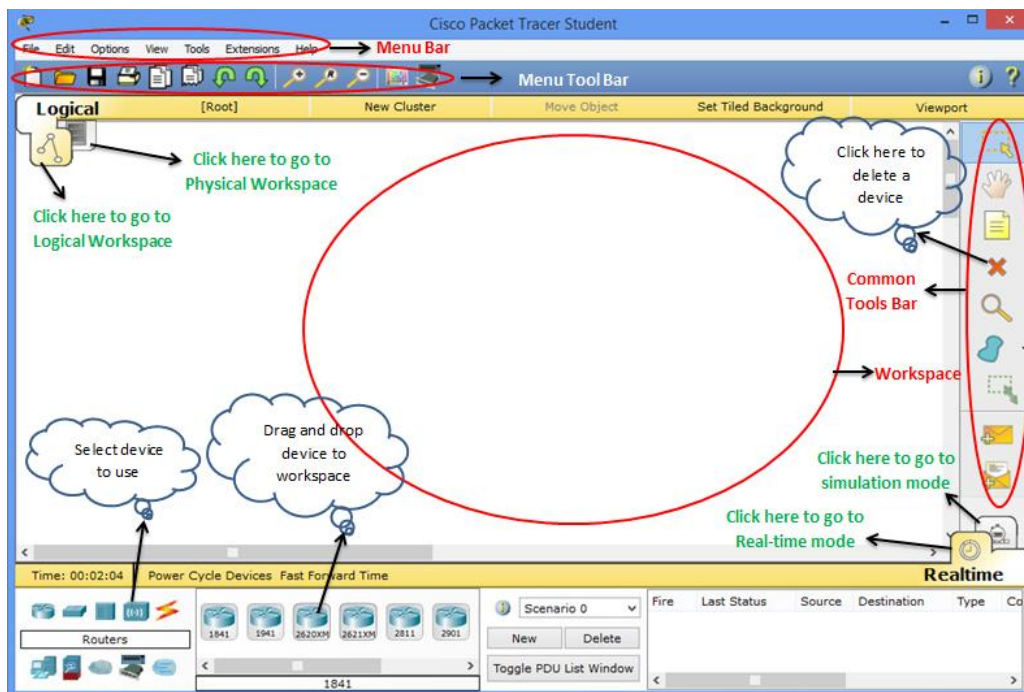


Fig.1 Packet Tracer Workspace

In Packet tracer, various networking devices such as Routers, Switches, Hubs, Wireless devices, End devices are available; End devices like PC, Server, Printer, IP Phone, VOIP Phone etc. Two or more devices are connected various type of cables such as Copper straight-through, Copper cross-over, Fiber, Phone, Coaxial, Serial DCE, Serial DTE, Octal, Console etc. shown in the table below.

Table 1 Types of cables to connect PC, Switch & Router

Devices	Cable
Pc to Pc	Cross-Over Cable
Pc to Router	Cross-Over Cable
Pc to Switch	Straight Cable
Switch to Router	Straight Cable
Router to Router	Cross-Over Cable

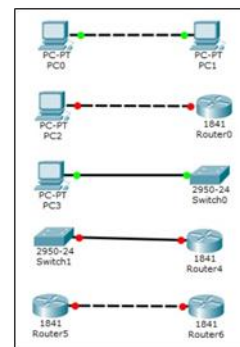


Fig.2 Cables connection between PC, Switch &

Packet Tracer has user friendly Command Line Interface (CLI). There are basic modes of a router, which are recognized by the symbols shown in the table below.

Table 2 Basic modes of a Router

Devices	Cable
User Mode	Router>
Privilege Mode	Router#
Global Configuration Mode	Router(config)#
Interface Configuration Mode	Router(config-if)#
Line Configuration Mode	Router(config-line)#

III. FEATURES OF UBUNTU LINUX

Ubuntu is open-source linux operating system for personal computers, smartphones and network servers.

Minimum System Requirements:

- ✓ CPU: Intel Pentium 4, 1 GHz or equivalent
- ✓ RAM: 1 GB
- ✓ Storage: 5 GB of disk space (at least 15 GB is recommended)
- ✓ Video support capable of 1024*768 resolution
- ✓ Audio support
- ✓ An internet connection

The Ubuntu desktop is based on the concept of graphical user interface (GUI); i.e. use mouse to navigate the desktop, open applications, move files/folders and perform most other tasks.

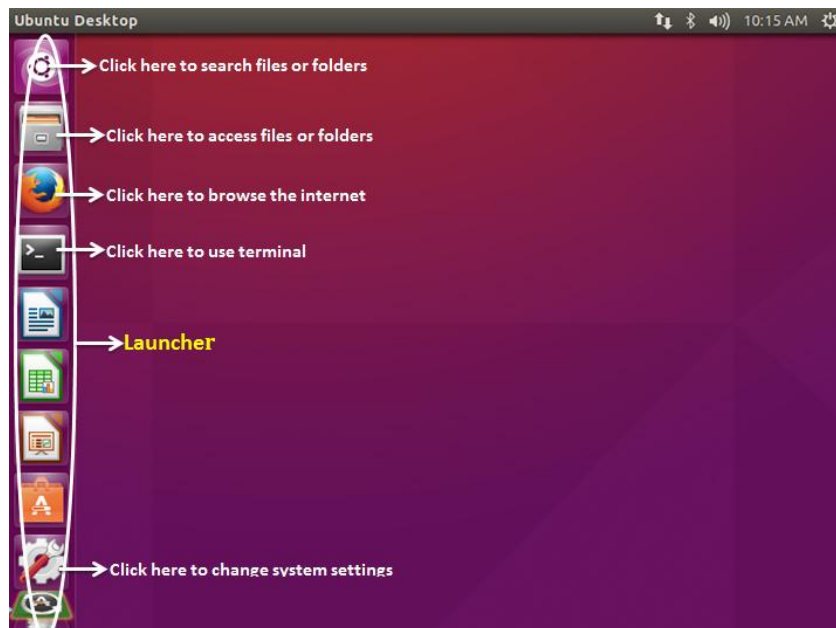


Fig.3 Ubuntu Desktop

The Ubuntu desktop consists of Menu Bar located at the top of desktop and Launcher vertically-oriented at the far left of desktop as shown in Fig.3. Network indicator, Bluetooth, Sound indicator, Clock and Session

indicator located at the right side of Menu Bar. To run an application from the Launcher, click on the application's icon.

IV. LABORATORY EXPERIMENTS

Now focuses on Laboratory experiments performed in Packet Tracer and Ubuntu Linux. List of experiments as:

Table 3 List of Laboratory Experiments

Sr. No.	Name of Experiments	Sr. No.	Name of Experiments
4.1	Installation and configuration of DHCP Server	4.5	Ubuntu Linux basic commands
4.2	Installation and configuration of DNS Server	4.6	Multimedia handling using ffmpeg in Ubuntu Linux
4.3	Installation and configuration of Email Server (SMTP + POP)	4.7	Installation and configuration of VOIP Telephony
4.4	Installation and configuration of FTP Server		

Experiments no. 4.1 to 4.4 and 4.7 are performed in Packet Tracer; 4.5 and 4.6 are performed in Ubuntu Linux.

4.1 Installation and configuration of DHCP (Dynamic Host Configuration Protocol) Server

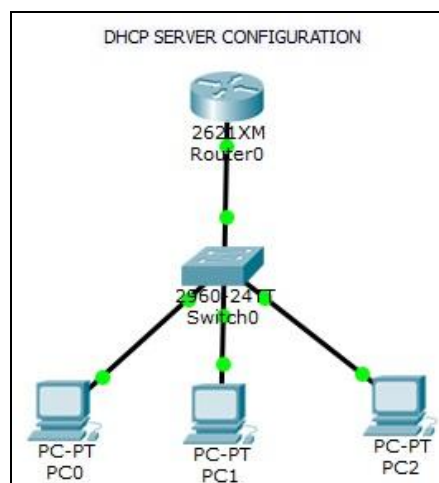


Fig.4 DHCP Server configuration

Step 1) Place the devices and make the connections as shown in above fig.4.

Step 2) Click on Router0 → CLI Tab; then it will prompt as:

--- System Configuration Dialog ---

Continue with configuration dialog? [yes/no]:

Type no and press Enter key. Then it will give prompt as:

Router>

Step 3) Type commands as follows for Router0 configuration:

Router> enable

Router# configure terminal

```
Router(config)# host R1
R1(config)# interface FastEthernet0/0
R1(config-if)# ip address 192.168.10.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# exit
R1(config)# ip dhcp pool IP10
R1(dhcp-config)# network 192.168.10.0 255.255.255.0
R1(dhcp-config)# default 192.168.10.1
R1(dhcp-config)# exit
R1(config)# ip dhcp exc 192.168.10.1 192.168.10.10
R1(config)# exit
R1# copy running-config startup-config
R1# show running-config
R1# exit
```

In the Step 3, configure router and name as R1, assigned IP address as 192.168.10.1 and this router is serves as DHCP with excluding IP addresses from 192.168.10.1 to 192.168.10.10.

Step 4) Click on PC0 → Desktop → IP Configuration

Select DHCP. It automatically assigns IP address as 192.168.10.11

Repeat the same step for remaining PC1 and PC2. It automatically assigns IP addresses as 192.168.10.12 and 192.168.10.13 respectively.

* copy running-config startup-config (copy run start) : This command will save the currently modified configuration in RAM; show running-config (sh run) : This command shows the router, switch or firewall's current configuration.

4.2 Installation and configuration of DNS (Domain Name System) Server

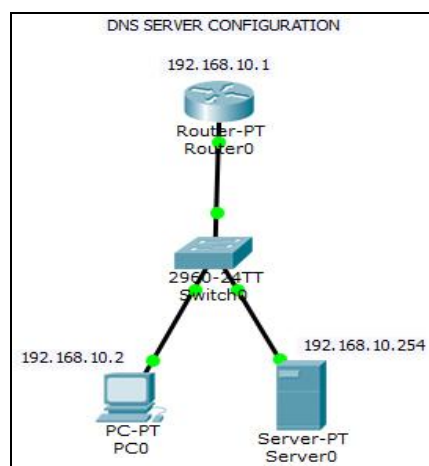


Fig.5 DNS Server configuration

Step 1) Place the devices and make the connections as shown in above fig.5.

Step 2) Router Configuration commands:

```
Router> enable
```

```
Router# configure terminal
Router(config)# interface FastEthernet0/0
Router(config-if)# ip address 192.168.10.1 255.255.255.0
Router(config-if)# no shutdown
```

Step 3) Click on PC0 → Desktop → IP Configuration

Type IP Address: 192.168.10.2 and Default Gateway: 192.168.10.1

Step 4) Click on Server0 → Desktop → IP Configuration

Type IP Address: 192.168.10.254 and Default Gateway: 192.168.10.1

Click on Server0 → Services → DNS

Select DNS Service → On, Type Name: www.google.com Address: 192.168.10.254

Click on Add button to add a Resource Record.

Step 5) Click on PC0 → Desktop → Web Browser

Type www.google.com and click on Go button. It will show default page of cisco.

* We can do changes in the default page by changing HTML code from HTTP services of Server0.

4.3 Installation and configuration of Email Server (SMTP + POP)

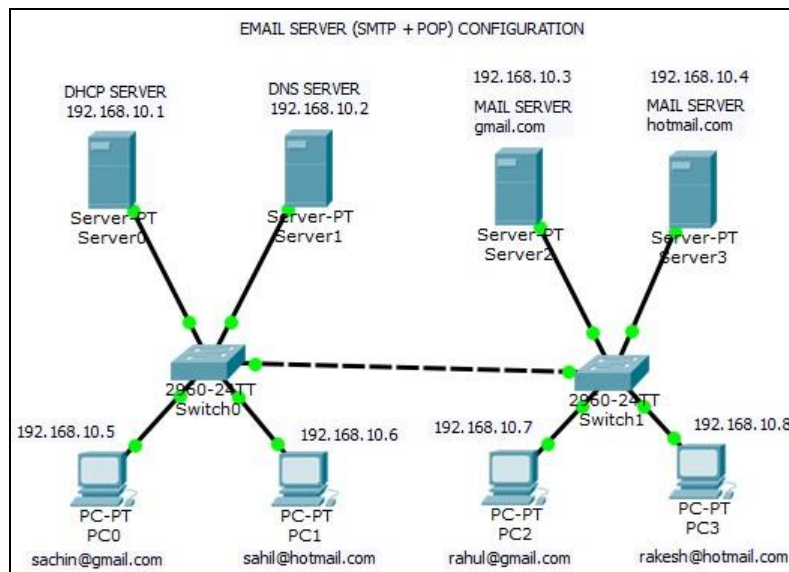


Fig.6 EMAIL Server configuration

Step 1) Place the devices and make the connections as shown in above fig.6.

Step 2) We consider two mail servers namely gmail.com and hotmail.com, each domain having two users; sachin and rahul in gmail.com and sahil and rakesh in hotmail.com

Step 3) Now we start configuration of DHCP Server, Click on Server0 → Desktop → IP Configuration

Type IP Address: 192.168.10.1 and DNS Server: 192.168.10.2

Then click on Tab Services → DHCP, type DNS Server: 192.168.10.2

Select On option of Service and click Save button.

Step 4) Now we start configuration of DNS Server, Click on Server1 → Desktop → IP Configuration

Select DHCP option, requesting IP address and then automatically assigns IP address as 192.168.10.2

Message displays as DHCP request successful.

- Step 5) Repeat step 4 for remaining devices except switches. So, it automatically assigns IP address to each device by requesting IP address from DHCP server.
- Step 6) Again go to DNS server → Services, Type Name: gmail.com and Address: 192.168.10.3 as Server2's IP Address, then click Add button, it will add the record in its list. Then Type Name: hotmail.com and Address: 192.168.10.4 as Server3' IP Address, click Add button.
- Step 7) Add gmail.com users in gmail server and hotmail.com users in hotmail.com.
Click on Server2 → Services → Email Note that SMTP and POP3 Service should be On.
Type Domain Name: gmail.com click Set button. Then User: sachin Password: sachin123 and click '+' Button, it will add the user. User: rahul Password: rahul123 and click '+' Button.
- Step 8) Repeat step 7 for hotmail server, add users sahil and rakesh; set password as sahil123 and rakesh123 respectively.
- Step 9) Now configure account from client side.
Click on PC0 → Desktop → Email → Configure Mail
Type Your Name: Sachin, Email Address: sachin@gmail.com , set gmail.com as Incoming & Outgoing Mail Server, User Name: sachin, password: sachin123 And click save button.
- Step 10) Repeat step 9 for PC1, PC2, PC3 and configure Mail account for respective users as shown in fig.6.
- Step 11) Now check mail server by sending mail from one client to other. First send mail from sachin@gmail.com to rahul@gmail.com
Click on PC0 → Desktop → Email → Compose
Type rahul@gmail.com in To field and type some text in Subject and Body fields. And click Send button to send the message to rahul@gmail.com.
- Step 12) Now check the received mail.
Click on PC2 → Desktop → Email → Receive
It will display message came from PC0 (sachin@gmail.com)
- * Same you can check mail server by sending mail from gmail.com to hotmail.com.

4.4 Installation and configuration of FTP (File Transfer Protocol) Server

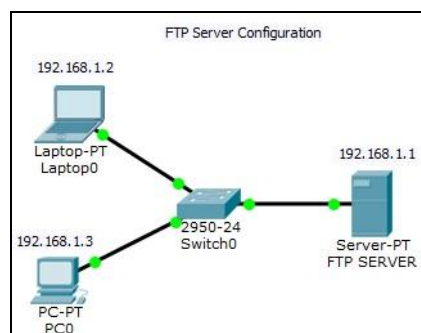


Fig.7 FTP Server configuration

- Step 1) Place the devices and make the connections as shown in above fig.7.
- Step 2) Now we start configuration of FTP Server, Click on Server-PT → Desktop → IP Configuration
Type IP Address: 192.168.1.1, Then Click on Server-PT → Services → FTP
Service should be On. Then type Username: extc Password: extc123

Select all options of Write, Read, Delete, Rename, List and click Add button. That means we are giving all rights of accessing file/folder to user extc.

Step 3) Assigns IP address to Laptop0 and PC0 as 192.168.1.2 and 192.168.1.3 respectively.

Step 4) Check FTP server ready or not from Laptop0.

Click on Laptop0 → Desktop → Command Prompt and type commands as follows:

PC> ftp 192.168.1.1 It will prompt for username, type 'extc' as username and 'extc123' as password.

It successfully Logged in FTP server and display prompt as ftp>

ftp> help

It will display all commands such as ?, cd, delete, dir, get, help, passive, put, pwd, quit, rename.

Step 5) Now test ftp server for uploading and downloading a file. First check files on PC and FTP server.

Click on PC0 → Desktop → Command Prompt and type commands as follows:

PC> dir It will display file sampleFile.txt

PC>ftp 192.168.1.1 type username and password same as in step 4.

ftp> dir It will display all files of extension .bin

ftp> put sampleFile.txt It will copy sampleFile.txt from client (PC0) to ftp server

ftp> dir It will display all files of extension .bin along with sampleFile.txt file

ftp> rename sampleFile.txt readme.txt It will rename file to readme.txt

ftp> get readme.txt It will copy readme.txt from ftp server to Client (PC0).

* get command is used to copy file from server to client (uploading a file).

put command is used to copy file from client to server (downloading a file).

4.5 Ubuntu Linux basic commands

To learn basic commands of Ubuntu Linux start Terminal window; click on Terminal of Launcher as shown in fig.3. Some basic commands as shown in below table 4.

Table 4 Basic commands of Ubuntu Linux

File and Directory			
\$ ls	Displays list of files & directory	\$ mkdir folder1	Create new directory named folder1
\$ ls -l	Displays formatted list of all files & directory	\$ sudo mkdir folder1	Create new directory named folder1 with super user rights
\$ ls -t	Displays time-wise listing	\$ mv dir1 dir2	Rename directory named dir1 to dir2
\$ ls *.txt	Displays all files with .txt extension	\$ mv dir1/ dir2/	Move folder dir1 to folder dir2
\$ ls -a	Displays all files including hidden files and directories	\$ cp -a dir3/ dir2/	Copy folder dir3 to dir2
\$ man ls	Display all available options of ls command	\$ mv file1.txt dir1/	Move file1.txt file to folder dir1
~\$ pwd	Displays present working directory	\$ cp file2.txt	Copy file2.txt file to folder dir1

	:/ \$ → root directory of all users :~\$ → home directory of current user	dir1/	
~\$ cd Desktop	Move into subdirectory Desktop	\$ rm dir1	Remove dir1
\$ touch file1.txt	Create new empty file named file1.txt	\$ del file1.txt	Delete file1.txt file
\$ cat file1.txt	View file contents	\$ sudo del file2.txt	Delete file1.txt file with super user rights
\$ gedit file1.txt	Open GUI editor with file contents	\$ del *.tmp	Delete files of .tmp extension
System			
\$ date	Displays current date and time	\$ sudo lshw -html>hw.html	Save details of system hardware into html file
\$ sudo date -set "01 May 2016 01:00:00"	Update date/time after system reboot	\$ sudo poweroff	Shutdown system
\$ sudo lshw	Displays details of system hardware	\$ sudo reboot	Restart system
Network			
\$ ping google.com	Ping host continuously until stop by CTRL+C to exit	\$ ifconfig	Get IP address and active interface details
\$ ping 192.168.10.1	Ping to specific IP address	\$ ifconfig eth0	Get details of specific interface
Other			
\$ clear	clear console (terminal) screen	\$ sudo apt-get install ffmpeg	Install ffmpeg package
\$ exit	Close the terminal window		

4.6 Multimedia handling using ffmpeg in Ubuntu Linux

FFmpeg is a freeware project that produces libraries and programs for handling multimedia data. FFmpeg command line program for transcoding multimedia file. We handled multimedia files like .jpg pictures files and .mpg video file. Turn on internet and install FFmpeg package by command: `$ sudo apt-get install ffmpeg`

We *encode single pictures into movie file*. First rename pictures to follow numerical sequence. For example `img1.jpg, img2.jpg, img3.jpg.....` And run the following command:

```
ffmpeg -f image2 -i img%d.jpg /tmp/a.mpg
```

Note that '%d' is replaced by the image number.

This encodes all .jpg files into a.mpg video file.

Now, we *encode movie into single pictures*. The `movie.mpg` used as input will be converted to `movie1.jpg, movie2.jpg, etc...` Run the following command:

```
ffmpeg -i movie.mpg movie%d.jpg
```

4.7 Installation and configuration of VOIP (Voice over Internet Protocol) Telephony

VOIP is a methodology used to deliver voice communications and multimedia sessions over Internet Protocol (IP) networks such as internet.

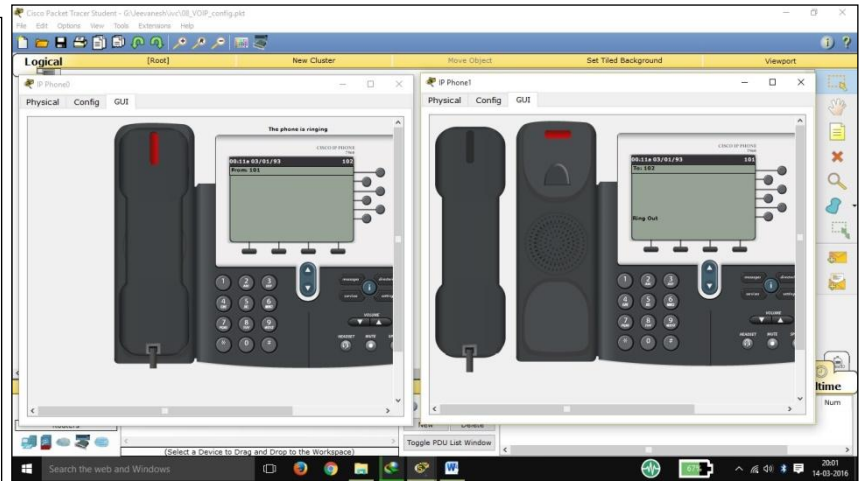
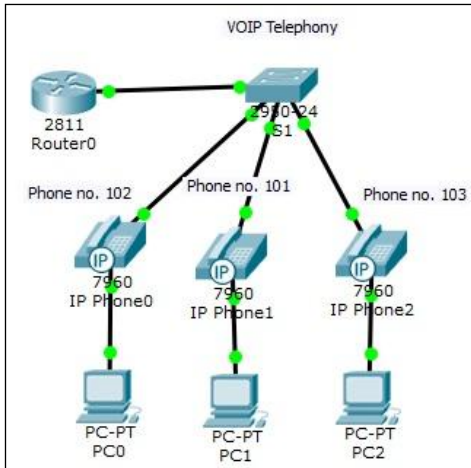


Fig. 8 VOIP Telephony Configuration

Fig. 9 Calling from Phone no.101 to 102 using VOIP Telephony

Step 1) Place the devices and make the connections as shown in above fig.8.

Step 2) Create VLAN's; VLAN10 →Data, VLAN20 → Voice, VLAN99 → Management

Click on Switch 0 → CLI and type following commands

Switch>enable

Switch#configure t

Switch(config)#host S1

S1(config)#vlan 10

S1(config-vlan)#name Data

S1(config-vlan)#vlan 20

S1(config-vlan)#name Voice

S1(config-vlan)#vlan 99

S1(config-vlan)#name management

S1(config-vlan)#exit

S1(config)#int vlan 99

S1(config-if)#ip add 192.168.99.10 255.255.255.0

S1(config-if)#no shut

Phon S1(config-if)#exit

S1(config)#ip default-gateway 192.168.99.1

S1(config)#int fa0/1

S1(config-if)#switchport mode trunk

S1(config-if)#switchport trunk native vlan 99

S1(config-if)#no shut

S1(config-if)#exit

Step 3) To power on the IP Phone, Click on IP Phone0 → Physical

Drag Cisco VOIP Power adapter from bottom right side and attach it to port below RS232 of the phone.

Repeat same step for IP Phone1 and IP Phone2.

Step 4) Click on PC0 →Desktop, Select DHCP. Repeat same step for PC1 and PC2.

Step 5) Configure access ports; Click on Switch0 →CLI and type following commands

S1(config)#int range fa0/2-4

S1(config-if-range)#switchport mode access

S1(config-if-range)#switchport access vlan 10

S1(config-if-range)#switchport voice vlan 20

S1(config-if-range)#no shut

S1(config-if-range)#exit

Step 6) Configure Router0; Click on Router0 → CLI and type following commands

```
Router>enable
Router#conf t
Router(config)#host R1
R1(config)#int fa0/0
R1(config-if)#no shut
R1(config-if)#exit
R1(config)#int fa0/0.10
R1(config-subif)#ip add 192.168.10.1 255.255.255.0
R1(config-subif)#encapsulation dot1Q 10
R1(config-subif)#ip add 192.168.10.1 255.255.255.0
R1(config-subif)#no shut
R1(config-subif)#exit
R1(config)#
R1(config)#int fa0/0.20
R1(config-subif)#encapsulation dot1Q 20
R1(config-subif)#ip add 192.168.20.1 255.255.255.0
R1(config-subif)#no shut
R1(config-subif)#exit

R1(config)#int fa0/0.99
R1(config-subif)#encapsulation dot1Q 99 native
R1(config-subif)#ip add 192.168.99.1 255.255.255.0
R1(config-subif)#exit
R1(config)#ip dhcp excluded-address 192.168.10.1 192.168.10.9
R1(config)#ip dhcp excluded-address 192.168.20.1 192.168.20.9
R1(config)#ip dhcp pool Data
R1(dhcp-config)#network 192.168.10.0 255.255.255.0
R1(dhcp-config)#default-router 192.168.10.1
R1(dhcp-config)#exit
R1(config)#ip dhcp pool Voice
R1(dhcp-config)#network 192.168.20.0 255.255.255.0
R1(dhcp-config)#default-router 192.168.20.1
R1(dhcp-config)#option 150 ip 192.168.20.1
R1(dhcp-config)#exit
```

Step 7) Click on PC0 → Desktop → IP Configuration and check IP address, it will be 192.168.10.12 and for PC1 and PC2, it will be 192.168.10.10 and 192.168.10.11 resp. Default Gateway: 192.168.10.1.

Step 8) Again configure Router0

```
R1(config)#telephony-service
R1(config-telephony)#max-dn 3
R1(config-telephony)#max-ephones 3
R1(config-telephony)#ip source-address 192.168.20.1 port 2000
R1(config-telephony)#exit
R1(config)#
R1(config)#ephone-dn 1
R1(config-ephone-dn)#number 101
R1(config-ephone-dn)#exit
R1(config)#
R1(config)#ephone-dn 2
R1(config-ephone-dn)#number 102
R1(config-ephone-dn)#exit
R1(config)#
R1(config)#ephone-dn 3
R1(config-ephone-dn)#number 103
R1(config-ephone-dn)#exit

R1(config)#ephone 1
R1(config-ephone)#type 7960
R1(config-ephone)#button 1:1
R1(config-ephone)#exit
R1(config)#
R1(config)#ephone 2
R1(config-ephone)#type 7960
R1(config-ephone)#button 1:2
R1(config-ephone)#exit
R1(config)#ephone 3
R1(config-ephone)#type 7960
R1(config-ephone)#button 1:3
R1(config-ephone)#exit
R1(config)#^Z
R1#sh ephone
```

R1(config)#

Step 9) Do the Call from VOIP phone no.101 to VOIP phone no.102 as shown in fig.9.

Click on IP Phone1 (Phone no.101)→ GUI, Pick up the receiver by clicking on receiver and dial Phone no.102 from dialling pad. It starts ringing and displays message as Ring out. Then click on IP Phone0 and pick up the phone by click on receiver and it displays message as ‘connected’ and vice versa.

V. CONCLUSION

There are various benefits of using packet tracer in learning basic concepts of computer networks. Packet tracer is user friendly and can easily use tool. As a teacher, we are using packet tracer for 2 years to teach Computer Networks Lab. Packet tracer can also be used to design real networks. Students can't afford to buy real equipment because of cost and chances of damage to the real equipment. The findings of this study conclude that there are benefits of learning computer networks on packet tracer and Ubuntu Linux.

VI. ACKNOWLEDGEMENTS

We take this opportunity to express my deepest gratitude and appreciation to all those who have helped me directly or indirectly towards the successful completion of this paper.

REFERENCES

- [1] Sheikh Raashid Javid, *Role of Packet Tracer in learning Computer Networks*, International Journal of Advanced Research in Computer and Communication Engineering, Vol.3, Issue 5, May 2014, 6508-6511.
- [2] Packet Tracer 6.1 student version: [http://cisco.edu.mn/Download/Cisco Packet Tracer 6.1.1 for Windows \(with tutorials\) – Student version.exe](http://cisco.edu.mn/Download/Cisco Packet Tracer 6.1.1 for Windows (with tutorials) – Student version.exe)
- [3] Ubuntu Linux 15.10 image: <http://mirrors.tripadvisor.com/releases/15.10/ubuntu-15.10-desktop-amd64.iso>
- [4] Andrew Smith, *Classroom-based Multi-player Network Simulation*, The Seventh International Conference on Networking and Services, 2011, 306-309
- [5] B. Forouzan, *TCP/IP Protocol Suite* (4th Edition, McGraw-Hill Publication).

BIOGRAPHY

1) Prof. Jeevanesh J. Chavathe is Assistant professor in Electronics and Telecommunication Engineering department at Shivajirao S. Jondhle college of Engineering and Technology, Asangaon, Mumbai. He received Master of Engineering (M.E. Digital Electronics) degree in 2015 from North Maharashtra University, Maharashtra, India. Also he is lifetime member of IETE having 8 years of academic teaching experience and 4 years of industry experience, his area of interest in Computer Networks and Image Processing.



2) Prof. Ashish S. Bhaisare is Assistant professor in Electronics and Telecommunication Engineering Department at Shivajirao S. Jondhle college of Engineering and Technology, Asangaon, Mumbai since 6 years. He completed B.E (Electronics) in 2009 from Mumbai University and M.E (Digital Electronics) from North Maharashtra University. His area of research work in Analog Electronics, VLSI Design, Integrated circuit, Mechatronics and satellite communication. He is lifetime member of IETE and UACEE.



3) Prof. Madhuri P. Rodge is Associate professor and Head of Department in Electronics and Telecommunication Engineering at Shivajirao S. Jondhle college of Engineering and Technology, Asangaon, Mumbai. Also she is lifetime member of IETE having 16 year of academic teaching experience, her area of expertisation work in microprocessors. Presently doing Ph.D in Mobile Communication.

