# Introduction to Computer Networks

Short introduction of Unit

In today's interconnected world, computer networks play a vital role in the functioning of societies and businesses. This chapter aims to provide a comprehensive understanding of computer networks as systems, including their components, objectives, and real-world applications.

Q.1 What do you know about network system? Describe its basic components. 09506001

Ans. A computer network is a system of linked devices and computers that may exchange data and operate together. Networks can range from small, Local Area Network (LANs, Local Area Networks) to large area network, WANs, including the Internet. Networks are arranged of various elements that work together to facilitate communication depicted in Figure.

Network Diagram (H.Q Picture is available on Pg# 235)
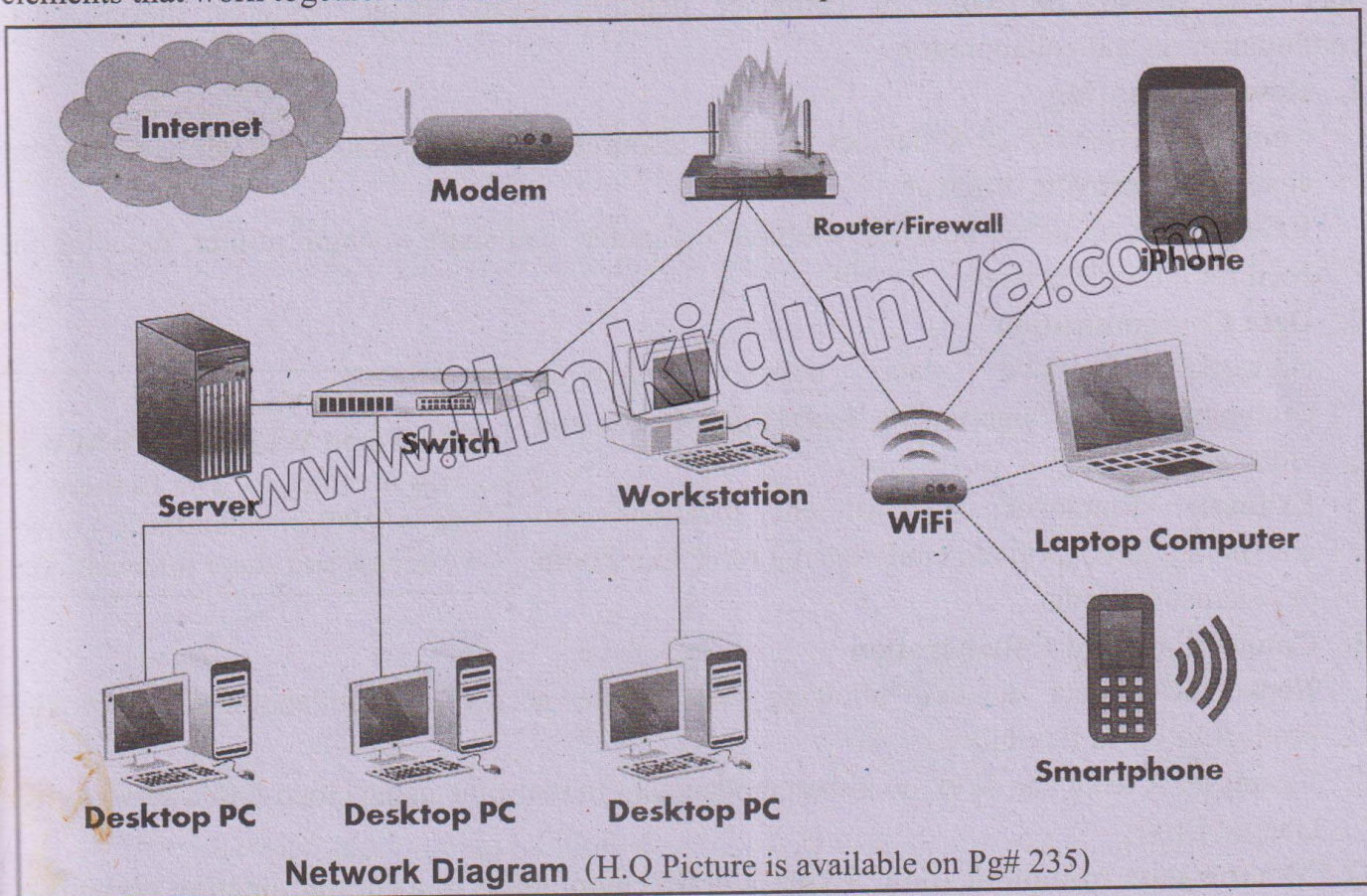
The primary components include

- **Nodes:** Devices that are connected to the network, such as computers, smartphones, and printers.
- **Links:** The connections between nodes, which can be wired (like Ethernet cables) or wireless (like Wi-Fi).
- **Switches:** Devices that connect multiple nodes within a network to forward data.

> **Did You Know**
> The Internet is the largest network, connecting all the networks worldwide!

- **Routers:** Devices that connect different networks and direct data packets between them.

Example of Using Switches

- Imagine a file transfer in an office network. You send a file from your computer to a colleague's computer in another room.
- The file is split into packets, and each packet has the destination MAC address (your colleague's computer).
- The packets are sent to a network switch.
- The switch examines the Media Access Control address and forwards the packets only to the port where your colleague's computer is connected.
- Once all packets are received, your colleague's computer reassembles them into the original file.

Q.2 Discuss the objectives of computer networks and provide examples of how they facilitate resource sharing and data communication.

Ans. The primary objective of computer network is to enable resource sharing, data communication and collaboration:

1. **Resource Sharing**

   Computer networks allow devices to share resources, such as printers and storage, reducing costs and improving efficiency.

   Example: In an office network, multiple computers can share a single printer, reducing the need for multiple printers.

2. **Data Communication**

   Networks facilitate data transfer, enabling communication through emails, instant messaging, and video conferencing.

   Example: Employees in different locations can collaborate through video conferencing tools like Zoom or Microsoft Teams.

> **Did You Know?**
> The **World Wide Web (WWW)** was invented by Tim Berners-Lee in 1989, revolutionizing how we access and share information.

3. **Connectivity and Collaboration**

   Networks connect devices, allowing for remote access and collaboration, improving productivity and flexibility.

   Example: A team can work on a shared document in real-time using cloud-based services like Google Drive.

Q.3 What is data communication? Explain main components of a communication system.

Ans. Data communication involves the exchange of data between a sender and a receiver through a communication medium. Key components include the sender, receiver, message, protocol, and medium.

Components of Data Communication

It comprises of five basic components:

1. **Sender:** The device that sends the data. **Example:** A computer sending an email.
2. **Receiver:** The device that receives the data. **Example:** A smartphone receiving the email.

3. **Message:** The data being communicated. **Example:** The content of the email.
4. **Protocol:** A set of rules governing data communication. **Example:** The HTTP protocol used for web communications.
5. **Medium:** The physical or wireless path through which data travels. **Example:** Ethernet cable or Wi-Fi.

Q.4 Describe how data is transmitted across computer networks using packet switching and other networking devices.

09506004

Ans. Networking devices include hubs, switches, routers, and access points are responsible for the management and direction of network traffic.

1. Switch

Switch is a network device that connects multiple network devices such as computers, printers, and servers, within a network and allows these devices to communicate with each other efficiently. Switches play an important role in modern networks by efficiently managing data traffic and ensuring that information reaches the correct device.

> **Did You Know?**
> SIM stands for **Subscriber Identity Module.**

Working of Switch

A switch is used at the Data Link layer which is called the Layer of the **OSI** model. It uses hardware address of a device called **Media Access Control (MAC)** addresses to forward data to the correct device. When a data packet reaches at the switch, it reads the destination MAC address and sends the packet only to the device with that address, rather than broadcasting it to all devices.

A network switch connecting multiple devices (H.Q Picture is available on Pg# 238)
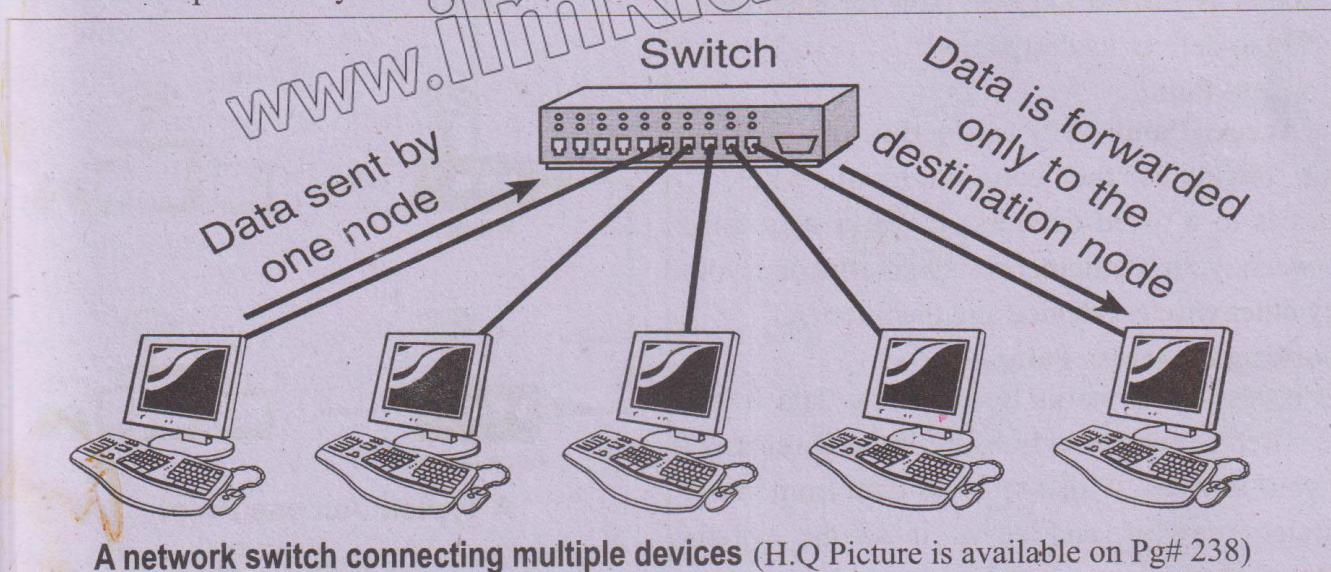
2. Router

A router is a networking device that interconnects networks or allows devices to connect to it. It directs data packets between different networks. Think of it as a traffic director on the internet, making sure that data gets from one place to another efficiently. Figure illustrates how a mobile internet connection (via SIM card) integrates with a home network. Alternatively, an Ethernet cable can be used to obtain internet access and distribute it among home devices. In enterprise environments, different types of routers are employed, as depicted in Figure.

Mobile Wi-Fi Router (H.Q Picture is available on Pg# 237)
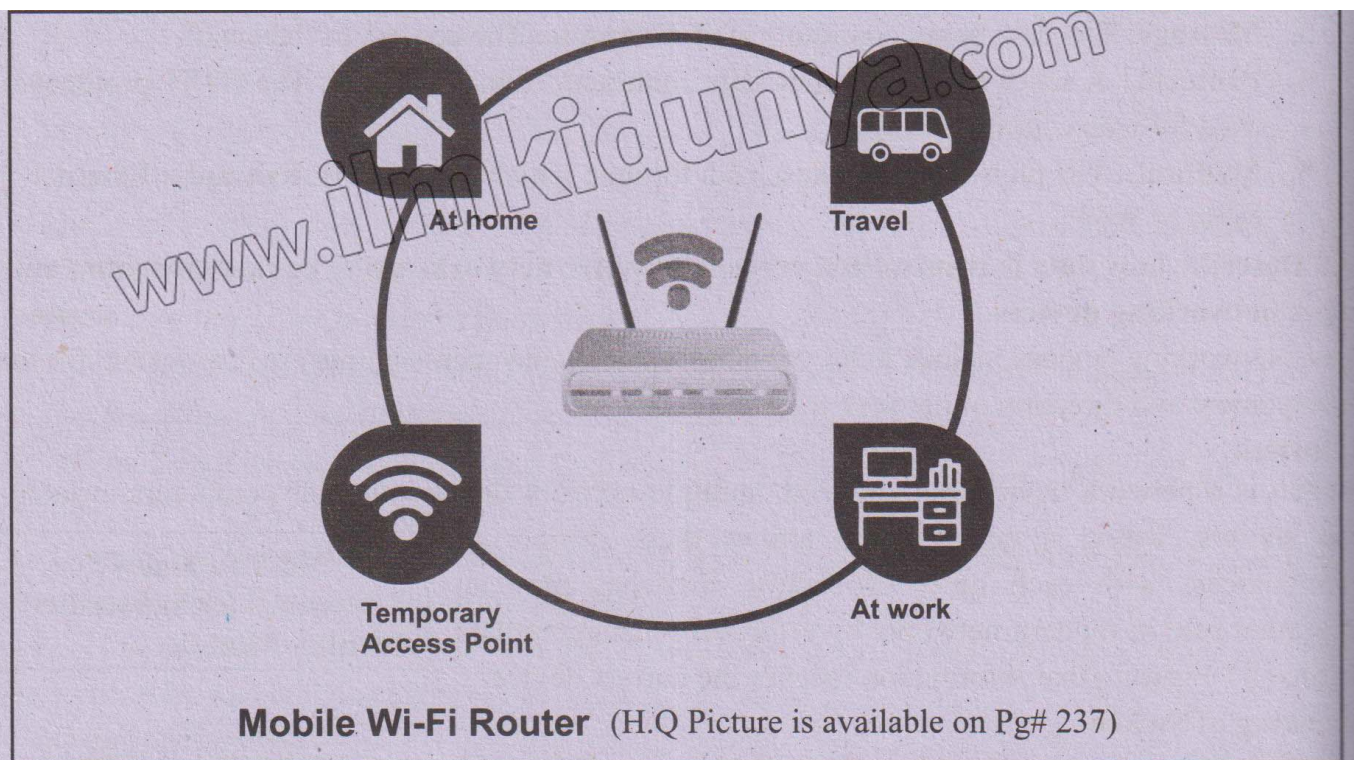
Working of Router

Packets: Each packet contains part of the data and the address of the destination. The main job of router is to find the best path for each data packet to deliver its destination.

3. Access Point

An **Access Point (AP)** is a networking device that facilitates the connection of wireless devices to a wired network. It works as a link between your computers and smartphones or any other wireless device and the internet.

Working of Access Point

An access point works by receiving data from the wired network and transmitting it wirelessly to your devices. It also receives data from your wireless devices and sends it to the wired network.

A Typical Access Point
(H.Q Picture is available on Pg# 237)
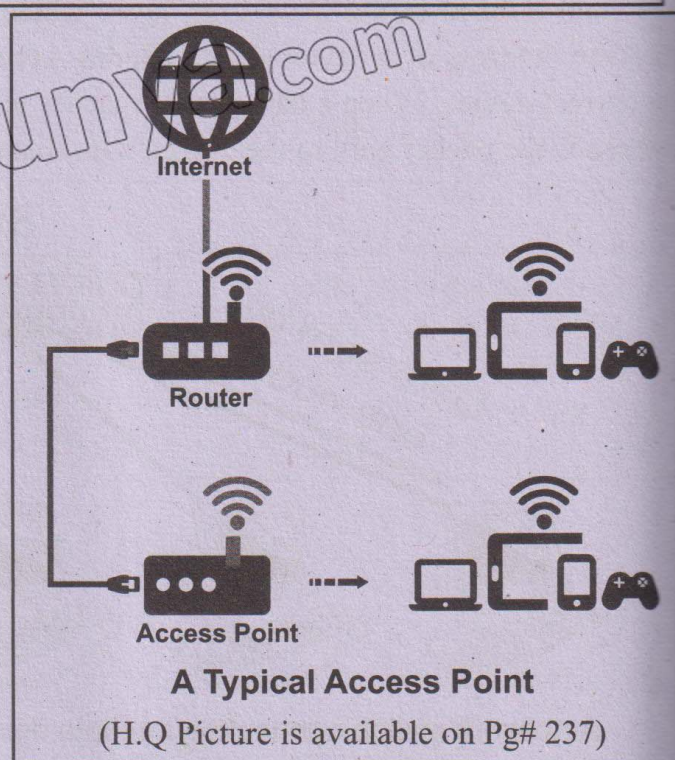
Q.5 Compare and contrast the different types of network topologies (star, ring, bus, and mesh).   09506005

Ans. Network topologies are methods used to define the arrangement of different devices in a computer network, where each device is called a node. The reliability and performance of a network are impacted by the way its device is linked.

1. Bus Topology:

In a Bus Topology, all devices share a single communication line called a bus. Each device is connected to this central cable.
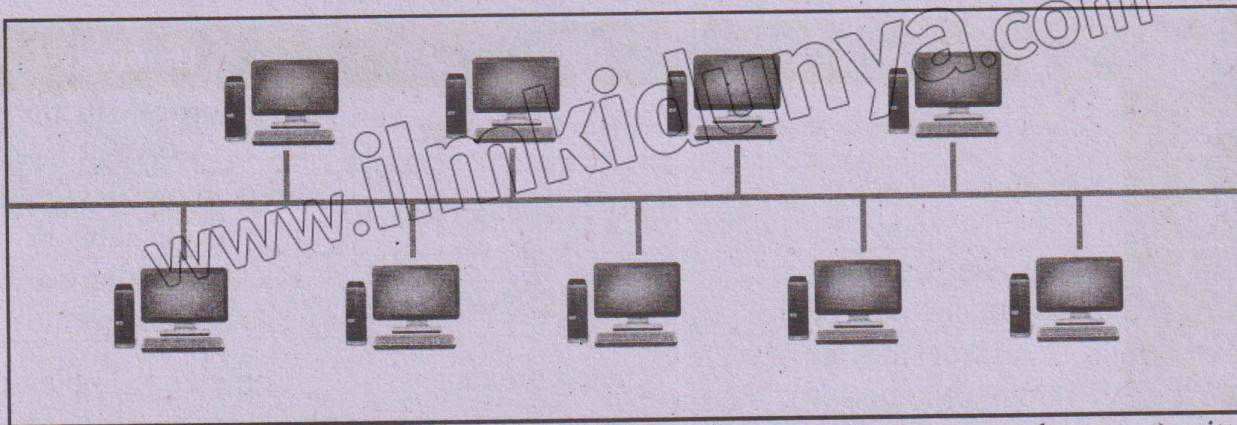
Example: Imagine a chalkboard in a classroom where every student can see the notes written by the teacher. Here, the chalkboard represents the shared communication line.

2. Star Topology

In a star topology each node in network communicates with the others via a central switch or hub. The hub works as a data flow repeater. Hub is a networking device used to connect multiple computing devices in LAN.

Example:

Think of a school principal's office is the hub, and the classrooms are the nodes.

Hub/Switch

(H.Q Picture is available on Pg# 236)
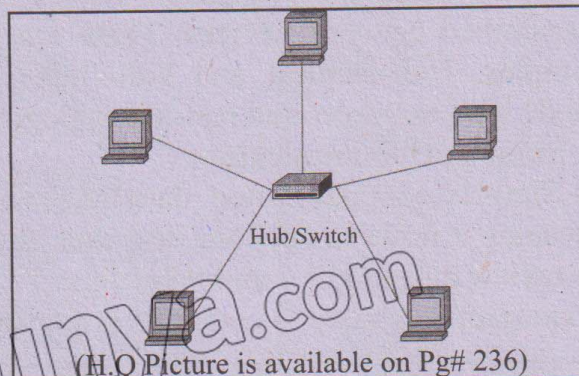
3. Ring Topology

In a Ring topology, each device is connected in a circular pathway with other devices. Data travels in one direction, passing through each device. Ring topology can handle high traffic, but if one connection fails, the whole network is affected.

Example:

Consider a relay race where each runner passes the baton to the next runner in a circle until it reaches the starting point again.
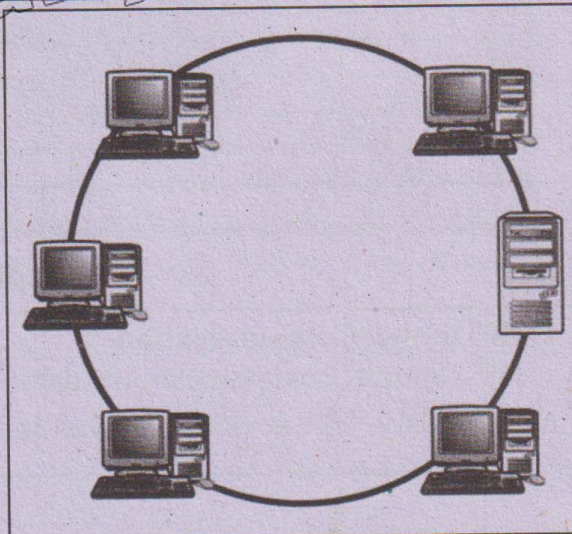

4. Mesh Topology

In a Mesh topology, each device is connected to every other device. This provides high redundancy and reliability. Mesh topology is very reliable because if one links fails, data can be rerouted through other devices.

Example:

Imagine a city where every house is directly connected to every other house by roads. If one road is blocked, there are multiple alternative routes.

(H.Q Picture is available on Pg# 236)
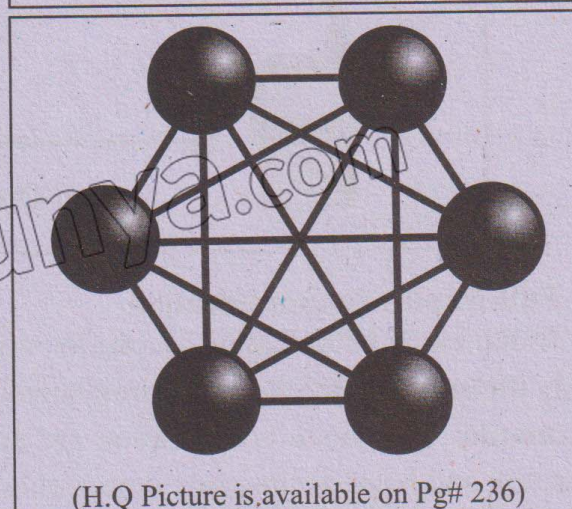
Topology	Working	Merits	Demerits
Star	Use central hub/switch	Easy to manage	Hub failure effects the whole system
Ring	Computers connected in a loop	Easy to add devices	Failure in one device effects whole network
Bus	Single shared communication device	Cost effective	Backbone failure effects network
Mesh	All devices are interconnected	Fault tolerant	Complex to implement

Q.6 Describe Modes of Data Transmission in details.

09506006

Ans. Network communication modes describe how data is transmitted between devices. There are three primary modes: Simplex, Half-Duplex, and Full-Duplex. Let's explore each mode with examples and real-life analogies.
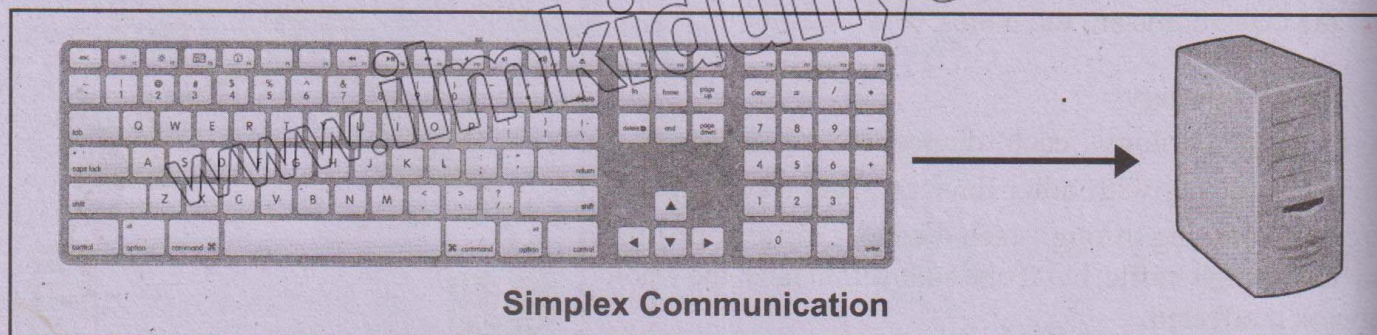
1. Simplex Communication

In Simplex communication, data transmission is unidirectional, meaning it flows in only one direction. A device can either send or review data in this communication.

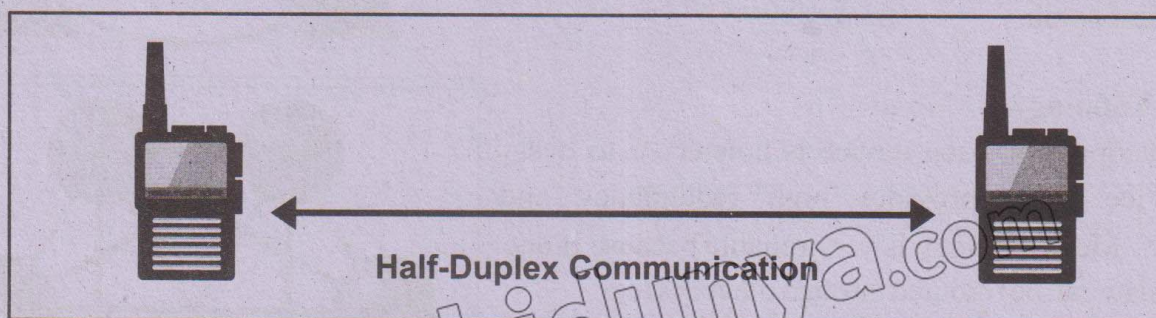**Example:** Keyboard to computer is an example of simplex communication.

Simplex Communication

2. Half-Duplex Communication

In Half-Duplex communication, data transmission can occur in both directions, but not simultaneously. One device must wait for the other to finish transmitting before it can start.


Half-Duplex Communication

3. Full-Duplex Communication

Full-duplex communication allows for simultaneous data delivery in both directions. Both devices may transmit and receive data simultaneously at the same time.

Example: Telephone conversation are an example of Full-Duplex communication. Both people can talk and listen at the same time without waiting for their turn.
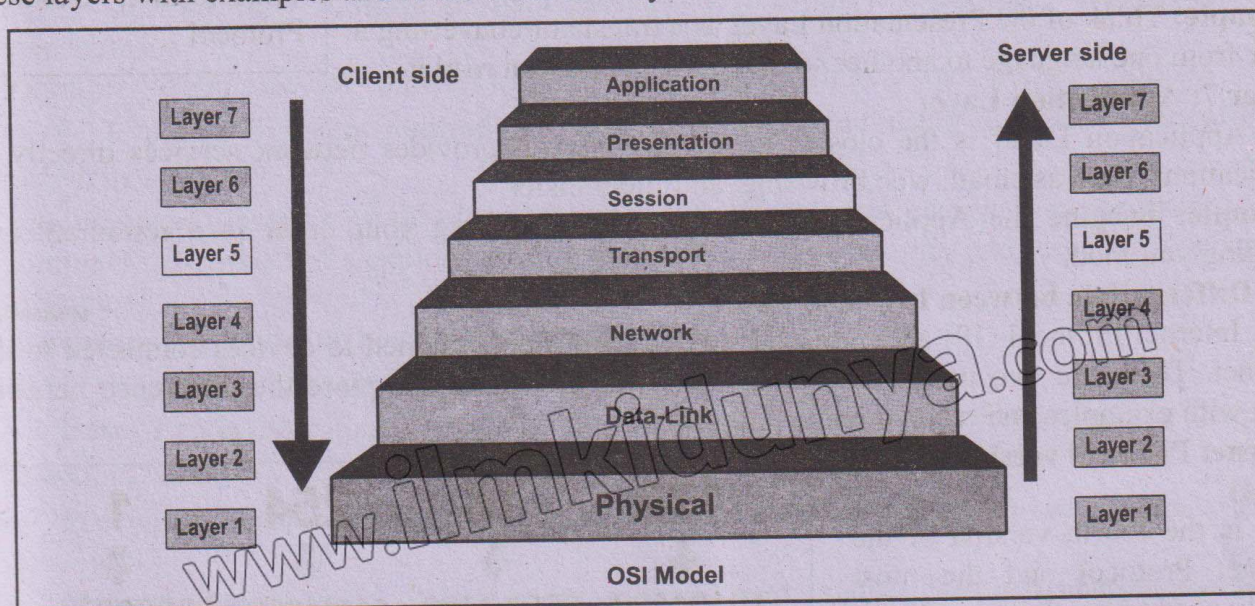
Full-Duplex Communication
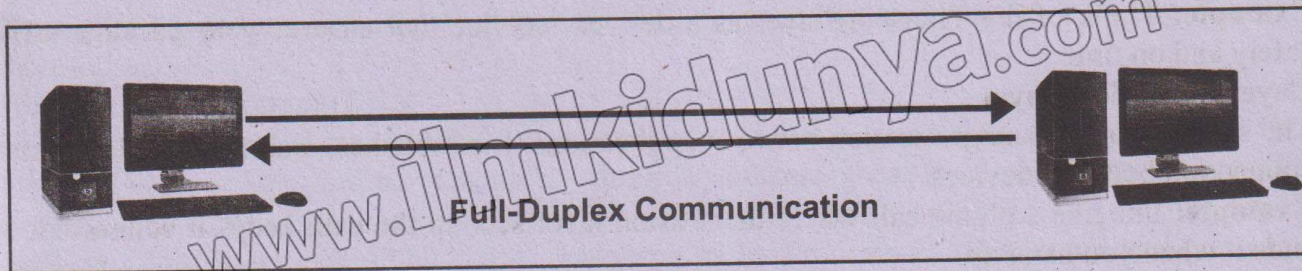
Q.7 What is OSI model? Explore its layers in details. 09506007

Ans. The Open Systems Interconnection (OSI) Model is a framework used to understand how different networking protocols interact. It has 7 layers, each with a specific function. Let's explore these layers with examples and relate them to daily life.

OSI Model

Layer 1: Physical Layer

The physical layer is liable for the actual connection between devices. The process of sending unprocessed data bits via a physical medium is the focus here.

Example: Imagine the hardware that connects computers, like a Network interface cables, repeaters, hubs and connectors.

Layer 2: Data Link Layer

Error detection and correction, as well as node-to-node data transport, are handled by the Data Link Layer. It ensures error-free data transmission from the physical layer.

Example: Think of the Data Link Layer as traffic lights at intersections, which manage the flow of cars (data) and prevent collisions.

Layer 3: Network Layer

The Network Layer is responding for data transfer between different networks. It determines the best path for data to travel from the source to the destination.

Example: Imagine a GPS system finding the best route for you travel from home to school.

Did You Know?
GPS stands for **Global Positioning System.**

Layer 4: Transport Layer

The Transport Layer ensures that data is transferred from one process rerunning on source end system to a process sourcing on destination end system. It manages data flow control and error checking.

Example: Think of the Transport layer as a delivery service that ensures your package arrives safely and on time.

Layer 5: Session Layer

The session Layer manages session between applications. It establishes, maintains, and terminates connection between devices.

Example: Imagine a phone call where the session layer sets up the call, keeps it connected, and ends it when you hang up.

Layer 6: Presentation Layer

The presentation layer translates data between the application layer and the network. It formats and encrypts data to ensure it is readable by the receiving system.

Did You Know?
TCP stands for Transmission Control Protocol.

Example: Think of the Presentation Layer as a translator converting a book from one language to another so that more people can read it.

Layer 7: Application Layer

The Application Layer is the closest to the end user. It provides network services directly to applications, such as email, web browsing, and file transfer.

Example: Imagine the Application Layer as a waiter taking your order in a restaurant and bringing you food.

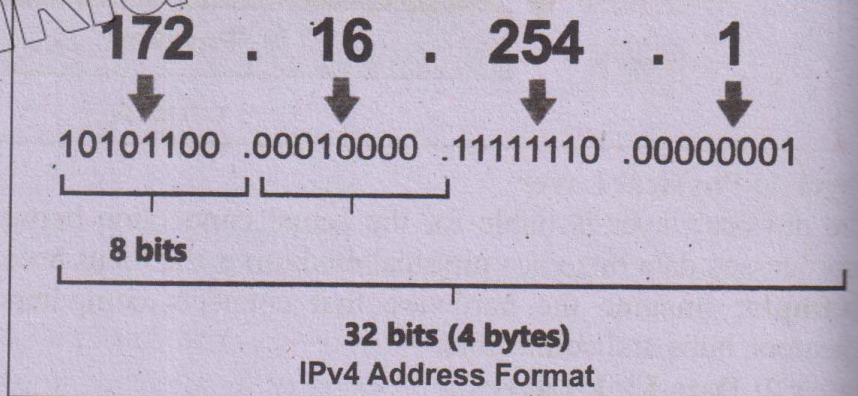**Q.8 Differentiate between Ipv4 and Ipv6.**   09506008

Ans. Internet Protocol (IP) addresses are unique identifiers assigned to devices connected to the Internet. There are two primary versions: Ipv4 and IPv6. Let's explore the difference between them with examples and relate them to daily life.

Internet Protocol version 4 (IPv4)

IPv4 is the fourth version of the Internet Protocol and the most widely used today. It uses a 32-bit address scheme allowing for approximately 4.3 billion unique addresses. To find the total number of unique IPv4 addresses, we calculate 2^{32}, which represent all possible combinations of 32 bits, i.e., $2^{32} = 4,294,967,296$.

172 . 16 . 254 . 1
10101100 .00010000 .11111110 .00000001
8 bits
32 bits (4 bytes)
IPv4 Address Format

Internet Protocol version 6 (IPv6)

IPv6 is the most recent version of the Internet Protocol designed to replace IPv4. It uses a 128-bit address scheme, allowing for an almost limitless number of unique addresses.

Example: Imagine an IPv6 address like a digital fingerprint. It can provide a unique identifier not just for house on a street, but for every grain of sand on a beach. e.g. 2001: 0000: 130F: 0000: 0000: 0900 876A: 130B

Q.9 Discuss the role and importance of protocols in data communication. Explain the functions of key protocols such as TCP/IP, HTTP, DNS, and DHCP.   09506009

Ans. Protocols are the fundamental rules, standards, and procedures that govern data flow across a network. They ensure that data is transferred smoothly, securely, and accurately. Without protocols, devices with varying hardware, software, and configurations would struggle to communicate properly. Common protocols include TCP/IP, HTTP, FTP and SMTP.

Example: Hypertext Transfer Protocol (HTTP) is used for transferring web pages over the internet.

Domain Name System (DNS)

The Domain Name System (DNS) is a fundamental mechanism that allows users to access websites and other online resources through human-readable domain names (such as www.google.com) rather than numerical IP addresses (such as 142.250.190.78). Further, DNS translates domain name to IP addresses, making it easier for users to access websites.

Example: When you type **www.example.com** in a browser, DNS translates it to the corresponding IP address.

Dynamic Host Configuration Protocol (DHCP)

DHCP automatically assigns IP addresses to devices on a network, simplifying network management.

Example: When a device connects to a Wi-Fi networks, DHCP assigns it an IP address.

Q.10 Evaluate different methods of network security, including firewalls, encryption, and antivirus software.

09506010

Ans. Network security involves measure to protect data and prevent unauthorized access to computer networks. Let's explore the importance of network security and some key concepts with examples.

Importance of Network Security

Network security is important for several reasons:

- **Data Protection:** Ensuring that sensitive information is not accessed or altered by unauthorized users.

- **Preventing Attacks:** Defending against malicious attacks that can disrupt networks and steal data.

- **Maintaining Privacy:** Safeguarding personal and confidential information accessible to authorized users.

- **Ensuring Availability:** Ensuring that network resources are available and accessible to authorized users.

Key Concepts in Network Security

Firewalls: Firewalls are security systems that monitor and control incoming and outgoing network traffic based on predetermined security rules.

Firwalls Concept (H.Q Picture is available on Pg# 238)
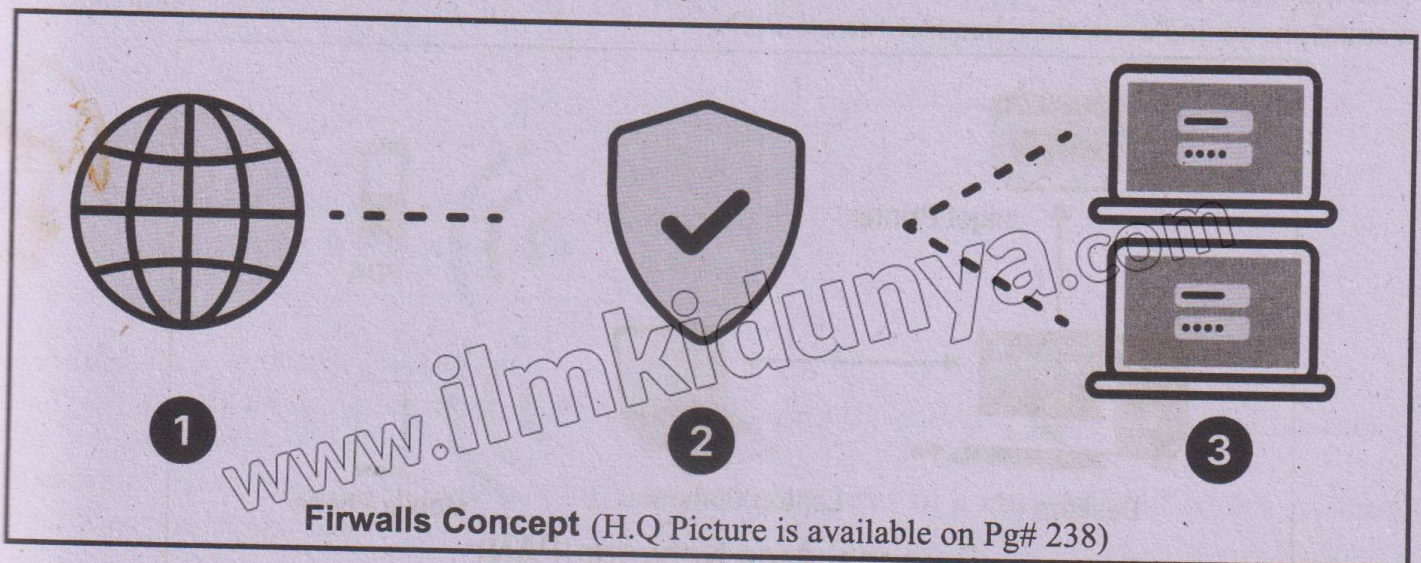
Encryption

Encryption transforms data into a secure format that can only be read or understood by authorized parties with the correct decryption key. **Decryption** is the process of converting the encrypted data back to its original form.

Example: Plain Text: Hello, World!

Encrypted Text (using a simple shift cipher): Khoor, Zruog! Where each letter in the plaintext is replaced by the letter that is 3 positions down the alphabet.

Decryption: Converting "Khoor, Zruog!" back to "Hello, World!" using the same shift cipher in reverse.

Ciphertext Exchanged Between Countries

Countries often exchange sensitive information securely using encryption. The encrypted data, known as ciphertext, can only be read by the intended recipient who has the decryption key. This ensures national security and protects classified information from being intercepted and read by unauthorized parties.

Passwords and Authentication

Passwords and authentication methods ensure that only authorized users can access network resources.

Common Threats to Network Security

- **Malware:** Malicious software such as viruses, worms, and ransomware that can damage or steal data.
- **Phishing:** Attempts to trick users into revealing sensitive information through deceptive emails or websites.
- **Denial of Service (DoS) Attacks:** Overwhelming a network with traffic to disrupt its normal operation and make it unavailable.
- **Man-in-the-Middle Attacks:** Intercepting communication between two parties to steal information or alter messages.

Q.11 Explain different types of Networks.   09506011

Ans. Networks are classified based on their size, range, and purpose. Let's explore some common types of networks and understand how they work.

1. Personal Area Network (PAN)

A PAN is a small network used for communication between personal devices, such as smartphones, tablets, and laptops, within a short range. **Example:** Bluetooth connections between a smartphone and a wireless headset form a PAN.

Personal Area Network (PAN)
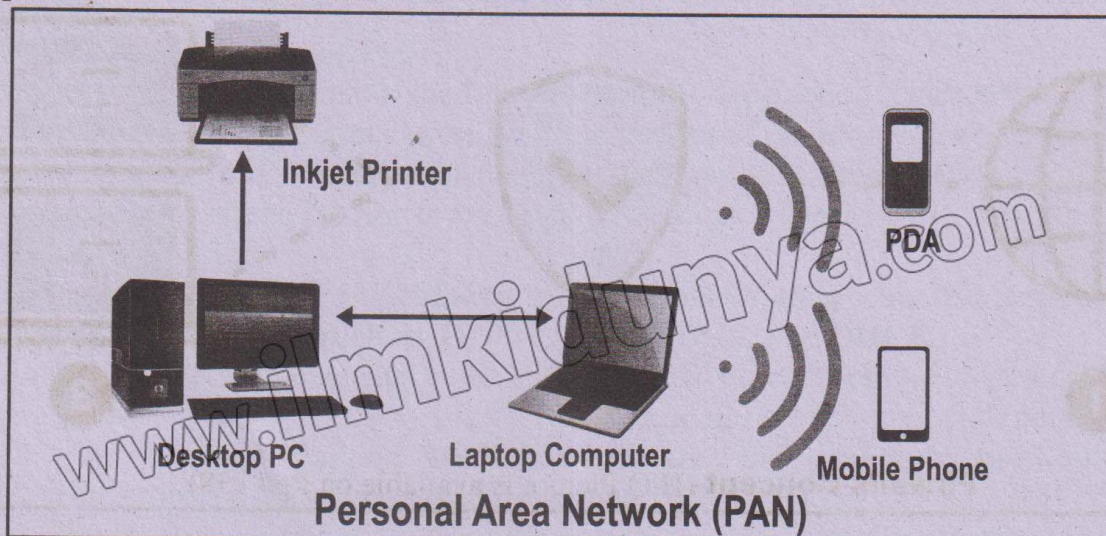
2. Local Area Network (LAN)

A LAN is a network that connects computers and devices within a limited area, such as a home, school, or office building.

Example: The computer network in your school that connects all the computers in the lab is a LAN.
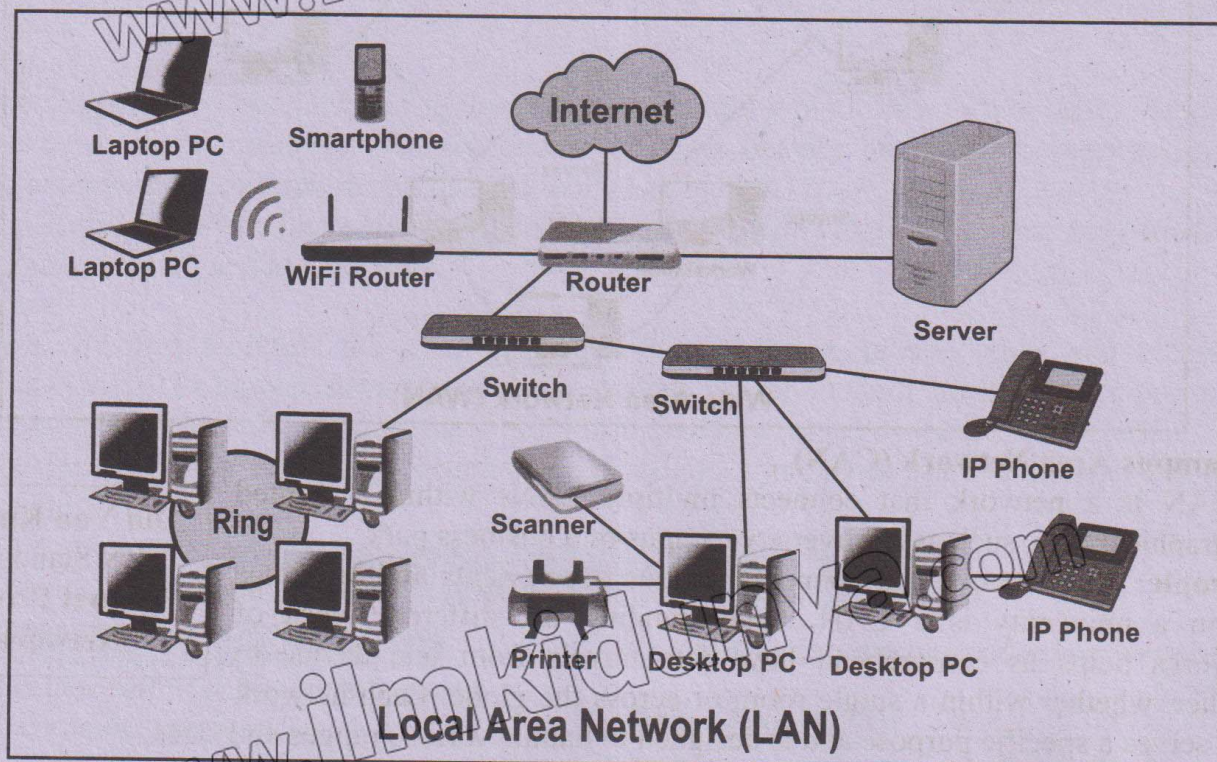

Local Area Network (LAN)

3. Metropolitan Area Network (MAN)

A MAN is a network that spans a city or a large campus, connecting multiple LANS together.

Example: The network that connects various branches of a university across a city is a MAN.
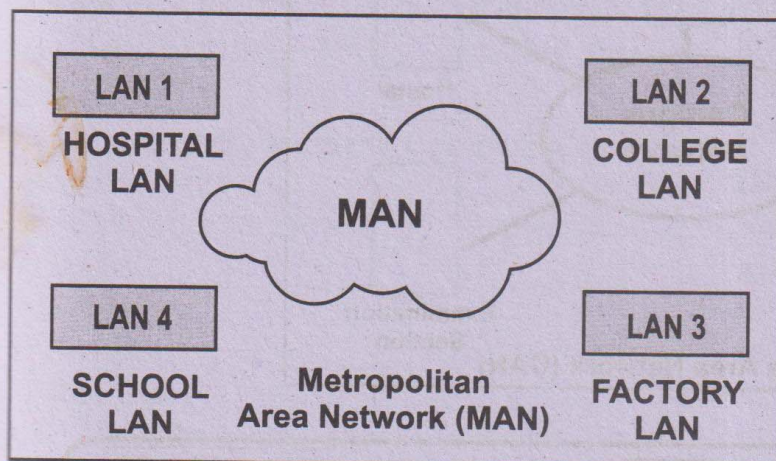
Did You Know?
A **MAN** can cover an area of up to **50 kilometers,** making it ideal for city-wide connectivity.

4. Wide Area Network (WAN)

A WAN covers a large geographical area, connecting multiple LANs and MANs. The internet is the largest example of a WAN.

Example: The network that connects different branch offices of a multinational company across countries is a WAN.

Wide Area Network (WAN)
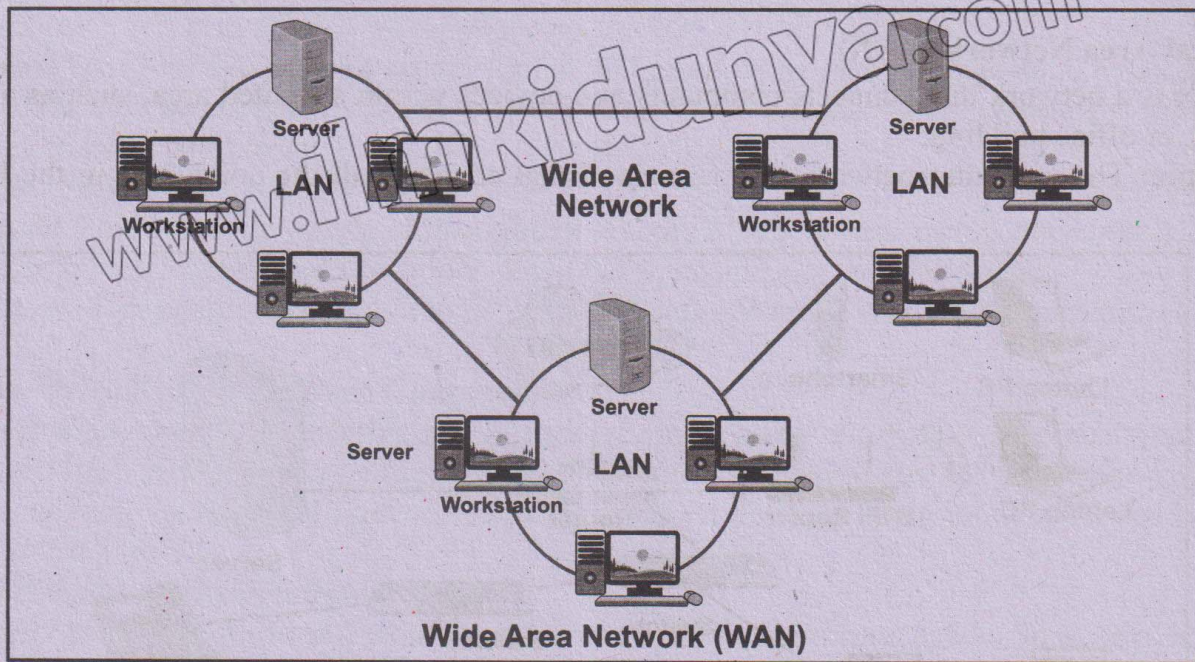
5. Campus Area Network (CAN).

A CAN is a network that connects multiple LANs within a limited geographical area, such as a university campus or a business park.

Example: The network that connects various departments and buildings within a university is a CAN. Understanding the different types of networks helps us comprehend how data travels from one device to another, whether within a single room or across the globe. Each network type serves a specific purpose and is designed to handle various ranges and sizes.

Campus Area Network (CAN)
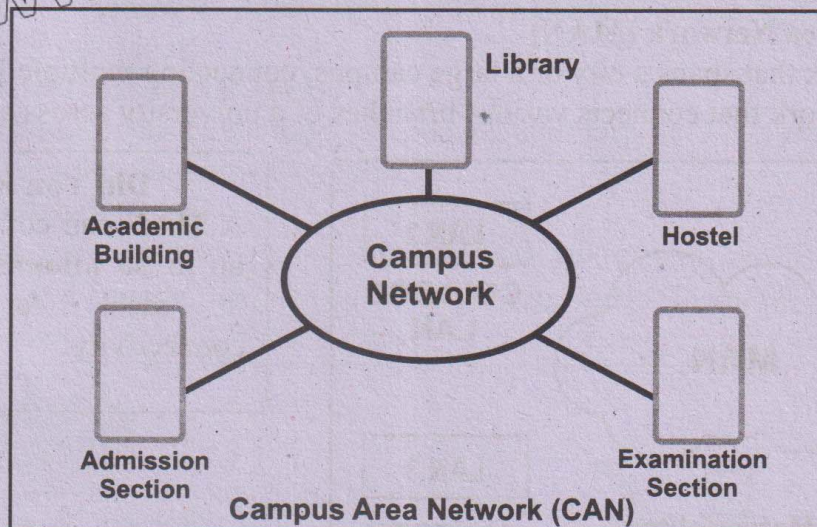
COMPUTER NETWORKING
- PAN
- LAN
- MAN
- WAN

Online Lecture YouTube

Q.12 Describe the role of Business, Healthcare and Education in Computer Networking

Business.

09506012

Ans. In business, networks enable efficient communication, resource sharing, and data management. Today's businesses rely heavily on computer networking. It improves communication, helps distant work, allows for data sharing, and protects sensitive information.

Example: Companies use intranets to share information and resources securely within the organization.

Education

Educational institutions use networks to provide online learning platforms, virtual classrooms, and access to educational resources. Modern schooling relies heavily on computer networking. It access to extensive educational materials, and remote education.

Example: Universities use Learning Management Systems (LMS) like Blackboard and Moodie to deliver course content and assessments.

Healthcare

Healthcare networks facilitate the sharing of patient information, telemedicine, and access to medical databases. Computer networking is the foundation of modern healthcare. It promotes effective patient care, telemedicine, remote monitoring, and increased operational efficiency.

Example: Hospitals use Electronic Health Records (EHR) systems to store and retrieve patient data efficiently.

Topic Wise Short Questions (Additional)

Computer Network & Its Types

Q.1 What is Computer Network? 09506013

Ans. A computer network is a system of linked devices and computers that may exchange data and operate together. Networks can range from small, Local Area Network (LANs, Local Area Networks) to large area network, WANs, including the Internet.

Q.2 What are the Primary Components of Computer Network? 09506014

Ans. Following are the primary components:

* **Nodes**
* **Links**
* **Switches**
* **Routers**

Q.3 Describe the role of nodes in networking. 09506015

Ans. Devices that are connected to the network, such as computers, smartphones, and printers. Nodes play an important role in many areas of computer science, including data structures, computer networks, neural networks, and blockchain systems.

Q.4 Define the purpose of using Switches.

09506016

Ans. Devices that connect multiple nodes within a network to forward data. In computer networks, switches serve as central devices that receive data packets from linked devices and intelligently transfer them to their intended destination, improving network efficiency and minimizing traffic congestion.

Q.5 What are the objectives of Computer Networks? 09506017

Ans. The primary objective of computer network is to enable resource sharing, data communication and collaboration:

* **Resource Sharing**
* **Data Communication**
* **Connectivity and Collaboration**

Q.6 Define Protocol.

Ans. A protocol is a formal agreement between two parties. A network protocol is a formal arrangement between two computers to send and receive information.

Q.7 What is the role of transmission medium? 09506018

Ans. Transmission Media is the channel or path through which the data or information is transferred from one place to another in a computer network. Some examples of transmission media are coaxial cable, fiber optic cable, microwaves, etc.

Q.8 Explain Router. 09506019

Ans. A router is a networking device that interconnects networks or allows devices to connect to it. It directs data packets between different networks. Think of it as a traffic director on the internet, making sure that data gets from one place to another efficiently.

Q.9 What do you know about SIM Card? 09506020

Ans. SIM stands for **Subscriber Identity Module**. It is a small card inserted into a mobile device that contains unique information to identify and authenticate the subscriber on a mobile network.

Q.10 How Access Point Works? 09506021

Ans. An access point works by receiving data from the wired network and transmitting it wirelessly to your devices. It also receives data from your wireless devices and sends it to the wired network.

Q.11 Define Network Topology. 09506022

Ans. Topology of a network is a geometric representation of the relationship among the interconnected devices.

Types: Four types of network topologies are:
- **Bus topology**
- **Ring topology**
- **Star topology**
- **Mesh topology**

Q.12 How many Data Transmission Modes are available? 09506023

Ans. Network communication modes describe how data is transmitted between devices. There are three primary modes: **Simplex, Half-Duplex, and Full-Duplex.**

Q.13 Define OSI model. 09506024

Ans. The Open Systems Interconnection (OSI) Model is a framework used to understand how different networking protocols interact. It has 7 layers, each with a specific function.

Q.14 What the 7 Layers of OSI model? 09506025

Ans. Here is the list of 7 layers of OSI model:
- **Physical Layer**
- **Data Link Layer**
- **Network Layer**
- **Transport Layer**
- **Session Layer**
- **Presentation Layer**
- **Application Layer**

Q.15 Define Internet Protocol. 09506026

Ans. IP stands for Internet Protocol. It is a method of identifying each computer on the internet. All IP addresses are unique. Each device gets its own unique IP address when its gets connected to the Internet.

Q.16 Why Firewall is applied? 09506027

Ans. Firewalls are security systems that monitor and control incoming and outgoing network traffic based on predetermined security rules. Firewalls act as barriers between trusted internal networks and untrusted external networks, like a security checkpoint.

Q.17 Write the role of applying Encryption & Decryption. 09506028

Ans. Encryption transforms data into a secure format that can only be read or understood by authorized parties with the correct decryption key. Decryption is the process of converting the encrypted data back to its original form.

Q.18 Differentiate Between Malware and Phishing. 09506029

Ans. Malware: Malicious software such as viruses, worms, and ransomware that can damage or steal data.

Phishing: Attempts to trick users into revealing sensitive information through deceptive emails or websites.

Q.19 What is Personal Area Network (PAN)?　09506030

Ans. A PAN is a small network used for communication between personal devices, such as smartphones, tablets, and laptops, within a short range. **Example:** Bluetooth connections between a smartphone and a wireless headset form a PAN.

Q.20 What do you know about Campus Area Network (CAN)?　09506031

Ans. A CAN is a network that connects multiple LANs within a limited geographical area, such as a university campus or a business park.

Q.21 Give an Example of Campus Area Network (CAN).　09506032

Ans. The network that connects various departments and buildings within a university is a CAN.

Q. 22 What is network of networks?　09506033

OR What is internet?

Ans: Networks are connected together to make a larger network which is called network of networks or internet.

Network Topologies

Q.23 How bus topology work?　09506034

Ans: A computer sends a message on the bus. The computer to whom the message is sent receives it while others ignore it. At each end of bus a device called terminator is attached so that the signals do not bounce back on the bus causing errors.

Q.24 What is terminator or endpoints in Bus topology?　09506035

Ans: In bus topology all of the devices of the network are connected to a common transmission medium which has exactly two endpoints called terminator.

Q.25 What is backbone in bus topology?　09506036

Ans: A bus topology connects all devices of the network through a single common cable having exactly two end points. This cable is called backbone of the topology.

Q.26 What is unidirectional or bidirectional in ring topology?　09506037

Ans: A ring can be unidirectional or bidirectional

Unidirectional: In a unidirectional ring topology, data is sent either clockwise or anti clockwise.

Bidirectional: In a bidirectional ring topology, data can travel in any direction. Upon receiving data, a computer may pass data to its next neighbor.

Q.27 What are the advantages and disadvantages of star topology over bus topology?　09506038

Ans: Advantages

1. Star topology is more reliable and support large numbers of computers than bus topology.
2. It is easy to detect and fix errors than bus topology.

Disadvantages

1. Lengthy cable is required as compared to bus topology.
2. Star topology is expensive as compared to bus topology.

Q.28 What happens if failure of connection between two computers in ring topology?　09506039

Ans: In ring topology, a failure of connection between two computers may down the whole network.

Communication & Protocols

Q.29 What is data communication? Mention its components.　09506040

Ans: Data communication refers to exchange of messages between sending and receiving devices through some communication medium. Following are the main components of data communication.

- Sender
- Receiver
- Message
- Protocol
- Transmission Medium

Q.30 What is sender (transmitter) and receiver (sink)? 09506041

Ans: Sender: Sender is a device that initiates the communication process. It sends messages consisting of text, numbers, picture etc. It is also called transmitter.

Receiver: Receiver is a device that receives a message. It is also called sink. The receiver can be a computer, printer or another device.

Q.31 Define message and packets. 09506042

Ans: Message is the data or information to be communicated. It may consist of text, number, pictures, sound, video or any combination of these.

Packet: In networking, a packet is a small unit of data that is transferred across a network. It includes **Payload** (Actual Content) and **Control Information** (Address of sender and receiver).

Q.32 What is transport layer? 09506043

Ans: The Transport Layer ensures that data is transferred from one process running on source end system to a process souring on destination end system. It manages data flow control and error checking.

Q.33 What is Data Link Layer and physical layer? 09506044

Ans: Error detection and correction, as well as node-to-node data transport, are handled by the Data Link Layer. It ensures error-free data transmission from the physical layer.

Physical Layer: Physical layer is about the physical medium used in communication, like cabling etc.

Q.34 What is IPv4 addressing? 09506045

Ans: IPv4 address is a 32 bit numbers that uniquely identifies a network interface on a machine. When the Internet Protocol was originally designed, the standard was known as Internet Protocol Version 4 (IPv4). IPv4 is divided in four groups separated by '.'

Example: IPv4 address is like: 172.16.254.1

Q.35 Define IPv6 addressing. 09506046

Ans: IPv6 address is a 128 bits numbers that uniquely identifies a network interface on a machine. In IPv6, there are 8 groups separated by ':'

Topic Wise Multiple Choice Questions (Additional)

Choose the correct option.

Network Protocols

1. **Which device is used to connect multiple devices within a local area network (LAN) and direct data only to the intended recipient?** 09506047
   (a) Hub   (b) Switch
   (c) Router   (d) Repeater.

2. **Which protocol is used to transfer files over the Internet securely?** 09506048
   (a) FTP   (b) SFTP
   (c) HTTP   (d) SMTP

3. **Which layer of the OSI model is responsible for end-to-end communication and error handling?** 09506049
   (a) Network Layer
   (b) Transport Layer
   (c) Data Link Layer
   (d) Application Layer

4. **What type of network topology connects all devices to a single central hub?** 09506050
   (a) Mesh   (b) Bus
   (c) Star   (d) Ring

5. **Which protocol is used to convert domain names into IP addresses?** 09506051
   (a) DHCP   (b) DNS
   (c) IP   (d) ARP

6. **Which device connects two or more networks and routes data between them?** 09506052
   (a) Switch   (b) Router
   (c) Bridge   (d) Modem

7. **Which of the following is a protocol used for email transmission?** 09506053
   (a) SMTP   (b) SNMP
   (c) FTP   (d) DNS

8. **Which IP address class is used for large networks and supports up to 16 million hosts?** 09506054
   (a) Class A   (b) Class B
   (c) Class C   (d) Class D

9. **Which protocol is used to automatically assign IP addresses to devices on a network?** 09506055
   (a) DNS   (b) ARP
   (c) DHCP   (d) TCP

10. **Which type of network spans a large geographic area, such as a country or the world?** 09506056
    (a) LAN   (b) MAN
    (c) WAN   (d) PAN

11. **The IPv4 address is made up of _____ binary bits.** 09506057
    (a) 31   (b) 29
    (c) 32   (d) 30

12. **DHCP stands for:** 09506058
    (a) Data Hosting Computer Protocol
    (b) Dynamic Host Computer Protocol
    (c) Dynamic Host Configuration Protocol
    (d) None of the above

13. **Email stands for:** 09506059
    (a) Electronic Mail
    (b) Mail electronic
    (c) Center
    (d) Problem

14. **How many types of IP address?** 09506060
    (a) 2   (b) 3
    (c) 4   (d) 5

15. **Which is a device that initiates the communication process?** 09506061
    (a) Sender   (b) Center
    (c) Networks   (d) Machine

16. **_____ is a device that receives message. It is also known as sink.** 09506062
    (a) Receiver
    (b) Rules
    (c) Computer networks
    (d) Computers

Network Topologies

17. **Which is the physical arrangements of devices and connecting lines?** 09506063

18.
    (a) Procedure
    (b) Network topology
    (c) Computer
    (d) Network

18. **TCP/IP is a stack of protocols and it has _____ layers.** 09506064
    (a) 2   (b) 5
    (c) 7   (d) 9

19. **Which is used to transfer file over a network?** 09506065
    (a) HTML   (b) HTTP
    (c) FTP   (d) ALP

20. **Which of a network is a geometric representation of the relationship among the interconnected devices?** 09506066
    (a) ring   (b) Star
    (c) Topology   (d) Machine

21. **How many basic topologies?** 09506067
    (a) 1   (b) 2
    (c) 3   (d) 4

22. **Which topology connects all devices of the network through a single common cable having exactly two end points?** 09506068
    (a) Ring   (b) Bus
    (c) Topology   (d) Machine

23. **In bus topology single common cable is also called:** 09506069
    (a) Backbone   (b) Normal
    (c) Hard   (d) Simple

24. **In which topology connect all devices using point to point connections via cables to a central point is known as a Hub or Switch.** 09506070
    (a) Ring   (b) Star
    (c) Topology   (d) Machine

25. **In which topology connects a computer with exactly two other computers forming a ring of computers:** 09506071
    (a) Ring   (b) Star
    (c) Topology   (d) Machine

26. **In which topology a computer can send data to its immediate neighbor:** 09506072
    (a) Ring   (b) Star
    (c) Topology   (d) Machine

27. In which topology, data is sent either clockwise or anticlockwise: 09506073
    (a) Bus   (b) Star
    (c) Single   (d) Ring

28. In a ring topology, a ring can be unidirectional or_____. 09506074
    (a) Directional   (b) Bidirectional
    (c) Main   (d) Similar

29. Which layer sends a message to the server connected with sender? 09506075
    (a) Transport   (b) Data link
    (c) Physical layer   (d) Main

30. Which layer is about the physical medium used in communication, like cabling etc.? 09506076
    (a) Application layer
    (b) Postal layer
    (c) Physical
    (d) Internet

31. How many components of data communication? 0950607
    (a) 6   (b) 5
    (c) 7   (d) 8

IP Addressing

32. IPv4 is divided in _____ groups by '.' 0950607
    (a) 2   (b) 3
    (c) 4   (d) 5

33. In IPv4 each group can contain decimal value from: 0950607
    (a) 1 to 255   (b) 0 to 255
    (c) 2 to 255   (d) 3 to 255

34. IPv6 consists of: 0950608
    (a) 200 bits   (b) 300 bits
    (c) 128 bits   (d) 127 bits

35. In IPv6, there are _____ group separated by ':' 0950608
    (a) 1   (b) 2
    (c) 8   (d) 5

Answer Key

1	b	2	b	3	b	4	c	5	b	6	b	7	a	8	a	9	c	10	c
11	c	12	c	13	a	14	a	15	a	16	a	17	b	18	b	19	c	20	c
21	d	22	b	23	a	24	b	25	a	26	a	27	d	28	b	29	b	30	c
31	b	32	c	33	b	34	c	35	c												

Solved Exercise

Choose the correct option.

1. What is the primary objective of computer networks? 09506082
   (a) Increase computational
   (b) Enable resource sharing and data communication
   (c) Enhance graphic capabilities
   (d) Improve software development

2. Which device is used to connect multiple networks and direct data packets between them? 09506083
   (a) Switch   (b) Hub
   (c) Router   (d) Modem

3. Which layer of the OSI is responsible for node-to-node data transfer and error detection? 09506084
   (a) Physical Layer
   (b) Data Link Layer
   (c) Network Layer
   (d) Transport Layer

4. What is the function of the Domain Name System (DNS)? 09506085
   (a) Assign IP addresses dynamically
   (b) Translate domain names to IP addresses
   (c) Secure data communication
   (d) Monitor network traffic

5. Which method of data transmission uses a dedicated communication path? 0950608
   (a) Packet Switching
   (b) Circuit Switching
   (c) Full-Duplex
   (d) Half-Duplex

6. **What is encapsulation in the context of network communication?** 09506087

(a) Converting data into a secure format

(b) Wrapping data with protocol information

(c) Monitoring Network traffic

(d) Translating domain names to IP addresses

7. **Which protocol is used for reliable data transfer in the TCP/IP mode?** 09506088

(a) HTTP   (b) FTP

(c) TCP   (d) UDP

8. **What is the main purpose of a firewall in network security?** 09506089

(a) Convert data into a secure format

(b) Monitor and control network traffic

(c) Assign IP addresses

(d) Translate domain names

9. **Which network topology connects all devices to a central hub?** 09506090

(a) Ring   (b) Mesh

(c) Bus   (d) Star

10. **What is a key benefit of using computer networks in businesses?** 09506091

(a) Increase computational power

(b) Enable resource sharing and efficient communication

(c) Enhance graphic capabilities

(d) Improve software development

Answer Key

1	b	2	c	3	b	4	b	5	b	6	b	7	c	8	b	9	d	10	b

Short Question Answers

Q.1 Define data communication and list its key components. 09506092

Ans: See Short Question No. 29

Q.2 Explain the role of routers in a computer network. 09506093

Ans: See Short Question No. 8

Q.3 What are the main functions of the Network layer in the OSI model? 09506094

Ans: The Network Layer is responding for data transfer between different networks. It determines the best path for data to travel from the source to the destination.

Example: Imagine a GPS system finding the best route for you travel from home to school.

Q.4 Describe the difference between packet switching and circuit switching. 09506095

Ans. A technique of data transmission in which data is divided into individual packets that are delivered independently over the network, sometimes via various routes, and then reassembled at the destination. It is used for internet, email, and **VoIP (Voice over Internet Protocol)**

Q.5 What is the purpose of the Dynamic Host Configuration Protocol (DHCP)? 09506096

Ans. DHCP automatically assigns IP addresses to devices on a network, simplifying network management.

Example: When a device connects to a Wi-Fi networks, DHCP assigns it an IP address.

Q.6 How does encapsulation ensure secure communication in a network? 09506097

Ans. The actual content of message called payload, is hidden inside the header at each layer, this is called encapsulation.

Q.7 Differentiate between TCP and UDP in terms of data transfer reliability. 09506098

Ans. Transmission Control Protocol (TCP): Ensures reliable data transfer.

User Datagram Protocol (UDP): Provides faster, but less reliable, data transfer.

Q.8 Explain the importance of encryption in network security. 09506099

Ans: See Short Question No. 17

Q.9 What are the advantages using a star topology in a network security? 09506100

Ans: See Short Question No. 27

Q.10 How do firewalls contribute network security? 09506[...]

Ans: See Short Question No. 16

Long Question Answers

Q.1 Discuss the objectives of computer networks and provide examples of how they facilita[...] resource sharing and data communication. 09506[...]

Ans. Long Question No. 2

Q.2 In a Simplex Communication System, assume data is transmitted at a rate of 500 bi[...] per second (bps). Compute the time to transmit a message if: 09506[...]

Note: Time (seconds)=Data Rate (bps)/Message Size (bits)

(a) it is of 10 kilobits

Ans. 1 kilobit = 10^3, so 10 kilobits=10×10^3 =10,000 bits

Time=10,000 bits/500 bps=20 seconds

(b) it is of 10 kilobytes

Ans. 1 kilobyte = 8×10^3 bits (since 1 byte = 8 bits)

So, 10 kilobytes = $10 \times 8 \times 10^3$ = 80,000 bits.

Time=80,000 bits / 500 bps=160 seconds

Q.3 Describe how data is transmitted across computer networks using packet switching an[...] circuit switching. 09506104

Ans. Long Question No. 4

Q.4 Discuss the role and importance of protocols in data communication. Explain th[...] functions of key protocols such as TCP/IP, HTTP, DNS, and DHCP. 09506105

Ans. Long Question No. 9

Q.5 Evaluate different methods of network security, firewalls, encryption, and antiviru[...] software. 09506106

Ans. Long Question No. 10

Q.6 Describe real world applications of computer networks in business, education an[...] healthcare. 09506107

Ans. Long Question No. 12

Q.7 Compare and contrast the different types of network topologies (star, ring, bus and mesh). 09506108

Ans. Long Question No. 5

Q.8 Consider a shift cipher with a shift amount of 4. 09506109

(a) Encrypt the message "SECURITY"

Ans. The message is **"SECURITY"**. Encrypt each letter by shifting 4 positions forward:
Encrypted message: **"WIGYVMXC"**

Letter	Shifted by 4	Result
S	W	W
E	I	I
C	G	G
U	Y	Y

R	V	V
I	M	M
T	X	X
Y	C	C

(b) Decrypt the message "WMXYVMI"

Ans. The message is **"WMXYVMI"**. Decrypt each letter by shifting 4 positions backward:
Decrypted message: **"SITURIE"**

Letter	Shifted by 4	Result
W	S	S
M	I	I
X	T	T
Y	U	U
V	R	R
M	I	I
I	E	E

Q.9 An IPv4 address is a 32-bit number. Calculate the total number of unique IPv4 addresses possible.

09506110

(a) Show the calculation for the total number of IPv4 addresses

Ans. The total number of unique IPv4 addresses can be calculated as:
$2^{32} = 4,294,967,296$

Total unique IPv4 addresses: 4,294,967,296

(b) How many addresses are left if 10% of the total addresses are reserved for special purposes?

Ans. If 10% of the total IPv4 addresses are reserved for special purposes, then 90% of the addresses are available for use.

Reserved Addresses=10% × 4,294,967,296=0.1×4,294,967,296 = 429,496,729.6

The number of reserved addresses is approximately 429,496,730.

The remaining addresses are:

Remaining Addresses=4,294,967,296−429,496,730=3,865,470,566

Activities

Activity 1

09506111

Human Network Activity: Create a simple network using the students in the class. Assign roles like computer, router, and data packet. Use strings to represent Ethernet cables and have students pass a ball (representing data) along the strings to simulate how a router directs data.

Ans. Class Room Work \ Practical \Lab Work

Activity 2

09506112

Create a human network with students. Assign roles such as Access Point, Router, and Devices. Use ropes to represent connections. Show how data moves from the Access Point to the Router and then to another network.

Ans. Class Room Work \ Practical \Lab Work

Activity 3

Create a Star topology model using strings and paper cups to simulate the connections between a central switch and peripheral nodes.

Ans. Class Room Work \ Practical \Lab Work

Activity 4

Draw your own network diagram using one of the topologies and explain how data travels from one device to another.

Ans. Class Room Work \ Practical \Lab Work

Activity 5

Use walkie-talkies or toy telephones to demonstrate Half-Duplex communication. Let students take turns speaking and listening.

Ans. Class Room Work \ Practical \Lab Work

Activity 6

Draw a diagram of each communication mode and label the direction of data flow. Explain your diagrams to the class

Ans. Class Room Work \ Practical \Lab Work

Activity 7

Draw a simple network with devices and label the physical connections and data link layer responsibilities.

Ans. Class Room Work \ Practical \Lab Work

Activity 8

Role-play a phone call and discuss how the session is established, maintained, and terminated.

Ans. Class Room Work \ Practical \Lab Work

Activity 9

List the application you use daily and identify which rely on the Application Layer for network services.

Ans. Class Room Work \ Practical \Lab Work

Activity 10

Encrypt a simple message using a shift cipher with a key of 3 (each letter is shifted by 3 places in the alphabet). Then, exchange messages with a classmate and decrypt each other's message.

Ans. Class Room Work \ Practical \Lab Work

Activity 11

Discuss the importance of strong passwords and practice creating secure passwords using a password generator.

Ans. Class Room Work \ Practical \Lab Work

Activity 12

Draw a diagram of your school's computer network, labeling the different devices and connections.

Ans. Class Room Work \ Practical \Lab Work