A Laboratory Manual for

Computer Networks
(3150710)

B.E. Semester 5
(Information Technology)

Directorate of Technical Education, Gandhinagar, Gujarat

L. D. College of Engineering, Ahmedabad
Certificate

This is to certify that Mr./Ms. _____

_____ Enrollment No. _____of B.E. Semester Information Technology of this Institute (GTU Code: 28) has satisfactorily completed the Practical / Tutorial work for the subject **Computer Networks (3150710)** for the academic year 2022-23.

Place: _____

Date: _____

Name and Sign of Faculty member

Head of the Department

Preface

Main motto of any laboratory/practical/field work is for enhancing required skills as well as creating ability amongst students to solve real time problem by developing relevant competencies in psychomotor domain. By keeping in view, GTU has designed competency focused outcome-based curriculum for engineering degree programs where sufficient weightage is given to practical work. It shows importance of enhancement of skills amongst the students and it pays attention to utilize every second of time allotted for practical amongst students, instructors and faculty members to achieve relevant outcomes by performing the experiments rather than having merely study type experiments. It is must for effective implementation of competency focused outcome-based curriculum that every practical is keenly designed to serve as a tool to develop and enhance relevant competency required by the various industry among every student. These psychomotor skills are very difficult to develop through traditional chalk and board content delivery method in the classroom. Accordingly, this lab manual is designed to focus on the industry defined relevant outcomes, rather than old practice of conducting practical to prove concept and theory.

By using this lab manual students can go through the relevant theory and procedure in advance before the actual performance which creates an interest and students can have basic idea prior to performance. This in turn enhances pre-determined outcomes amongst students. Each experiment in this manual begins with competency, industry relevant skills, course outcomes as well as practical outcomes (objectives). The students will also achieve safety and necessary precautions to be taken while performing practical.

This manual also provides guidelines to faculty members to facilitate student centric lab activities through each experiment by arranging and managing necessary resources in order that the students follow the procedures with required safety and necessary precautions to achieve the outcomes. It also gives an idea that how students will be assessed by providing rubrics.

Utmost care has been taken while preparing this lab manual however always there is chances of improvement. Therefore, we welcome constructive suggestions for improvement and removal of errors if any.

Practical – Course Outcome matrix

	Course Outcomes (COs): CO-1 Familiarize with the basic taxonomy - terminologies used in networking and the layered architecture of computer networks CO-2 Explain work of layers of OSI and TCP/IP model according to how they can be used to assist in network design and implementation. CO-3 Examine work of protocols of TCP/IP protocol suite. CO-4 Design network architecture, assign IP addressing and apply various networking algorithms CO-5 Implement different types of network using different tools and simulators						
Sr. No.	**Objective(s) of Experiment**	**Platform to be used**	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
1.	Study of different network devices in detail	Network Devices	√				
2.	Study of different types of network cables and practically implement the cross-wired cable and straight through cable using clamping tool.	Cables, Clamping tool, Connectors	√				√
3.	Perform basic network command and Network configuration commands	Computer	√				
4.	Implement different LAN topologies using Network Simulator	Cisco Packet tracer					√
5.	Implement the concept of VLAN using Network Simulator.	Cisco Packet tracer					√
6.	Implement the concept of static routing.	Cisco Packet tracer				√	
7.	Implement the concept of dynamic routing (RIP, OSPF, BGP).	Cisco Packet tracer				√	
8.	Packet capture and header analysis by wire-shark (TCP,UDP,IP)	Wireshark			√		
9	Visit to Server room of Institute					√	√

Industry Relevant Skills

The following industry relevant competencies are expected to be developed in the student by undertaking the practical work of this laboratory.

1. Identify, connect various network devices.
2. Prepare LAN cable
3. Configuration network and understand protocols behaviors on simulator.

Guidelines for Faculty members

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain basic concepts/theory related to the experiment to the students before starting of each practical
3. Involve all the students in performance of each experiment.
4. Teacher is expected to share the skills and competencies to be developed in the students and ensure that the respective skills and competencies are developed in the students after the completion of the experimentation.
5. Teachers should give opportunity to students for hands-on experience after the demonstration.
6. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected from the students by concerned industry.
7. Give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions or not.
8. Teacher is expected to refer complete curriculum of the course and follow the guidelines for implementation.

Instructions for Students

1. Students are expected to carefully listen to all the theory classes delivered by the faculty members and understand the COs, content of the course, teaching and examination scheme, skill set to be developed etc.
2. Students shall organize the work in the group and make record of all observations.
3. Students shall develop maintenance skill as expected by industries.
4. Student shall attempt to develop related hand-on skills and build confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. apart from those included in scope of manual.
6. Student shall refer technical magazines and data books.
7. Student should develop a habit of submitting the experimentation work as per the schedule and s/he should be well prepared for the same.

Index
(Progressive Assessment Sheet)

Sr. No.	Objective(s) of Experiment	Page No.	Date of performance	Date of submission	Assessment Marks	Sign. of Teacher with date	Remarks
1	Study of different Network devices						
2	Study of different types of network cables and practically implements the cross- wired cable and straight through cable using clamping tool						
3	Study of basic network command and Network configuration commands						
4	Implement different LAN topologies using Network Simulator						
5	Implement the concept of VLAN using Network Simulator.						
6	Implement the concept of static routing.						
7	Implement the concept of dynamic routing (RIP, OSPF, and BGP).						
8	Packet capture and header analysis by wire-shark (TCP, UDP, IP).						
9	A visit to server room at LDCE.						
Total							

Experiment No: 0

1. Vision & Mission

1.1.1 Vision of DTE

- To provide globally competitive technical education;
- Remove geographical imbalances and inconsistencies;
- Develop student friendly resources with a special focus on girls' education and support to weaker sections;
- Develop programs relevant to industry and create a vibrant pool of technical professionals.

1.2.1 Vision of L. D. College of Engineering

- To contribute for sustainable development of nation through achieving excellence in technical education and research while facilitating transformation of students into responsible citizens and competent professionals.

1.2.2 Mission of L. D. College of Engineering

- To impart affordable and quality education in order to meet the needs of industries and achieve excellence in teaching-learning process.
- To create a conducive research ambience that drives innovation and nurtures research-oriented scholars and outstanding professionals.
- To collaborate with other academic & research institutes as well as industries in order to strengthen education and multidisciplinary research.
- To promote equitable and harmonious growth of students, academicians, staff, society and industries, thereby becoming a center of excellence in technical education.
- To practice and encourage high standards of professional ethics, transparency and accountability.

1.3.1 Vision of Information Technology Department, L.D.College of Engineering

- To shape the young minds of aspiring Information Technology engineers to become the front runner in the sustainable technological growth of our country, conserving its rich cultural heritage and catering to its socioeconomic needs.

1.3.2 Mission of Information Technology Department, L.D.College of Engineering

- Bringing innovative approach in teaching-learning process to produce competent Information Technology engineers.
- Provide opportunities and necessary exposure to the young engineers to develop themselves into responsible professionals.
- Infusing lifelong learning ability in the aspiring minds with the view of making them sensible towards their social responsibilities.

2. Program outcomes as prescribed by NBA
   Engineering Graduates will be able to:
   1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

   2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

   3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

   4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

   5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

   6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

   7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

   8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

   9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

   10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

   11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

   12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. PSOs of the Information Technology Department, L. D. College of Engineering

The Information technology engineers of L D College of engineering College will be able to

1. Apply the detailed knowledge of code optimization to complex application problems.
2. Write programs with strong skill set with standard coding practices.
3. Assess risk and vulnerability through standard security practices.

4. PEOs of the Information Technology Department, L. D. College of Engineering

1. Pursue a professional career in the field of Information Technology Engineering and excel in it.
2. Enhance their knowledge by continuing higher education and research.
3. Work as torch bearer in a multidisciplinary environment to bring innovation and to improvise the existing technology as entrepreneurs.
4. Keep pace with cutting edge scenario of the field with the view of contributing to the social and environmental needs in efficient ways.

5. Course outcomes of Computer Networks course

CO-1: Familiarize with the basic taxonomy - terminologies used in networking and the layered architecture of computer networks
CO-2: Explain work of layers of OSI and TCP/IP model according to how they can be used to assist in network design and implementation.
CO-3: Examine work of protocols of TCP/IP protocol suite.
CO-4: Design network architecture, assign IP addressing and apply various networking algorithms
CO-5: Implement different types of network using different tools and simulators

Experiment No: 1

AIM: Study of different Network devices

Date:

Competency and Practical Skills: Identify, connect various network devices.

Relevant CO: CO1: Familiarize with the basic taxonomy - terminologies used in networking and the layered architecture of computer networks

Objectives: (a) To observe various network devices
(b) Find out usage of each in different case with advantage and disadvantage
(c) Connect devices to establish network of two or more devices

Equipment/Instruments: Desktop/laptop, Hub, Switch, Router, Bridge, Gateway, Modem, Repeater, NIC

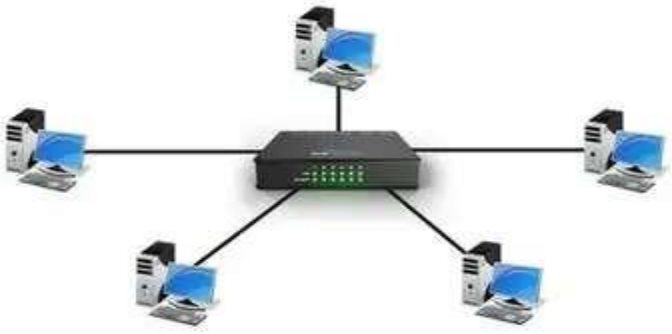
Theory:

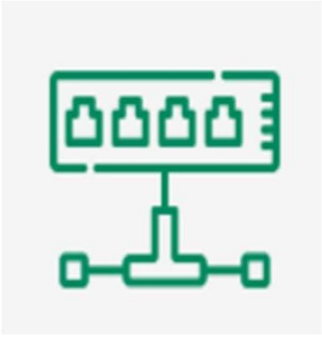
Ref: http://swayam.gov.in/

Computer Networking- A Top-Down approach (6th edition), Kurose and Ross, Pearson

Observations: (Give detailed answer of each question with required figure)

1. **Hub:**





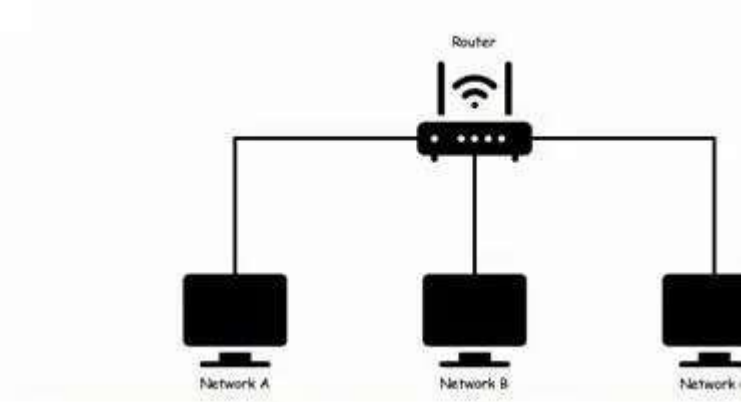
1. What is hub?
   Ans. A hub is a basic networking device that connects multiple computers or devices in a LAN (Local Area Network). It broadcasts data to all connected devices.

2. Features of Hub:
   Ans,
   - Works at Physical Layer (Layer 1) of OSI model (Open Systems Interconnection)
     - No data filtering, no intelligent routing
     - Passive or Active types
     - Simple and inexpensive

3. Applications of Hub:
   Ans.
   - Small home/office networks
   - Temporary setups for testing
   - Network traffic monitoring

4. Types of Hub:
   Ans.
   - Passive Hub
   - Active Hub
   - Intelligent Hub

2. **Router**



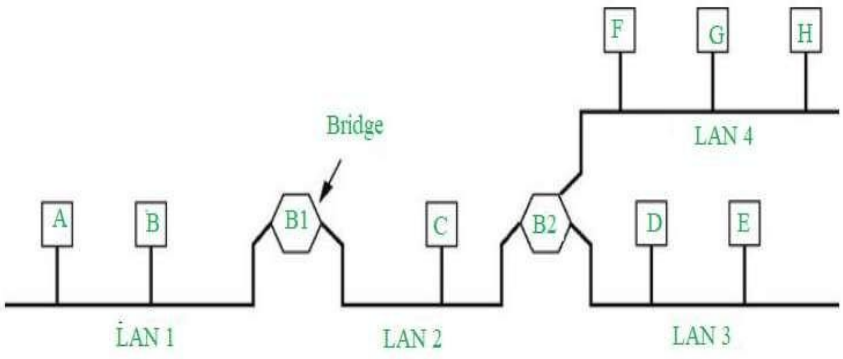
1. What is Router?
   Ans. A router is a device that connects different networks together and routes data between them based on IP addresses.

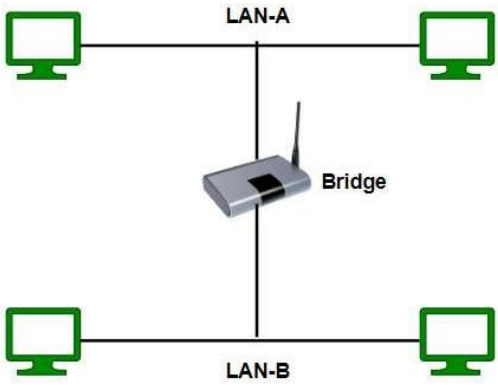
2. Features of Router:
   Ans.
   - Operates at Network Layer (Layer 3)
   - Uses routing tables to determine path
   - Supports NAT, DHCP
   - Connect LAN to the Internet

3. Applications of Router:
   Ans.
   - Inter-network communication
   - Internet sharing at home/offices
   - Connecting different LANs

4. Types of Router:
   Ans.
   - Wireless Router
   - Wired Router
   - Core Router
   - Edge Router
   - Virtual Router

3. **Bridge**





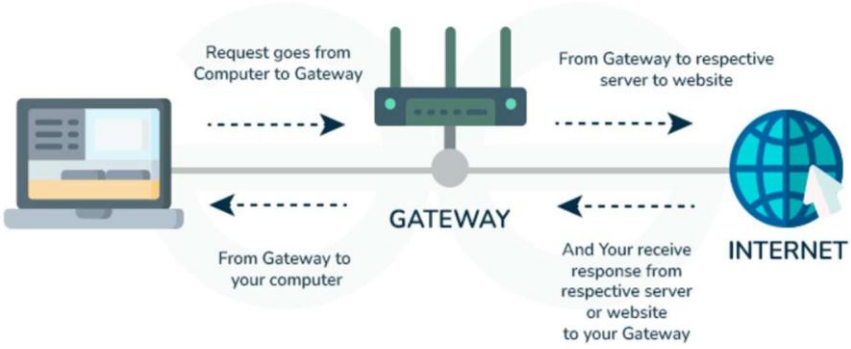
1. What is Bridge?
   Ans. A bridge is used to
   divide a large network into smaller segments and manage traffic between them.

2. Features of Bridge:
   Ans.
   - Operates at Data Link Layer (Layer 2)
   - Stores and forwards frames
   - Learns MAC addresses
   - Reduces network traffic by filtering

3. Applications of Bridge:
   Ans.
   - Connect two LAN segments
   - Improve traffic control
   - Reduce collisions

4. Types of Bridge:
   Ans.
   - Transparent Bridge
   - Source Routing Bridge
   - Translational Bridge

4. **Gateway**



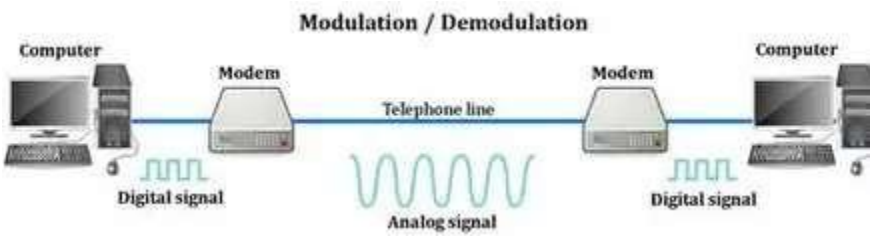
1. What is Gateway?
   Ans. A gateway is a network node that acts as an entry/exit point from one network to another. It translates communication protocols between networks.

2. Features of Gateway:
   Ans.
   - Operates at all layers of OSI model
   - Performs protocol conversion
   - Acts as translator and firewall

3. Applications of Gateway:
   Ans.
   - Connect LAN to the Internet
   - Use between VoIP and PSTN
   - Enterprise networks

4. Types of Gateway:
   Ans.
   - Protocol Gateway
   - Cloud Storage Gateway
   - IoT Gateway
   - API Gateway

5. **Modem**



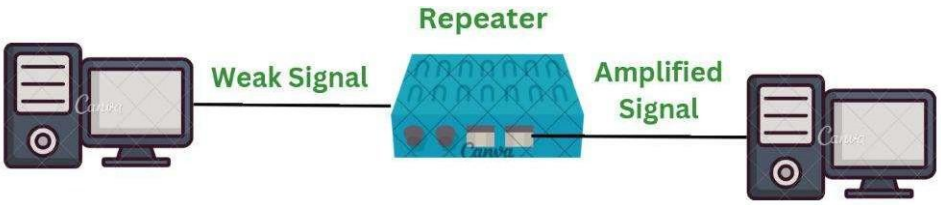
1. What is Modem?
   Ans. A modem (modulator-demodulator) converts digital signals into analog and vice versa so data can be transmitted over telephone lines.

2. Features of Modem:
   Ans.
   - Converts digital ↔ analog
   - Enables internet over phone lines
   - Serial transmission

3. Applications of Modem:
   Ans.
   - Internet access in homes/offices
   - Fax services
   - DSL/Broadband connections

4. Types of Modems:
   Ans.
   - Cable Modem
   - DSL Modem
   - Wireless Modem
   - External/Internal Modems

6. **Repeater**



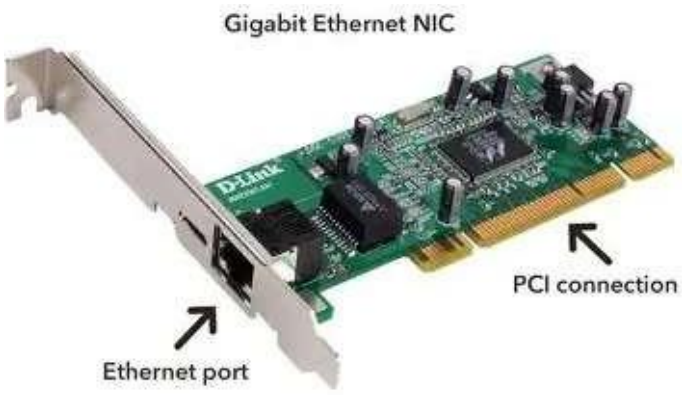
1. What is Repeater?
   Ans. A repeater is a device used to regenerate and amplify signals to extend the range of a network.

2. Features of Repeater:
   Ans.
   - Operates at Physical Layer (Layer 1)
   - Boosts weak signals
   - No filtering or routing

3. Applications of Repeater:
   Ans.
   - Long-distance communication
   - Wi-Fi signal boosting
   - Used in optical fiber communication

4. Types of Repeater:
   Ans.
   - Analog Repeater
   - Digital Repeater
   - Wi-Fi Repeater (Range Extender)
   - Optical Repeater

7. **NIC**



1. What is NIC?
   Ans NIC is a hardware component that connects a computer to a network.

2. Features of NIC:
   Ans.
   - Has a unique MAC address
   - Can be wired or wireless
   - Plugs into motherboard or USB

3. Applications of NIC:
   Ans.
   - Internet connection
   - LAN/WLAN access
   - Remote communication

4. Types of NIC:
   Ans.
   - Ethernet NIC
   - Wireless NIC (Wi-Fi Card)
   - Fiber Optic NIC
   - USB NIC
   - Virtual NIC

Quiz :

1. Find out the cases where above devices are used?
   Ans.
   - Hub: Simple LAN for sharing
   - Switch: Efficient traffic handling in LAN
   - Router: Internet access, inter-networking
   - Bridge: Network segmentation
   - Gateway: Protocol translation
   - Modem: ISP connection
   - Repeater: Extending network range
   - NIC: Device network access

2. Differentiate each device?
   Ans.

Device	OSI Layer	Purpose	Intelligence	Signal
Hub	1	Connects multiple devices	None	Broadcast
Switch	2	Filters & forwards frames	Medium	Unicast
Router	3	Routes packets	High	Unicast
Bridge	2	Divides network	Yes	MAC-based
Gateway	3–7	Protocol translation	Very High	Converts
Modem	1	Digital ↔ Analog	Low	Modulate
Repeater	1	Boost signal	None	Analog
NIC	1–2	Interface to network	Medium	Transmit/Receive

3. Give approximate cost of each device with name of 2 manufactures.

Ans.

Device	Cost (₹)	Manufacturers
Hub	₹500–₹1200	D-Link, Netgear
Router	₹1500–₹5000	TP-Link, Cisco
Bridge	₹1500–₹3000	Cisco, Mikrotik
Gateway	₹5000+	Cisco, Juniper
Modem	₹1200–₹3000	Motorola, Netgear
Repeater	₹900–₹2500	TP-Link, Tenda
NIC	₹500–₹1500	Intel, Realtek

References used by the students:

Rubric wise marks obtained:

	3	2	1
Ability to identify and connect networking device	Clear (Good)	Average/partial	Poor/not at all
Organization	Can easily tell from which sources information was drawn	Can tell with difficulty from where information came	Cannot tell from which source information came
Bibliography	All relevant bibliographic information is included	Bibliography contains most relevant information	Bibliography contains very little information

Experiment No: 2

AIM: Study of different types of network cables and practically implements the cross-wired cable and straight through cable using clamping tool

Date:

Competency and Practical Skills: Identify different types of network cables and Prepare own LAN Cable

Relevant CO: CO1: Familiarize with the basic taxonomy - terminologies used in networking and the layered architecture of computer networks

Objectives: (a) To see and check various network Cables
(b) Find out usage of each in different case with advantage and disadvantage
(c) Prepare own cross-wired cable and straight through cable using clamping tool

Equipment/Instruments: RJ-45 connector, Clamping Tool, Twisted pair Cable

Theory

Study four different types of cables:

1. **Coaxial Cable**
   - A coaxial cable is an electrical cable with a copper conductor and an insulator shielding around it and a braided metal mesh that prevents signal interference and cross talk.
   - Coaxial cable is also known as coax.
   - The term coaxial refers to the inner conductor and the outer shield sharing a geometric axis.

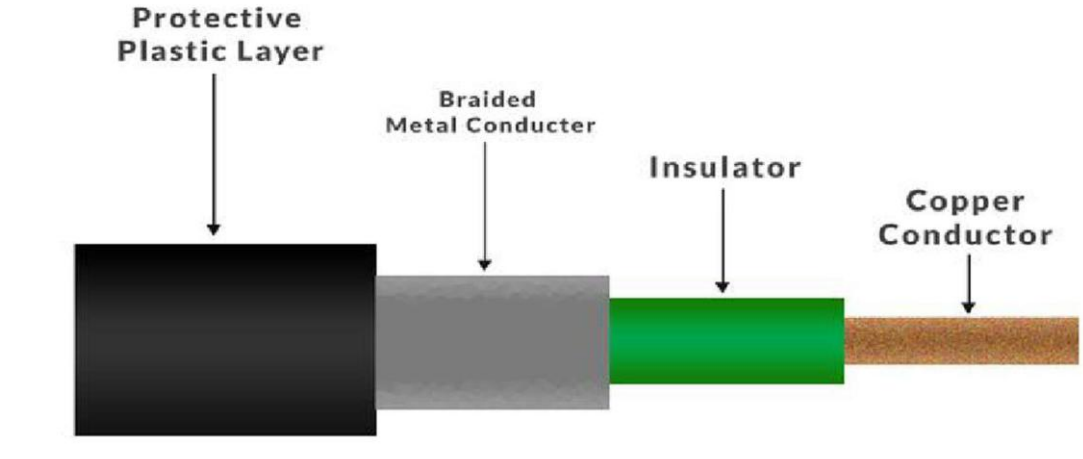


Fig. 1. Coaxial Cable

Structure of coaxial cable:

Copper conductor: A central conductor, which consists of copper. The conductor is the point at which data transmits.

Insulator: Dielectric plastic insulation around the copper conductor. It is used to maintain the spacing between the center conductor and shield.

Braided mesh: A braided mesh of copper helps to shield from electromagnetic interference, the braid provides a barrier against EMI moving into and out of the coaxial cable

Protective plastic layer: An external polymer layer, which has a plastic coating. It is used to protect internal layers from damages.

Types of coaxial cables:

- Hard line coaxial cable.
- Flexible coaxial cable.
- Semi-rigid coaxial cable.
- Formable coaxial cable.
- Rigid coaxial cable.
- Twin axial cable.
- Triaxial cable.

Advantages:

1. Coaxial cables have better cut-through resistance so they are more reliable and durable.
2. Less affected by noise or cross-talk or electromagnetic inference.
3. Coaxial cables support multiple channels

Disadvantages:

1. Coaxial cables are expensive.
2. The coaxial cable must be grounded in order to prevent any crosstalk.
3. As a Coaxial cable has multiple layers it is very bulky.

2. Twisted Pair Cable

- Shielded Twisted Pair (STP) Cable
- Unshielded Twisted Pair (UTP) Cable

3. Fibre Optical Cable

4. Patch Cable

(Sufficient space to be provided)

(Give Details, Give Figure, Discuss Advantages, Discuss Disadvantages, and Discuss Applications of each)

Ref: http://swayam.gov.in/

Computer Networking- A Top-Down approach (6th edition), Kurose and Ross, Pearson

Procedure to prepare cross-wired cable and straight through cable using clamping tool

1. Start by stripping off about 2 inches of the plastic jacket off the end of the cable. Be very careful at this point, as to not nick or cut into the wires, which are inside. Doing so could alter the characteristics of your cable, or even worse render is useless. Check the wires, **one more time** for nicks or cuts. If there are any, just whack the whole end off, and start over.

2. Spread the wires apart, but be sure to hold onto the base of the jacket with your other hand. You do not want the wires to become untwisted down inside the jacket. Category 5 cable must only have 1/2 of an inch of 'untwisted' wire at the end; otherwise it will be 'out of spec'. At this point, you obviously have ALOT more than 1/2 of an inch of un-twisted wire.

3. You have 2 end jacks, which must be installed on your cable. If you are using a pre-made cable, with one of the ends whacked off, you only have one end to install - the crossed over end. Below are two diagrams, which show how you need to arrange the cables for each type of cable end. Decide at this point which end you are making and examine the associated picture below.

Following diagram shows you how to prepare Cross wired connection

RJ45 Pin # (END 1)	Wire Color	Diagram End #1	RJ45 Pin # (END 2)	Wire Color	Diagram End #2
1	White/Orange		1	White/Green	
2	Orange		2	Green	
3	White/Green		3	White/Orange	
4	Blue		4	White/Brown	
5	White/Blue		5	Brown	
6	Green		6	Orange	
7	White/Brown		7	Blue	
8	Brown		8	White/Blue	

Fig. 2. Cross Wired Connections.

Following diagram shows you how to prepare straight through wired connection

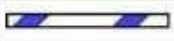
RJ45 Pin # (END 1)	Wire Color	Diagram End #1	RJ45 Pin # (END 2)	Wire Color	Diagram End #2
1	White/Orange		1	White/Green	
2	Orange		2	Green	
3	White/Green		3	White/Orange	
4	Blue		4	White/Brown	
5	White/Blue		5	Brown	
6	Green		6	Orange	
7	White/Brown		7	Blue	
8	Brown		8	White/Blue	

Fig. 3. Straight Through Wired Connections.

Quiz:

1. Find out the cases where above cables are used:
a) HDMI Cable – Used to transmit high-definition video and audio from devices like laptops, gaming consoles, and Blu-ray players to TVs and monitors.
b) VGA Cable – Commonly used to connect a computer to a monitor or projector. It carries only video signals.
c) USB Cable – Used for data transfer and charging between devices like smartphones, printers, external hard drives, and computers.
d) Ethernet Cable (LAN) – Used to connect computers or routers to the internet or to local area networks for wired communication.
e) AUX Cable – Used for audio connections between devices like smartphones, car stereos, and speakers.
f) Power Cable – Supplies electrical power to electronic devices like desktops, monitors, and home appliances.

2. Differentiate each device:
a) HDMI – Transfers both high-quality audio and video signals. Used mostly for modern multimedia devices.
b) VGA – Analog video signal only. Older standard, usually replaced by HDMI and DisplayPort in newer devices.
c) USB – Transfers data and power. Available in different types (Type-A, Type-B, Type-C, Micro-USB).
d) Ethernet – Used for wired internet and LAN connections. Provides faster and more stable connections compared to Wi-Fi.
e) AUX – Transfers analog audio signals. Typically uses 3.5mm jack.
f) Power Cable – Delivers electric current from power source to device. Not used for data transmission.

3. Approximate cost of each cable with name of 2 manufacturers:
a) HDMI Cable – ₹150 to ₹500
Manufacturers: Zebronics, Belkin
b) VGA Cable – ₹100 to ₹300
Manufacturers: Frontech, Targus
c) USB Cable – ₹50 to ₹300 (depends on type)
Manufacturers: Boat, Portronics

d) Ethernet Cable – ₹100 to ₹400 (Cat 6 standard)
Manufacturers: D-Link, Tenda
e) AUX Cable – ₹50 to ₹200
Manufacturers: JBL, Ubon
f) Power Cable – ₹100 to ₹250
Manufacturers: V-Guard, Anchor

References used by the students:
http://swayam.gov.in/

Rubric wise marks obtained:

	3	2	1
Ability to identify and connect networking cables	Clear(Good)	Average/partial	Poor/not at all
Organization	Can easily tell from which sources information was drawn	Can tell with difficulty from where information came	Cannot tell from which source information came
Bibliography	All relevant bibliographic information is included	Bibliography contains most relevant information	Bibliography contains very little information
cross-wired cable and straight through cable using clamping tool	Cable working properly with all connections looks proper	Cable working properly with all connections looks poorly connected	Cable not working properly

Experiment No: 3

AIM: Study of basic network command and Network configuration commands

Date:

Competency and Practical Skills: Exploration of network commands to troubleshoot networking errors.

Relevant CO: CO1: Familiarize with the basic taxonomy - terminologies used in networking and the layered architecture of computer networks

Objectives: (a) To understand the usage of various network commands
(b) Perform commands with various options on given OS.
(c) Prepare the report with screenshots/Output and analyze the usage of each command.

Equipment/Instruments: Desktop/laptop

Theory:

The operating system consists of various built-in, command-line networking utilities that are used for network troubleshooting. There are many various commands such as:

- Ping
- Ipconfig
- Tracert
- Hostname
- Pathping
- Route
- Nslookup
- Netstat
- ARP
- Getmac

1.) Ping:

- The ping command is also known as **Packet Internet Groper**.
- The ping command is used to ensure that a computer can communicate to a specified device over the network.
- The pings command sends Internet Control Message Protocol (ICMP) Echo Request messages in the form of packets to the destination computer and waits in order to get the response back. Once the packets are received by the destined computer, it starts sending the packets back.
- This command keeps executing until it *si* interrupted.

- ping command provides details such as
  - number of packets transmitted
  - number of packets received
  - time taken by the packet to return

- ping command in generally used for the following purposes:
  - measuring the time taken by the packets to return to determine the speed of the connection
  - to make sure that the network connection between the host and the destined computer can be established

- The ping command uses various options such as :
  - target - This is the destination IP address or a hostname user want to ping.
  - -a - This option resolves the hostname of an IP address target.
  - -t - This ping command option will ping the target until you stop it by pressing Ctrl-C.
  - -n count - This option is used to set the number of ICMP Echo Requests to send, from 1 to 4294967295. If -n is not specified, the ping command will return 4 by default.

Fig. 1. Use of PING command to check connection

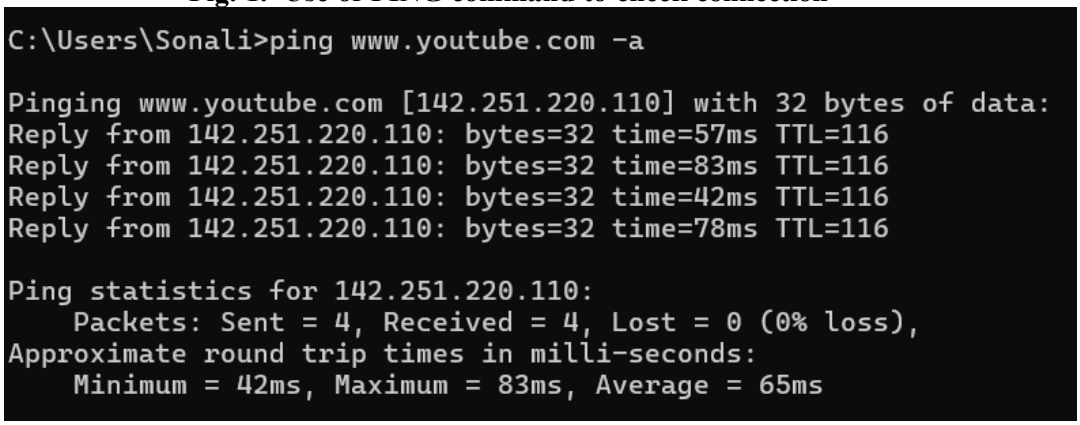


Fig. 2. Use of PING command with "–a" option

Getting Help

In any command mode, you can get a list of available commands by entering a question mark (?).
Router>**?**

To obtain a list of commands that begin with a particular character sequence, type in those characters followed immediately by the question mark (?).
Router#**co?**
Configure connect copy

To list keywords or arguments, enter a question mark in place of a keyword or argument. Include a space before the question mark.
Router#**configure ?**
memory Configure from NV memory
network Configure from a TFTP network
hostterminal Configure from the terminal

You can also abbreviate commands and keywords by entering just enough characters to make thecommand unique from other commands. For example, you can abbreviate the **show** command to **sh**.

Configuration Files

Any time you make changes to the router configuration, you must save the changes to memory because if you do not they will be lost if there is a system reload or power outage. There are two types of configuration files: the running (current operating) configuration and the startup configuration.
Use the following privileged mode commands to work with configuration files.

- **configure terminal** – modify the running configuration manually from the terminal.
- **show running-config** – display the running configuration.
- **show startup-config** – display the startup configuration.
- **copy running-config startup-config** – copy the running configuration to the startupconfiguration.
- **copy startup-config running-config** – copy the startup configuration to the runningconfiguration.
- **erase startup-config** – erase the startup-configuration in NVRAM.

- **copy tftp running-config** – load a configuration file stored on a Trivial File Transfer Protocol (TFTP) server into the running configuration.

- **copy running-config tftp** – store the running configuration on a TFTP server.

IP Address Configuration

Take the following steps to configure the IP address of an interface.

Step 1: Enter privileged EXEC mode:
Router>**enable** password

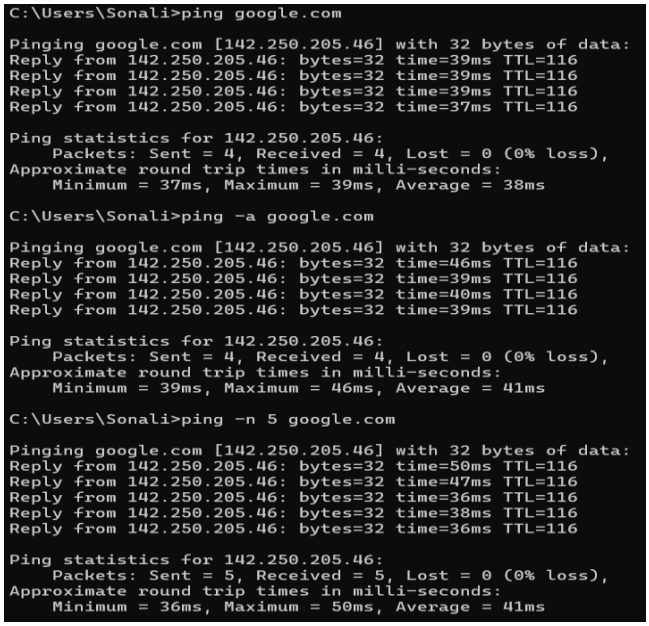
Step 2: Enter the **configure terminal** command to enter global configuration mode.
Router#**config terminal**

Step 3: Enter the **interface** type slot/port (for Cisco 7000 series) or **interface** type port (for Cisco2500 series) to enter the interface configuration mode.
Example:
Router (config)#**interface ethernet 0/1**

Step 4: Enter the IP address and subnet mask of the interface using the **ip address** ipaddresssubnetmask command.
Example,
Router (config-if)#**ip address 192.168.10.1 255.255.255.0**

Step 5: Exit the configuration mode by pressing Ctrl-Z
Router(config-if)#**[Ctrl-Z]**

(Give details of each command as above)
Observations:
➔ **ping Command:**



➔ **getmac command:**

```
C:\Users\Sonali>getmac

Physical Address    Transport Name
=================== ==========================================================
3C-55-76-90-64-59   \Device\Tcpip_{23281849-897C-46C5-BFCB-ED6F9059A92E}
```

➔ **ipconfig Command:**

```
C:\Users\Sonali>ipconfig

Windows IP Configuration


Wireless LAN adapter Local Area Connection* 1:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::9b69:b654:bbc3:69ee%5
   IPv4 Address. . . . . . . . . . . : 192.168.2.114
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.2.1
```

➔ **tracert Command:**

```
C:\Users\Sonali>tracert google.com

Tracing route to google.com [142.250.205.46]
over a maximum of 30 hops:

  1     2 ms     1 ms     1 ms  192.168.2.1
  2    42 ms     2 ms     5 ms  192.168.1.1
  3    40 ms    23 ms    27 ms  10.130.32.1
  4     *        *        *     Request timed out.
  5     *        *        *     Request timed out.
  6    37 ms    38 ms    41 ms  broadband.actcorp.in [183.82.14.78]
  7    39 ms    39 ms    37 ms  72.14.243.242
  8    45 ms    38 ms    42 ms  72.14.234.9
  9    37 ms    40 ms    38 ms  74.125.252.215
 10    50 ms    38 ms    42 ms  pnmaaa-am-in-f14.1e100.net [142.250.205.46]
```

➔ **hostname Command:**

```
C:\Users\Sonali>hostname
LAPTOP-2AQ6LI1F
```

➔ **pathping Command:**

```
C:\Users\Sonali>pathping

Usage: pathping [-g host-list] [-h maximum_hops] [-i address] [-n]
                [-p period] [-q num_queries] [-w timeout]
                [-4] [-6] target_name

Options:
    -g host-list     Loose source route along host-list.
    -h maximum_hops  Maximum number of hops to search for target.
    -i address       Use the specified source address.
    -n               Do not resolve addresses to hostnames.
    -p period        Wait period milliseconds between pings.
    -q num_queries   Number of queries per hop.
    -w timeout       Wait timeout milliseconds for each reply.
    -4               Force using IPv4.
    -6               Force using IPv6.
```

➔ **arp command:**

```
C:\Users\Sonali>arp -p

Displays and modifies the IP-to-Physical address translation tables used by
address resolution protocol (ARP).

ARP -s inet_addr eth_addr [if_addr]
ARP -d inet_addr [if_addr]
ARP -a [inet_addr] [-N if_addr] [-v]

  -a            Displays current ARP entries by interrogating the current
                protocol data.  If inet_addr is specified, the IP and Physical
                addresses for only the specified computer are displayed.  If
                more than one network interface uses ARP, entries for each ARP
                table are displayed.
  -g            Same as -a.
  -v            Displays current ARP entries in verbose mode.  All invalid
                entries and entries on the loop-back interface will be shown.
  inet_addr     Specifies an internet address.
  -N if_addr    Displays the ARP entries for the network interface specified
                by if_addr.
  -d            Deletes the host specified by inet_addr. inet_addr may be
                wildcarded with * to delete all hosts.
  -s            Adds the host and associates the Internet address inet_addr
                with the Physical address eth_addr.  The Physical address is
                given as 6 hexadecimal bytes separated by hyphens. The entry
                is permanent.
  eth_addr      Specifies a physical address.
  if_addr       If present, this specifies the Internet address of the
                interface whose address translation table should be modified.
                If not present, the first applicable interface will be used.
Example:
  > arp -s 157.55.85.212   00-aa-00-62-c6-09  .... Adds a static entry.
  > arp -a                                    .... Displays the arp table.
```

➔ **nslookup Command:**

```
C:\Users\Sonali>nslookup google.com
Server:  UnKnown
Address:  192.168.2.1

Name:    google.com
Addresses:  2404:6800:4007:835::200e
          142.250.205.46
```

➔ **netstat Command:**

```
C:\Users\Sonali>netstat

Active Connections

  Proto  Local Address          Foreign Address        State
  TCP    127.0.0.1:49669        LAPTOP-2AQ6LI1F:49670  ESTABLISHED
  TCP    127.0.0.1:49670        LAPTOP-2AQ6LI1F:49669  ESTABLISHED
  TCP    127.0.0.1:49671        LAPTOP-2AQ6LI1F:49672  ESTABLISHED
  TCP    127.0.0.1:49672        LAPTOP-2AQ6LI1F:49671  ESTABLISHED
  TCP    192.168.2.114:49700    4.213.25.240:https     ESTABLISHED
  TCP    192.168.2.114:49963    4.213.25.242:https     ESTABLISHED
  TCP    192.168.2.114:49995    sf-in-f188:5228        ESTABLISHED
  TCP    192.168.2.114:50072    104.20.41.79:https     ESTABLISHED
  TCP    192.168.2.114:50105    20.249.115.164:https   ESTABLISHED
  TCP    192.168.2.114:50218    52.168.117.169:https   TIME_WAIT
  TCP    192.168.2.114:50220    13.107.137.11:https    ESTABLISHED
  TCP    192.168.2.114:50221    52.104.100.53:https    ESTABLISHED
  TCP    192.168.2.114:50222    104.208.16.89:https    ESTABLISHED
  TCP    192.168.2.114:50224    broadband:https        TIME_WAIT
  TCP    192.168.2.114:50227    whatsapp-chatd-edge-shv-01-hyd1:5222  TIME_WAIT
  TCP    192.168.2.114:50228    20.189.173.18:https    TIME_WAIT
  TCP    192.168.2.114:50229    a23-63-84-106:https    ESTABLISHED
  TCP    192.168.2.114:50230    broadband:https        ESTABLISHED
  TCP    192.168.2.114:50231    150.171.27.11:https    TIME_WAIT
  TCP    192.168.2.114:50232    a-0003:https           TIME_WAIT
  TCP    192.168.2.114:50235    20.190.146.34:https    ESTABLISHED
  TCP    192.168.2.114:50237    whatsapp-chatd-edge-shv-01-hyd1:5222  TIME_WAIT
  TCP    192.168.2.114:50238    broadband:https        ESTABLISHED
```

➔ **route Command:**

```
C:\Users\Sonali>route

Manipulates network routing tables.

ROUTE [-f] [-p] [-4|-6] command [destination]
                  [MASK netmask]  [gateway] [METRIC metric]  [IF interface]

  -f            Clears the routing tables of all gateway entries.  If this is
                used in conjunction with one of the commands, the tables are
                cleared prior to running the command.

  -p            When used with the ADD command, makes a route persistent across
                boots of the system. By default, routes are not preserved
                when the system is restarted. Ignored for all other commands,
                which always affect the appropriate persistent routes.

  -4            Force using IPv4.

  -6            Force using IPv6.

  command       One of these:
                  PRINT     Prints  a route
                  ADD       Adds    a route
                  DELETE    Deletes a route
                  CHANGE    Modifies an existing route
  destination   Specifies the host.
  MASK          Specifies that the next parameter is the 'netmask' value.
  netmask       Specifies a subnet mask value for this route entry.
                If not specified, it defaults to 255.255.255.255.
  gateway       Specifies gateway.
  interface     the interface number for the specified route.
  METRIC        specifies the metric, ie. cost for the destination.

All symbolic names used for destination are looked up in the network database
file NETWORKS. The symbolic names for gateway are looked up in the host name
database file HOSTS.

If the command is PRINT or DELETE. Destination or gateway can be a wildcard,
(wildcard is specified as a star '*'), or the gateway argument may be omitted.

If Dest contains a * or ?, it is treated as a shell pattern, and only
matching destination routes are printed. The '*' matches any string,
and '?' matches any one char. Examples: 157.*.1, 157.*, 127.*, *224*.

Pattern match is only allowed in PRINT command.
Diagnostic Notes:
    Invalid MASK generates an error, that is when (DEST & MASK) != DEST.
    Example> route ADD 157.0.0.0 MASK 155.0.0.0 157.55.80.1 IF 1
             The route addition failed: The specified mask parameter is invalid.

Examples:

    > route PRINT
    > route PRINT -4
    > route PRINT -6
    > route PRINT 157*            .... Only prints those matching 157*

    > route ADD 157.0.0.0 MASK 255.0.0.0  157.55.80.1 METRIC 3 IF 2
              destination^      ^mask      ^gateway     metric^    ^
                                                        Interface^
      If IF is not given, it tries to find the best interface for a given
      gateway.
    > route ADD 3ffe::/32 3ffe::1

    > route CHANGE 157.0.0.0 MASK 255.0.0.0 157.55.80.5 METRIC 2 IF 2

      CHANGE is used to modify gateway and/or metric only.

    > route DELETE 157.0.0.0
    > route DELETE 3ffe::/32
```

Quiz:

1. Give the sequence of troubleshoots commands you will perform with proper justification if your network is not working.

Ans.: If the network is not working, follow this sequence of troubleshooting commands with justification:

i. ping 127.0.0.1 – Checks if the TCP/IP stack is installed and working correctly (loopback test).

ii. ipconfig (Windows) / ifconfig (Linux) – Displays IP address, subnet, and gateway to verify correct IP configuration.

iii. ping <default gateway> – Tests connectivity to the local network and router.

iv. ping <external IP or website> (e.g., ping 8.8.8.8) – Verifies internet connectivity and DNS issues.

v. nslookup <website> – Checks DNS resolution of a domain name to an IP address.

vi. tracert <destination> / traceroute <destination> – Identifies where the connection fails in the network path.

vii. netstat -rn or route print – Verifies routing table to ensure correct gateway and routes.

viii. arp -a – Displays MAC address to IP address mappings to check local device connectivity.

This sequence starts from local system checks and progresses outward—local stack → IP config → gateway → internet → DNS → route analysis—ensuring systematic and layered diagnosis of connectivity issues.

Suggested Reference: https://www.cisco.com/c/en/us/td/docs/routers/nfvis/switch_command/b-nfvis-switch-command-reference.html

References used by the students:

https://www.cisco.com/c/en/us/td/docs/routers/nfvis/switch_command/b- nfvis-switch-command-reference.html

Rubric wise marks obtained:

	3	**2**	**1**
Ability to understand the output of each command	**Clear(Good)**	**Average/partial**	**Poor/not at all**
Organization	**Can easily tell from which sources information was drawn**	**Can tell with difficulty from where information came**	**Cannot tell from which source information came**
Bibliography	**All relevant bibliographic information is included**	**Bibliography contains most relevant information**	**Bibliography contains very little information**

Experiment No: 4

AIM: Implement different LAN topologies using Network Simulator

Date:

Competency and Practical Skills: Exploration of network layout to connect devices with each other to establish network

Relevant CO: CO-5 Implement different types of network using different tools and simulators

Objectives:
(a) Download network simulator – preferably cisco packet tracer
(b) Implement topologies by configuring interconnecting devices and computing devices.
(c) Analyze the performance of connecting devices in different ways

Equipment/Instruments: Desktop/laptop, Network simulator

Theory:

What is Network Topology?

The arrangement of a network that comprises nodes and connecting lines via sender and receiver is referred to as network topology.
There are various types of topologies and they are:

- Bus Topology
- Star Topology
- Ring Topology
- Mesh Topology
- Hybrid Topology

1. Bus Topology:

(Give details of each topology with advantages, disadvantages and applications.)

Bus topology using Packet Tracer:

- Take 4 switches, connect them through single cable.
- Each of the switches will be connected with an end device whose IP addresses are given.
- To configure the IP addresses of the devices "Click on the device for which you want to configure the IP address-> Click Desktop -> IP configuration -> Provide IP of your choice -> Press Tab for automatically having Subnet Mask which is: 255.0.0.0 for all the devices available in the topology.
- Provide IP addresses to all the End devices only and then you can send the data among these devices.

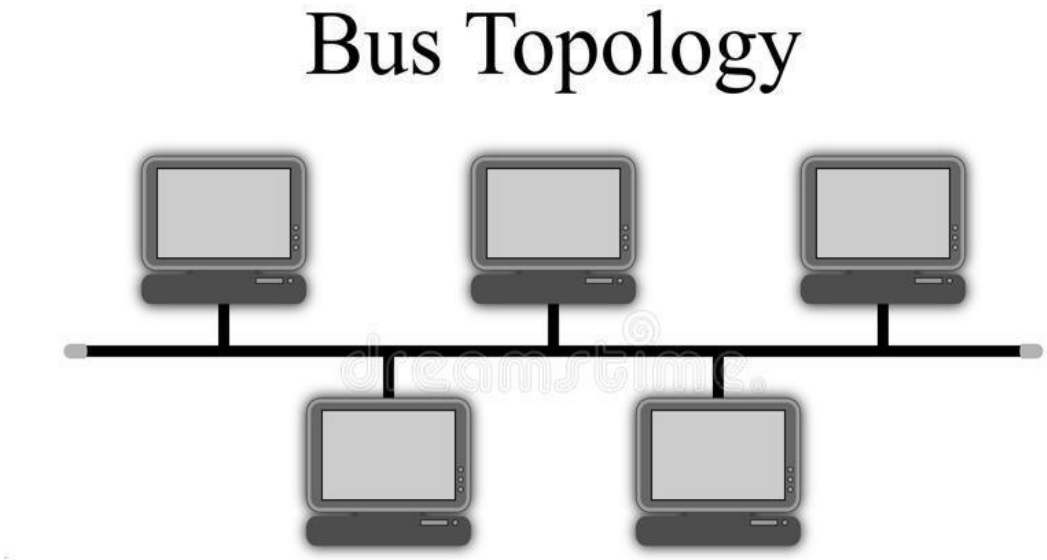


Fig. 1. Bus Topology.

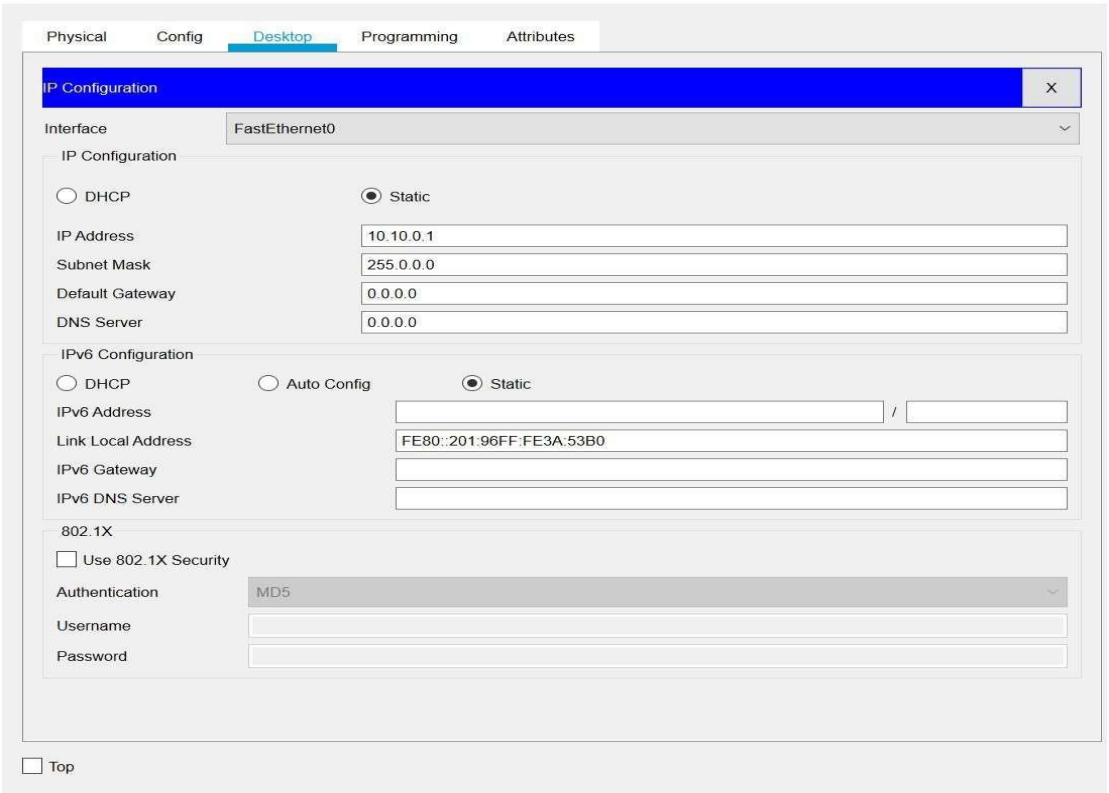


Fig. 2. Static IP Configuration

- Check the network by sending messages/packets from one device to another and check the status of the message as “Successful”. If the messages are not sent due to some reasons it will show “Failed” as the status of the message.

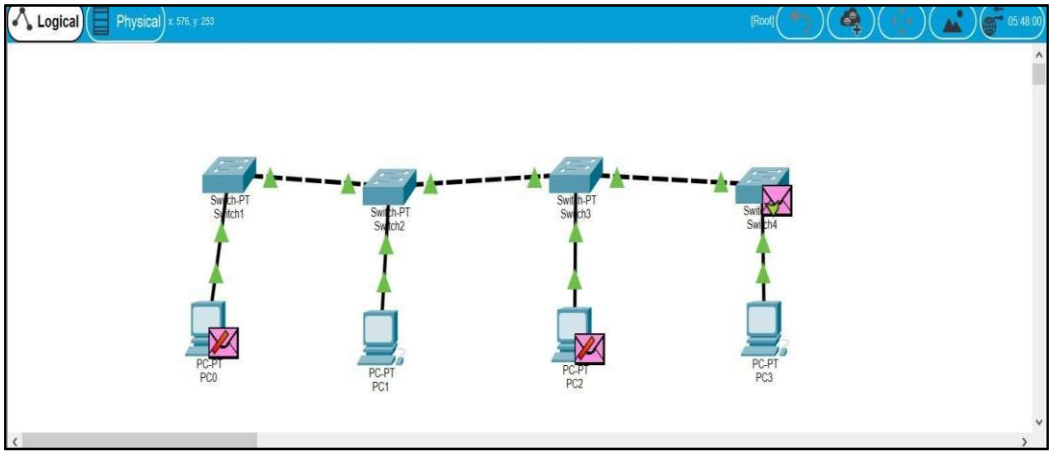


Fig. 3. Bus topology configuration in simulator

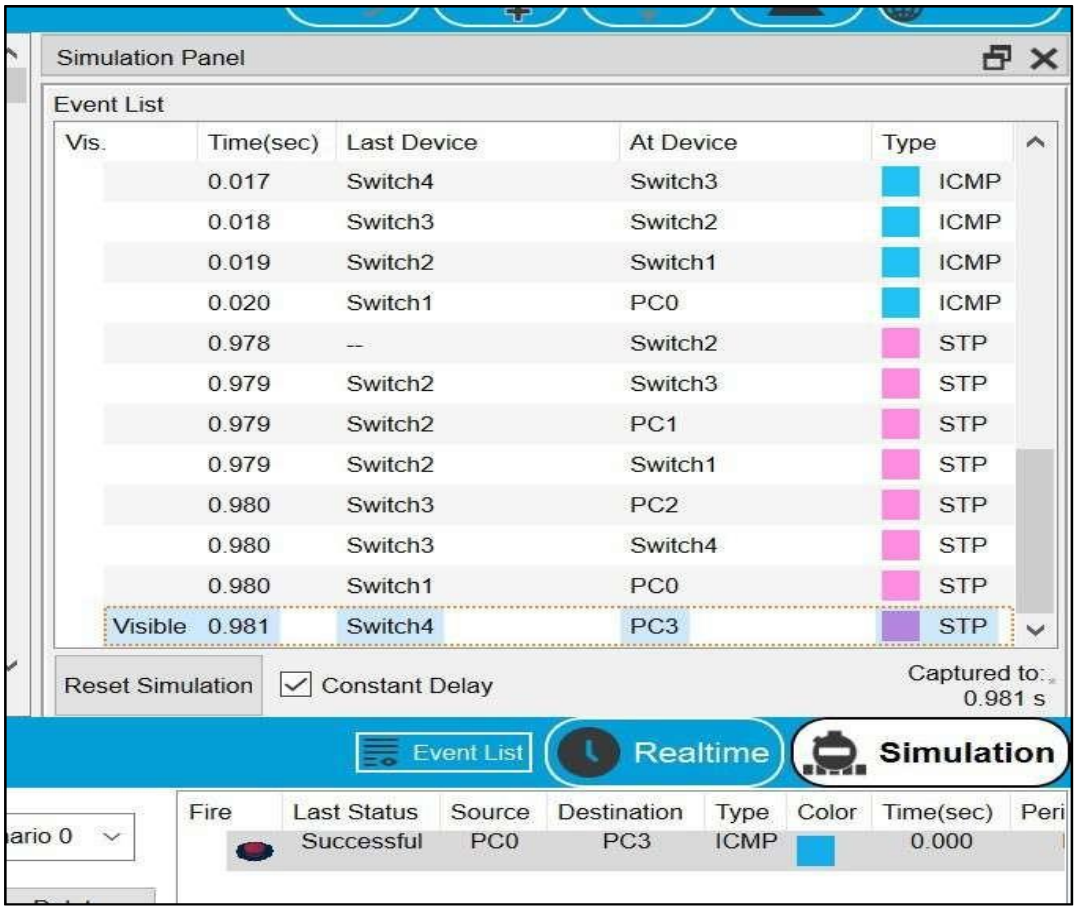


Fig. 4. Bus topology simulation

1. Star Topology:

- A star topology is a topology for a Local Area Network (LAN) in which all nodes are individually connected to a central connection point, sort of a hub or a switch.

Star Topology Using Pac ket Tracer:

- Have a single switch which will be the central node.
- All the end devices are connected with the central switch so if any of the cable fail occurs it does not affect the whole system.
- Configure the IP address of all the connected devices.
- Send messages to other devices connected to the same Switch.
- As we can see in the elodw image we can send the messages from one device to another and we can also see the status of the message as “Successful” here. If the messages are not sent due to some reasons it will show “Failed” as the status of the message.

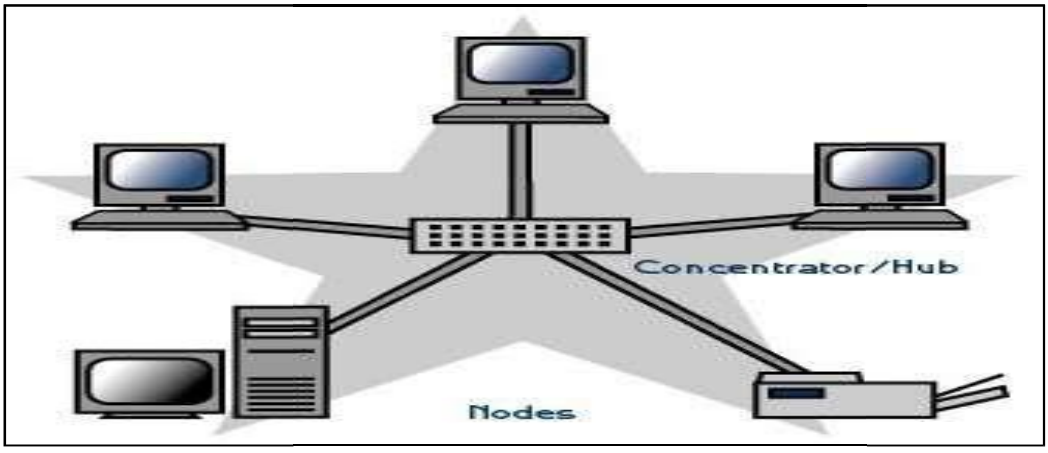


Fig. 5. Star Topology.

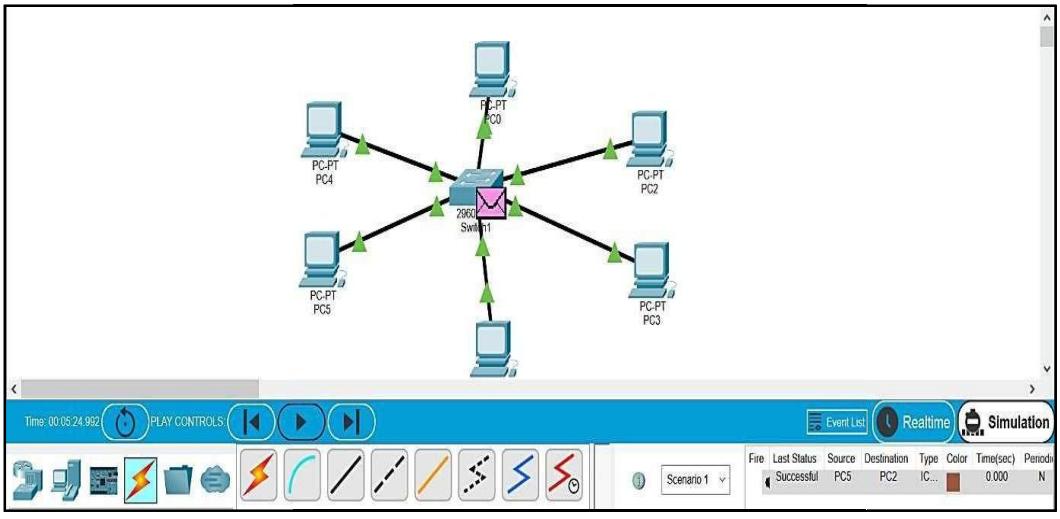


Fig. 6. Star Topology in simulator.

2. Ring Topology:

- In this topology, it forms a ring connecting devices with exactly two neighboring devices.
- It is a network configuration where device connections create a circular data path. In this each device is conne ted to with its exactly two neighboring devices, like points on a circle which forms like a ring structure.
- The most common access method of ring topology is token passing.

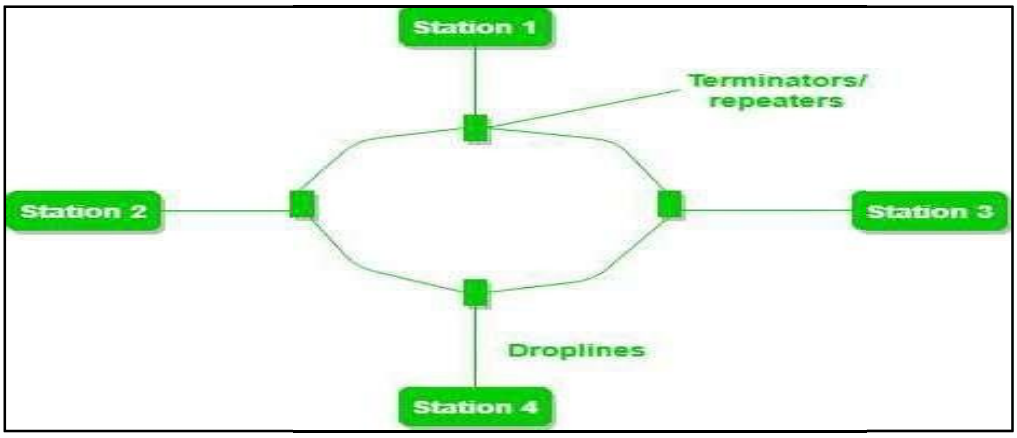


Fig. 7. Ring Topology.

Ring Topology using Pac ket Tracer:

- Take 4 switches and connect them with each other.
- Each of the hubs is connected with an end device whose IP addresses can be configured
- After configuring the IP addresses send messages to other devices connected in the Network.
- As we can see in the below image we can send the messages from one device to another and also see the status of the message as “Successful” here. If the messages are not sent due to some reasons it will show “Failed” as the status of the message.

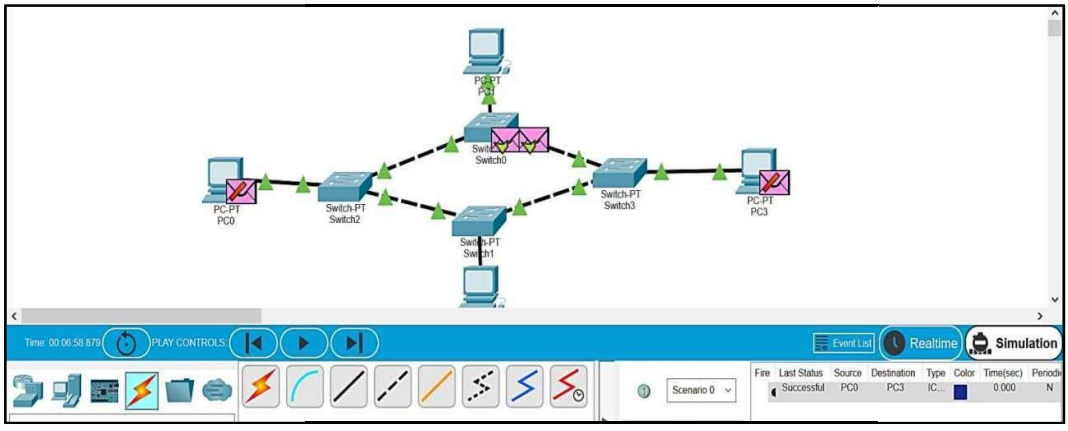


Fig. 8. Ring Topology in simulator.

3. Mesh Topology:

- In a mesh topology, every device is connected to another device via a particular channel.
- There are two types of Mesh topologies:
  1. Fully-connected Mesh Topology
  2. Partially-connected Mesh Topology

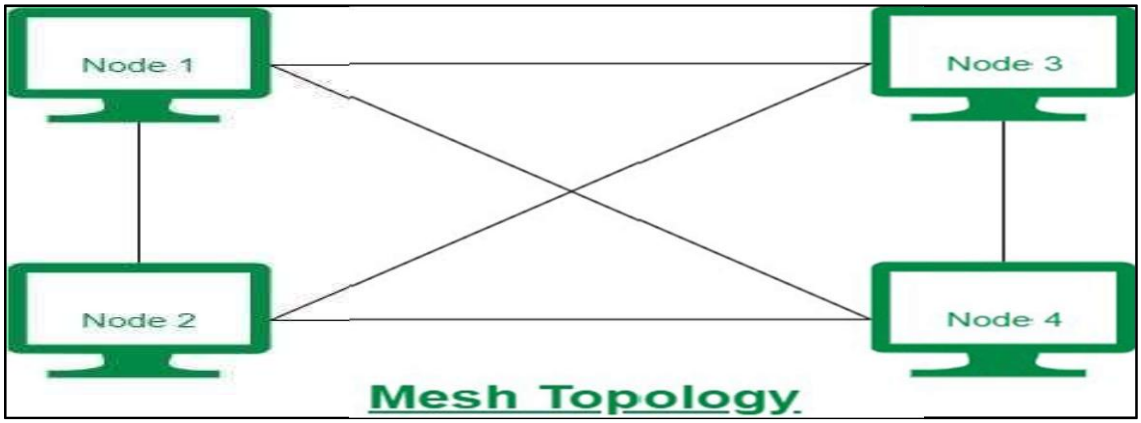


Fig. 9. Mesh Topology

Mesh Topology using Packet Tracer:

- 4 network switches which are connected to each other through network cables.
- Each of the switch is connected all the other switches as well as an end device.
- Configure the end devices and then can send the message to any other device connected to particular network.
- As we can see in the below image we can send the messages from one device to another and we can also see the status of the message as "Successful" here. If the messages are not sent due to some reasons it will show "Failed" as the status of the message.

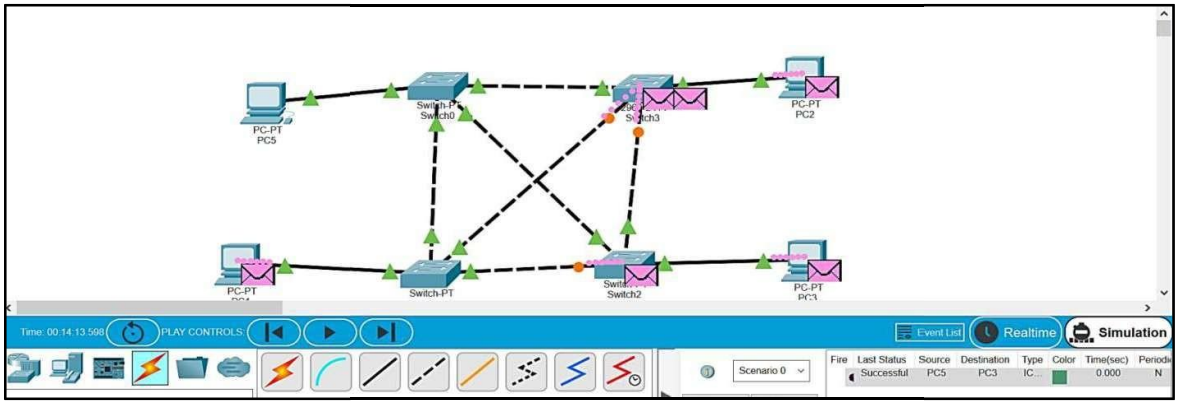


Fig. 10. Mesh Topology in simulator.

4. Hybrid Topology:

- A network structure whose design contains more than one topology is said to be hybrid topology. Hybrid topology inherits merits and demerits of all the incorporating topologies.

Hybrid Topology Using Packet Tracer:

- Have 4 network switches which are connected to each other through network cables forming ring.
- Then have central switch which is connected to one of the switches used in forming ring and also to other devices forming star, thus forming hybrid topology.
- Each of the switch is connected all the other switches as well as an end device.
- We can configure the end devices as seen before and then can send the message to any other device connected to particular network.

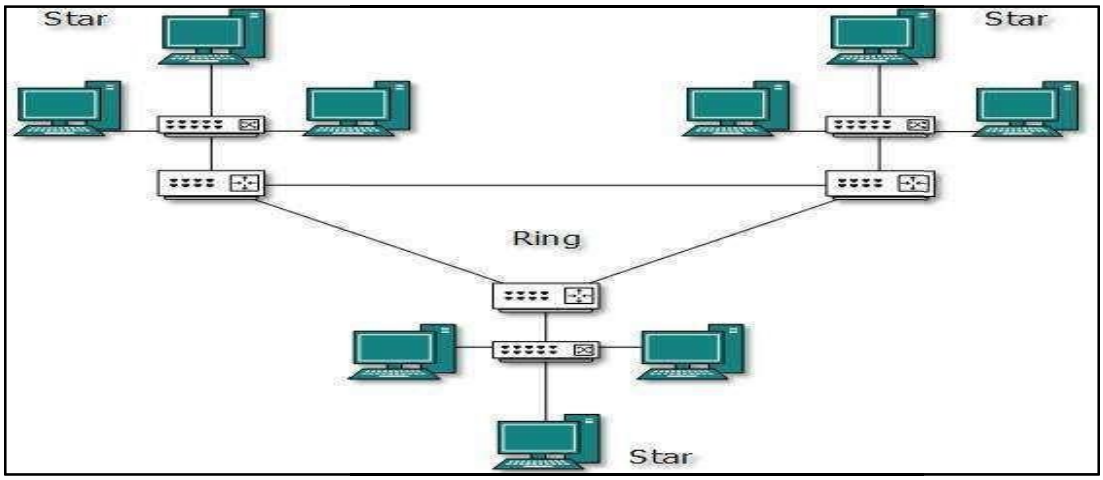


Fig. 11. Hybrid Topology.

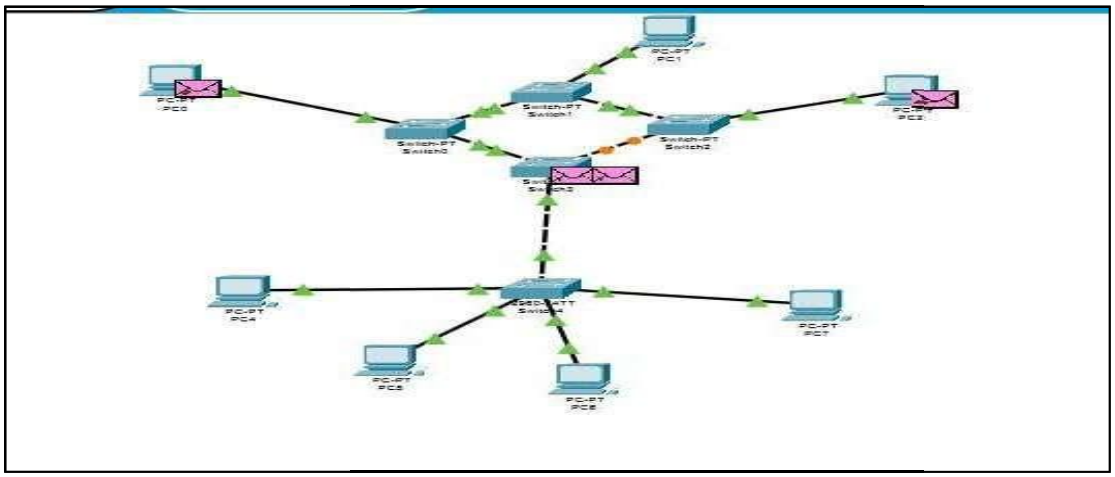


Fig. 12. Hybrid Topology in simulator (Packet Sent).

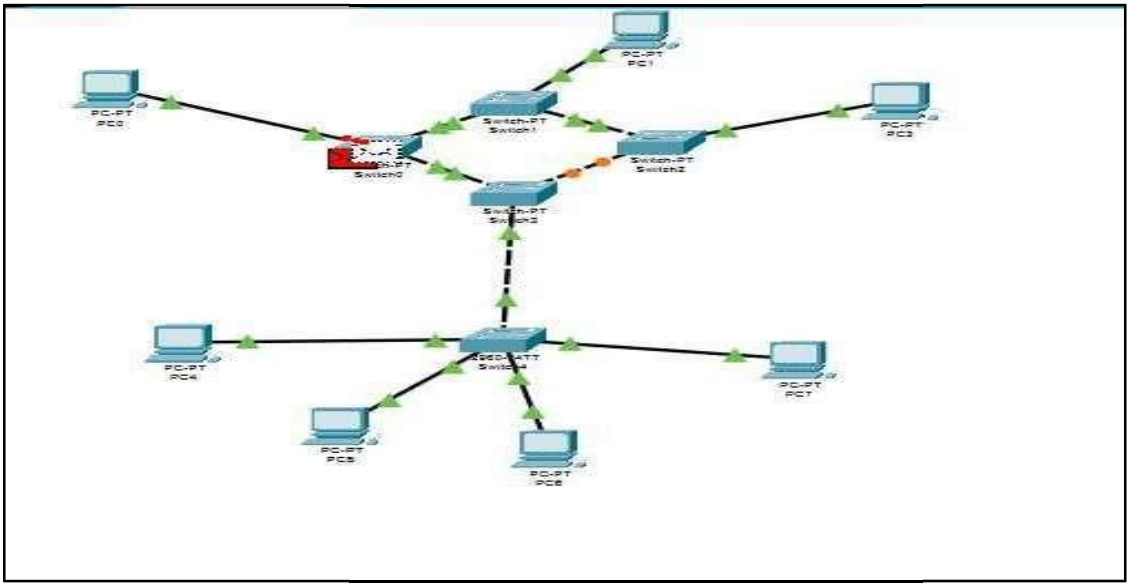


Fig. 13. Hybrid Topology in simulator (Packet lost).

- As we can see in the below image we can send the messages from one device to another and we can also see the status of the message as "Successful" here. If the messages are not sent due to some reasons it will show "Failed" as the status of the message.

Fig. 14. Status of the sent message in simulator.

Observations:

(1) Which topology or topologies are implemented at your institute?
Ans.: At my institute, the following topologies are typically implemented:

- Star Topology: This is the most common topology used in modern institutes. In this setup, each computer (node) is connected to a central switch or hub.
- Extended Star or Hybrid Topology: Larger networks often use a combination of star topologies, connected together using switches and routers. This is often referred to as a hierarchical star or hybrid topology.

Reason for Use:

- Easy to manage and troubleshoot.
- Scalable for labs, admin offices, and classrooms.
- Failure in one node does not affect others.

(2) If there is a small setup of your office having 10 Computers connected, which topology you will prefer? Why?

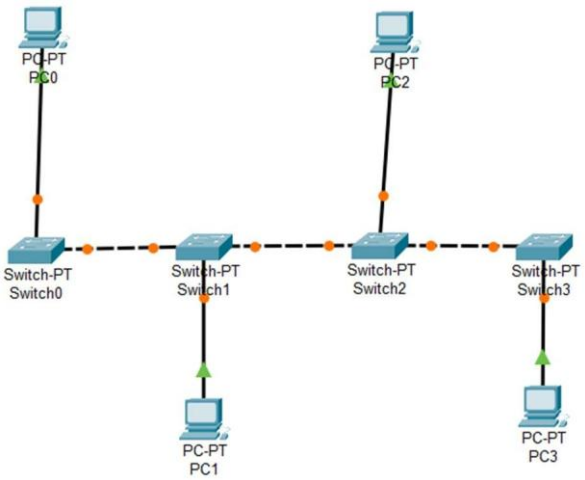
Ans.: For small set-up of 10 computers, I prefer Star Topology

Reason:

- Reliability: Failure of one computer or its cable doesn't affect others.
- Easy to add/remove nodes: You can expand easily by adding more computers.
- Simpler troubleshooting: Any issue can be identified at the central point (switch/hub).
- Performance: Offers better performance compared to bus/ring in small setups.

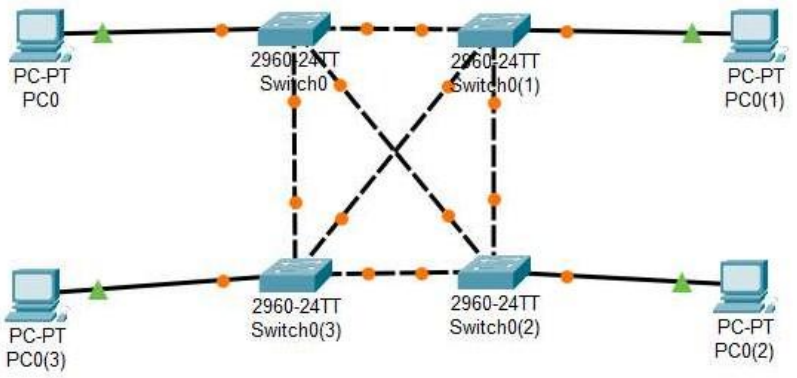
(3) Interpret and analyze the output of each topology

Ans.:



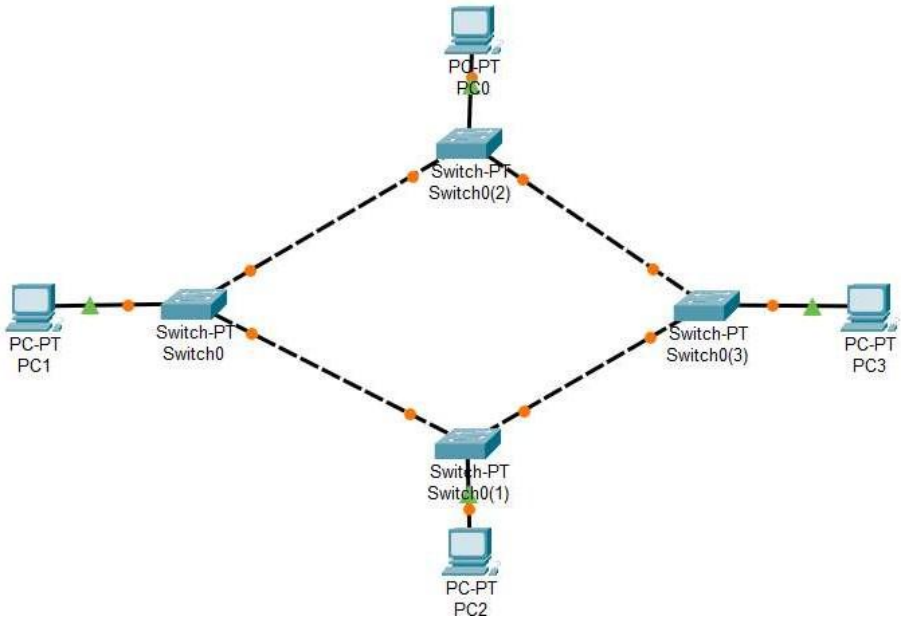
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC3	ICMP		0.000	N	0	(edit)	

Bus Topology



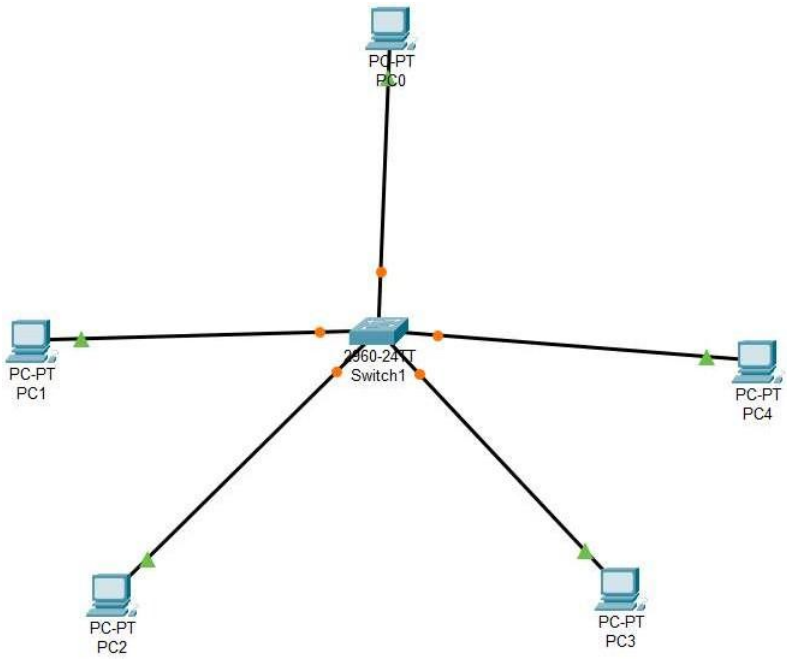
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0(3)	PC0(1)	ICMP		0.000	N	0	(edit)	

Mesh Topology



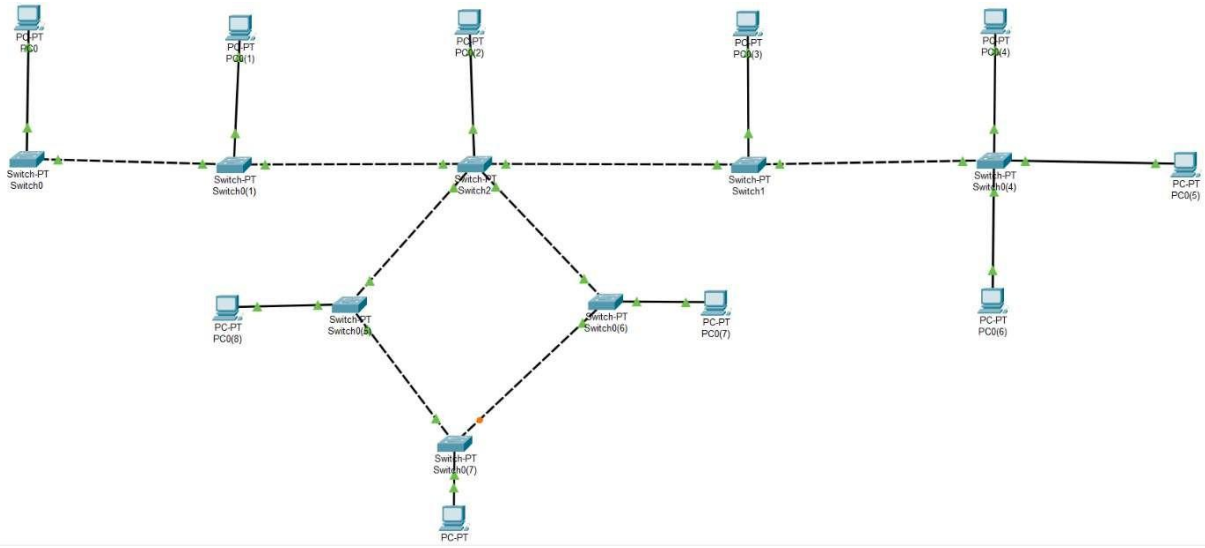
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC1	PC3	ICMP		0.000	N	0	(edit)	

Ring Topology



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC2	PC4	ICMP		0.000	N	0	(edit)	

Star Topology



Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	PC0	PC0(9)	ICMP		0.000	N	0	(edit)	

Hybrid Topology

Quiz:

1. Give Advantages, disadvantages of each topology.
   Ans.:

Topology	Advantages	Disadvantages
Bus	- Easy to implement- Cost-effective for small networks	- Limited cable length & number of stations- Troubleshooting is difficult- Entire network goes down if main cable fails
Star	- Easy to manage & expand- Failure of one node doesn't affect others- Easy to detect faults	- High cable cost- Central hub failure affects entire network
Ring	- Equal access to all nodes- Performs well under heavy load	- Failure of a single node or link can break the whole network- Difficult to troubleshoot and expand
Mesh	- High fault tolerance- Provides dedicated links for each device- Excellent reliability and security	- Very expensive due to many cables- Complex installation and maintenance
Hybrid	- Combines benefits of multiple topologies- Flexible and scalable	- Complex to design and manage- Expensive setup depending on design

2. Find out application case of each topology.
   Ans.:

Topology	Application Case
Bus	Small offices, LANs with few devices
Star	Schools, universities, and corporate networks
Ring	WANs like SONET (Synchronous Optical Network)
Mesh	Military communications, mission-critical networks
Hybrid	Large enterprises, data centers, campus networks

3. Which topology you will implement in your campus and why?
   Ans.: In our college campus Hybrid topology is good choice. It allows combining Star topology within departments for easy management and Mesh links between major hubs for high-speed, reliable communication. This design ensures fault tolerance, scalability, and efficient data transmission, which is ideal for a large and growing campus environment with varying connectivity needs across departments and hostels.

Suggested Reference:

1. https://www.netacad.com/courses/packet-tracer
2. Computer Networks- A Top-Down approach, Behrouz Forouzan, McGraw Hill

References used by the students:
https://www.netacad.com/courses/packet-tracer

Rubric wise marks obtained:

Program	**(Excellent)(4)**	**(Good)(3)**	**(Fair)(2)**	**(Beginning)(1)**
Installation of tool	Tool installed Properly	Tool executes with a minor error	Tool executes with multiple minor (easily fixed error)	Tool does not execute (0-1)
Topology Implementation	Tool displays correct output with no errors	Output has minor errors	Output has multiple errors	Output is incorrect (0-1)
Analysis/Interpretation of output	Analysis and understanding are as per requirement	Analysis and understanding are not as per requirement	Multiple misunderstanding	Analysis and understanding are not proper
Documentation	Practical is well documented	Missing required comment	Missing two or more required comments	Most or all documentation missing (0-1)

Experiment No: 5

AIM: Implement the concept of VLAN using Network Simulator.

Date:

Competency and Practical Skills: Exploration of network layout and configuration to connect devices with each other to establish VLAN

Relevant CO: CO-5: Implement different types of network using different tools and simulators

Objectives: (a) Download network simulator – preferably cisco packet tracer
(b) Implement VLAN by configuring interconnecting and computing devices.
(c) Analyze the performance of Network

Equipment/Instruments: Desktop/laptop, Network simulator

Theory:

What is VLAN?

Virtual Local Area Networks or Virtual LANs (VLANs) are a logical group of computers that appear to be on the same LAN irrespective of the configuration of the underlying physical network.

Features of VLANs:

VLAN ranges:

Steps to Implement a Virtual Local Area Network (VLAN):

1) Take a switch and 4 end devices (PCs), and connect the switch with end devices using Copper Straight-Through cable. While connecting the cables it is needed to select the port through which you want to connect the switch to the end devices.

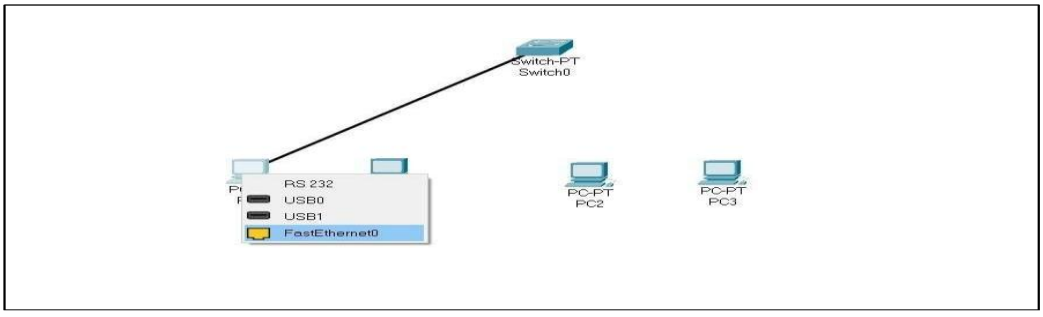


Fig. 1. Configuring VLAN in simulator.

- As in the above images to connect switch to PC0 choose 'FastEthernet0/1' port in the switch and then in PC0 is selected 'FastEthernet0' port. Similarly, connect the entire PC with the switch.

2) Now, to configure two VLANs in which take 2 PC for each VLAN. Separate 2 PCs for each VLAN which are numbered as VLAN 2 and VLAN 3. We cannot use VLAN 1 because it default VLAN usedby the switch. Let us assume that the VLAN 2 is being used by the Sales Department of the organization and VLAN 3 being used by the HR Department of the organization

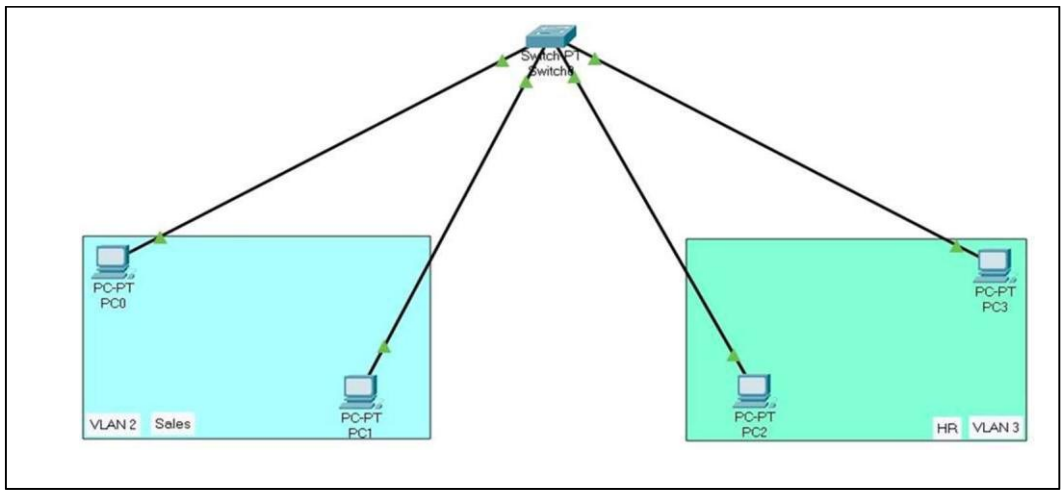


Fig. 2. Configuring two VLANs in simulator.

3) Provide the IP addresses and gateways to the end devices as shown in the below image.

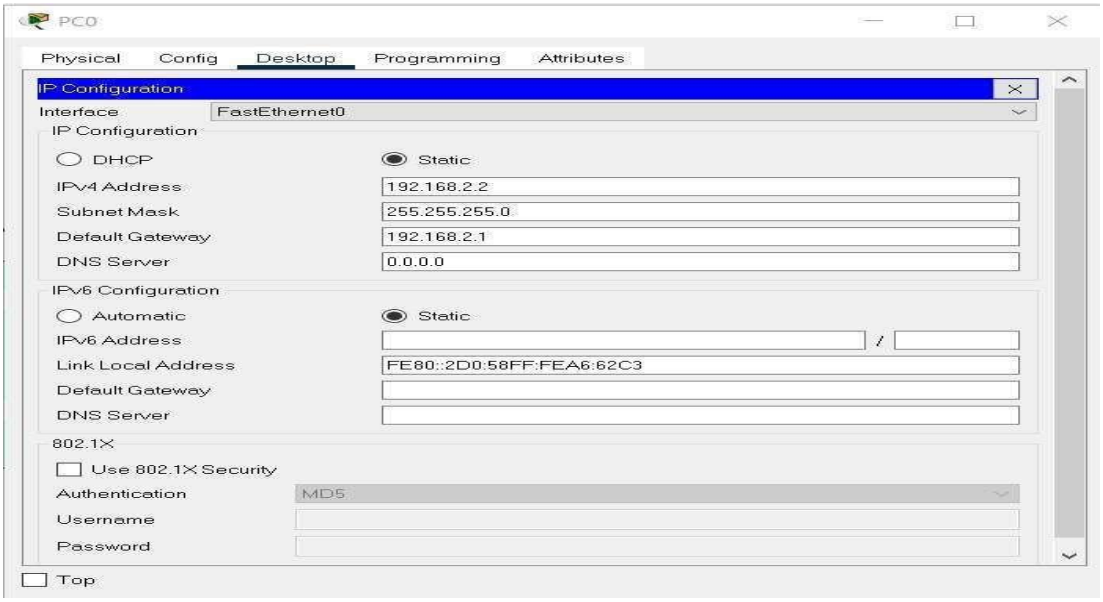


Fig. 3. Providing IP address and gateways to end devices.

Note: To provide IP address and gateways click on the PC you want provide IP address to and then click Desktop -> IP Configuration

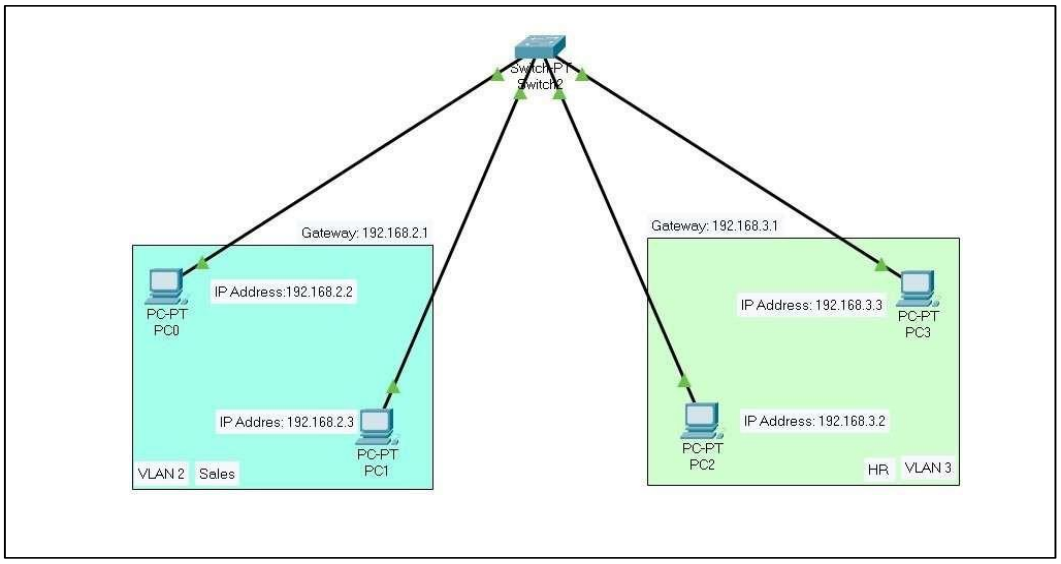


Fig. 4. Providing IP addresses to VLANs

4) Configure the VLAN

click on the switch -> go to CLI and press "Enter" then write the following commands to configure the VLANs andprovide the names to VLANs.

- Commands:

  - en/enable: Logs you into enable mode, which is also known as user exec mode or privileged mode.
  - confi/configure terminal: Logs you into configuration mode.
  - vlan number(except 1): Creates a VLAN and enters VLAN configuration mode for further definitions of specified number of the VLAN.
  - name vlan_name: Provides the specified name to the VLAN chosen by the vlan number command. To provide name to VLAN 2 we have to write name Sales after vlan 2 command. To provide name to VLAN 3 we have to write name HR after vlan 3 command.
  - exit: Exits from VLAN configuration mode.

```
%LINK-5-CHANGED: Interface FastEthernet2/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet2/1, changed state to up

%LINK-5-CHANGED: Interface FastEthernet3/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet3/1, changed state to up


Switch>en
Switch#confi
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 2
Switch(config-vlan)#name Sales
Switch(config-vlan)#exit
Switch(config)#vlan 3
Switch(config-vlan)#name HR
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#exit
Switch#
```

Fig. 5. Providing specific name to VLANs

5) Now, both the VLANs have been configured. To verify whether the VLANs have been activated or not we have to write "**show vlan**" command. And after pressing Enter we can see both the created VLANs as shown in thebelow image.

```
%SYS-5-CONFIG_I: Configured from console by console

Switch#show vlan

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa1/1, Fa2/1, Fa3/1
                                                 Fa4/1, Fa5/1
2    Sales                             active
3    HR                                active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
2    enet  100002     1500  -      -      -        -    -        0      0
3    enet  100003     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

 --More--
```

Fig. 6. VLANs activation status.

Here we can see in the above image that both the VLANs (VLAN 2 & VLAN3)which are "Sales" & "HR" are successfully configured and are active.

6) Now, to make the VLANs work properly we have to assign the devices among the manually configured host which are "VLAN 2(Sales)" & "VLAN 3(HR)".

- To assign devices among the VLANs we have to write series of commandswhich are:

1. confi/configure terminal: Logs you into configuration mode.

2. interface: Enters interface configuration mode for the specified fast ethernet interface
3. switchport access vlan: Sets the VLAN that the interface belongs to. It means it assigns the previously specified interface using interface command to work in the specific VLAN only if the device from the other VLAN tries to communicate with the specific interface it will not be successful.

```
Switch#
Switch#confi
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface f0/1
Switch(config-if)#switchport access vlan2
                                        ^
% Invalid input detected at '^' marker.

Switch(config-if)#switchport access vlan 2
Switch(config-if)#exit
Switch(config)#interface f1/1
Switch(config-if)#switchport access vlan 2
Switch(config-if)#exit
Switch(config)#interface f2/1
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#interface f3/1
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#
```

Fig. 7. Configuring interface to VLANs

Now we can see in the below image that if we send the message to the device in the same VLAN then the message is sent successfully, but if we send the message to the device in the different VLAN it cannot be sent to successfully.

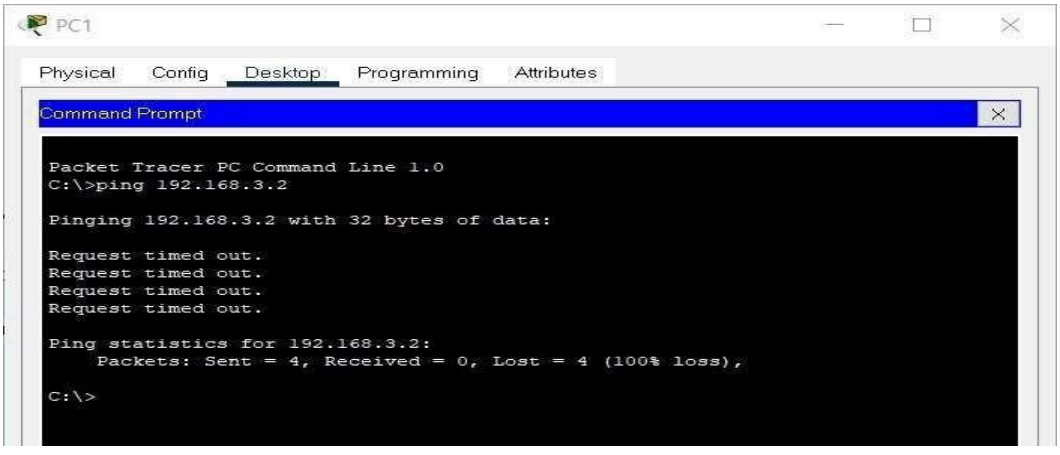


Fig. 8. Sending message to different VLAN

Now to check whether the message can be sent to the device in another VLAN we will click the PC from which we have to send the message and then click “Desktop” and then go to “Command Prompt” and then give command “ping IP address” here the IP address in the command specifies the destination device’s IP address

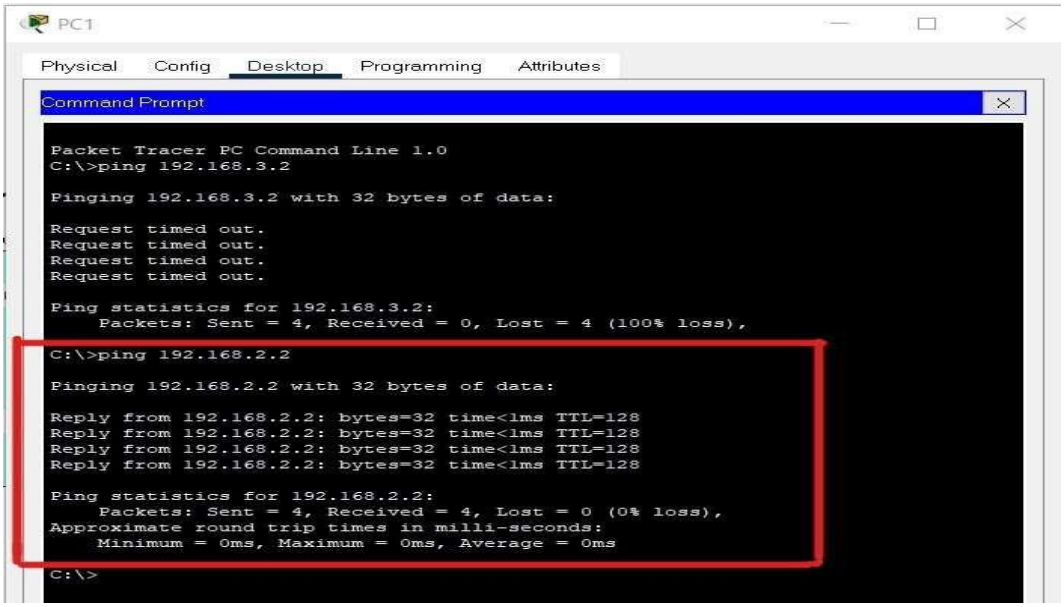


Fig. 9. Sending message to same VLAN

As we can see in the above image if we ping to the device from another VLAN it will not give reply as it is in the other VLAN. But if we ping to the device which is in the same VLAN as the sender is then the message will be successfully sent.

Now to check whether the message can be sent to the device in another VLAN we will click the PC from which we have to send the message and then click “Desktop” and then go to “Command Prompt” and then give command “ping IP address” here the IP address in the command specifies the destination device’s IP address

Observations:

(1) Differentiate LAN and VLAN

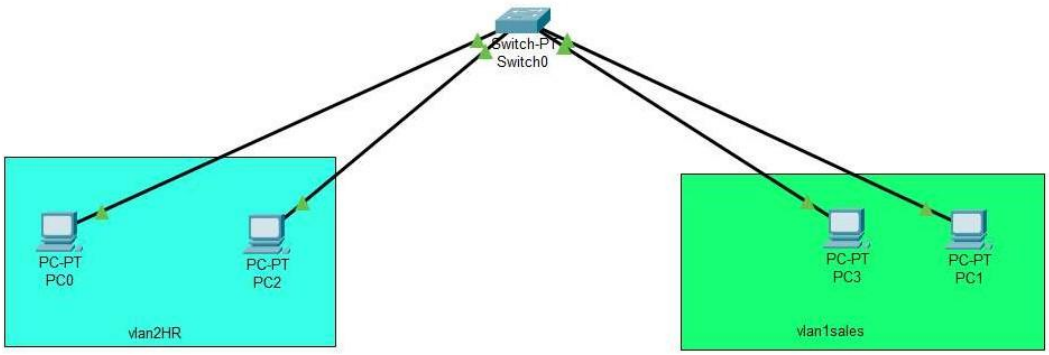
Ans.:

Feature	LAN (Local Area Network)	VLAN (Virtual LAN)
Definition	A physical network that connects devices within a limited area	A logical network created over LAN to group devices virtually
Type of Network	Physical network	Logical/virtual network

Feature	LAN (Local Area Network)	VLAN (Virtual LAN)
Segmentation	All devices share the same broadcast domain	Broadcast domain is divided into multiple VLANs
Security	Less secure; all devices can communicate unless restricted	More secure; devices in different VLANs are isolated
Flexibility	Requires rewiring to move devices between groups	Devices can be moved across VLANs via configuration
Configuration	No special configuration needed	Requires VLAN-aware switches and configuration
Performance	Broadcast traffic affects all devices	Reduces broadcast traffic by limiting it to VLAN members
Example	All computers in a lab connected via a switch	Staff in VLAN 10, Students in VLAN 20, using the same switch

(2) Interpret and analyze the output

Ans.:



```
Switch>en
Switch#config
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 2
Switch(config-vlan)#name HR
Switch(config-vlan)#exit
Switch(config)#vlan 3
Switch(config-vlan)#name sales
Switch(config-vlan)#
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#show vlan

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa4/1, Fa5/1
2    HR                                active    Fa0/1, Fa1/1
3    sales                             active    Fa2/1, Fa3/1
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
2    enet  100002     1500  -      -      -        -    -        0      0
3    enet  100003     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
```

```
Switch#
Switch#confi
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface f0/1
Switch(config-if)#switchport access vlan2
                                        ^
% Invalid input detected at '^' marker.

Switch(config-if)#switchport access vlan 2
Switch(config-if)#exit
Switch(config)#interface f1/1
Switch(config-if)#switchport access vlan 2
Switch(config-if)#exit
Switch(config)#interface f2/1
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#interface f3/1
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#
```

Quiz:

1. Give Advantages, disadvantages of VLAN

Ans.:

Advantage	Description
Improved Security	VLANs isolate sensitive traffic (e.g., HR, Finance) from general users. Devices in different VLANs cannot communicate without routing.
Reduced Broadcast Traffic	VLANs create smaller broadcast domains, limiting unnecessary network traffic.
Better Network Management	Logical grouping of users makes it easier to manage devices without moving cables.
Flexibility and Scalability	Devices can be in different physical locations but grouped under the same VLAN. Easy to expand.
Cost Efficient	Reduces the need for separate physical switches for each department or function.

Disadvantage	Description
Complexity in Configuration	VLAN setup requires configuration of managed switches and proper planning.
Inter-VLAN Communication Requires Layer 3 Device	VLANs cannot communicate directly; you need a router or Layer 3 switch.
Troubleshooting Can Be Difficult	Misconfiguration can lead to traffic being blocked or incorrectly routed.
Requires VLAN-Supported Hardware	Not all older switches support VLANs, so upgrades may be needed.

2. Find out application case of VLAN

Ans.:

In a college campus network, VLANs are implemented to logically segment different departments. For example:

- VLAN 10 – Administration
- VLAN 20 – Student Network
- VLAN 30 – Library
- VLAN 40 – Examination Department

This logical separation helps enhance security, reduce unnecessary traffic, and simplify network management. Each VLAN operates as an independent broadcast domain, ensuring that data remains confined to its respective department unless explicitly allowed.

Suggested Reference:

1. https://www.netacad.com/courses/packet-tracer
2. Computer Networks- A Top-Down approach, Behrouz Forouzan, McGraw Hill

References used by the students:

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Rubric wise marks obtained:

Program	**(Excellent)(4)**	**(Good)(3)**	**(Fair)(2)**	**(Beginning)(1)**
Installation of tool	Tool installed Properly	Tool executes with a minor error	Tool executes with multiple minor (easily fixed error)	Tool does not execute (0-1)
Topology Implementation	Tool displays correct output with no errors	Output has minor errors	Output has multiple errors	Output is incorrect (0-1)
Analysis/Interpretation of output	Analysis and understanding are as per requirement	Analysis and understanding are not as per requirement	Multiple misunderstanding	Analysis and understanding are not proper
Documentation	Practical is well documented	Missing required comment	Missing two or more required comments	Most or all documentation missing (0-1)