NETWORK COMMUNICATION AND PROTOCOLS

CHAPTER 5

After completing this lesson, you will be able to:

UNIT INTRODUCTION

A network is a collection of computers or other devices called nodes that communicate with each other on a-shared network medium. This unit is dedicated to data communication over computer networks and the protocols that make it possible. It describes how computer network are created and what their advantages are. It introduces different types of computer network and network devices. It describes the purpose of having communication standards discusses OSI model that allows computers of different manufacturers to communicate with each other. The last section of this unit explains how IP addressing schemes identify a computer on Internet.

5.1 NETWORK COMMUNICATION

Q.1 What is computer network? Describe the need of network communication.

Answer

Computer Network

A computer network is an interconnection between two or more computers and/or other network devices so that they can communicate with each other to share network resources (both hardware and software). A network is made up of collection of computers and other network devices that allow information exchange to take place. While most networks connect computers using some form of cable, the connections can also be wireless, for example radio or microwave communication.

Simple Communication Network

A simple communication network having wired and wireless connections is shown in Fig.5.1.

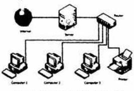


Fig.5.1 A Communication Network

Need of Network Communication

People use computer networks almost daily to conduct personal and professional business. This trend is accelerating as more people discover the power of computers and communication networks

both for businesses and for homes. The day-to-day transactions at departmental stores, banks, reservation counters and other businesses are all dependent upon computer networks.

5.1.1 BASIC NETWORK COMMUNICATION COMPONENTS

Q.2 Define data communication. Explain basic components of network communication.

Answer

Data Communication

Data communication is the process of transferring information from one point to another in a network environment.

Basic Components of Network Communication

Network communication consists of five basic components, as shown in Fig.5.2.

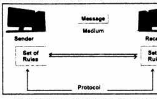


Fig.5.2 Components of Network Communication

- Sender
- Message
- Medium
- Receiver
- Protocol

1. Sender

Sender, also called transmitter is a computer/device that sends the message (data or information) from source to destination in a communication network. It may be a computer, workstation, cell phone or camera. The sender device converts the electrical signal into a form that is suitable for transmission over the communication network.

2. Message

Message is the data or information that is to be transmitted. Message can be in the form of text, audio, video, or any combination of these.

3. Medium

Medium is the path through which message travels from source to destination. Medium can be wired, for example, telephone cable, coaxial cable and fibre optics. It can also be wireless, for example Bluetooth, Wi-Fi, microwave, radio wave and satellite.

4. Receiver

Receiver is the device, which receives transmitted message. It can be a computer, workstation, telephone handset or television set. The data received from the transmission medium may not be in proper form to be accepted to the receiver and it must be converted to appropriate form before it is received.

5. Protocol

A protocol is a set of rules that governs data communications. It represents an agreement between the communicating devices. Without a protocol, two devices can be connected but may not communicate with each other.

5.1.2 MODES OF NETWORK COMMUNICATION

Q.3 Define modes of network communication. What are different modes of data communication?

Answer

Modes of network communication

Modes of network communication refer to the methods or the ways information is transmitted from one place to another.

Modes of Data Communication

The following are different modes of data communication:

- Simplex, Half-duplex and Full-duplex
- Synchronous and Asynchronous

1. Simplex, Half-duplex and Full-duplex communication modes

Q.4 Explain simplex, half-duplex and full-duplex of communication modes.

Answer

Simplex mode

In Simplex mode, the communication takes place in only one direction. In this mode, communication is unidirectional, i.e. the communication can only take place in one direction and it is not possible for the receiver to send data back.

Examples

i) Data being sent to an electronic notice board found in train stations and Airports.
ii) Radio and television broadcastings are also examples of simplex transmission.
iii) Transmission of information from a computer to a printer is also in one direction, as shown in Fig. 5.3.

Sender
Receiver

Fig 5.3 Simplex mode of data Communication

Half-duplex mode

In half-duplex mode, the communication takes place in both the directions but not at the same time. The signal can only be sent or received at one time.

Examples

i) A common example of this type of communication is the use of walkie-talkies, where each of the persons communicating must indicate when they have finished speaking.
ii) Half-duplex transmission is used also in transaction-oriented systems, for example, communication between a computer and credit card machine as shown in the Fig.5.4.

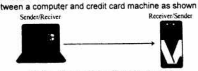


Fig.5.4 Half-duplex mode of data communication

Full-duplex mode

In full-duplex mode, the communication takes place in both the directions at the same time. In this mode, both sender and receiver can send and receive the data simultaneously, for example two or more computers connected to a network device such as a switch that provides full duplex activity. It is

the fastest bi-directional mode of communication. The full-duplex mode is like a two way street, with traffic flowing in both directions at the same time.

Examples

i) One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.
ii) Also full-duplex mode is the most suitable for data communication between computers as shown in Fig. 5.5.

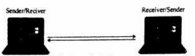


Fig.5.5 Full-duplex mode of data communication

2. Asynchronous and Synchronous Transmission

Q.5 Explain asynchronous transmission, synchronous transmission and their difference.

Answer

Transmitting Characters between Components

Asynchronous and Synchronous Transmissions are the two different methods, which are used for transmitting characters between components within a computer or from computer to other devices such as printer, modem, etc..

Asynchronous Transmission

In asynchronous transmission, the time interval between two characters is variable and not fixed as shown in Fig.5.6.

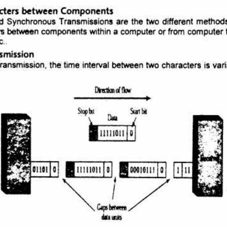


Fig.5.6 Asynchronous transmission

The computer devices can exchange information at their own rate, slow or fast. Start and Stop bits are used in asynchronous transmission. These bits provide timing (synchronization) for the connection between the sender and the receiver. The start bit tells the receiver that a character is coming and stop bit indicates that the transmission of character has ended. This type of transmission is ideal for slow-speed communication when gaps may occur during transmission.

Example

Example of asynchronous transmission is keyboard data transmission.

Synchronous Transmission

In synchronous transmission, the time internal between two characters is always the same as shown in Fig.5.6.

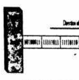


Fig.5.6 Synchronous transmission

In this method, two communicating devices are synchronized and they continue to send characters in order to remain synchronized, even if there is no data to be transmitted. A special "idle" character is sent when there is no data for transmission. It does not require transmission of start and stop bits. It sends data as one long bit stream or block of data and each bit is sent one after the other. The receiver counts the bits and reconstructs the sent information in bytes. It is essential that timing is maintained as there are no start and stop bits and no gaps. Accuracy is dependent on the receiver keeping an accurate count of the bits as they come in.

Example

The best example of synchronous transmission is the data transmission between devices in network communications links.

Synchronous VS Asynchronous

Synchronous transmission is faster than asynchronous because fewer bits have to be transmitted; i.e. only data bits and no extra control bits are sent.

5.1.3 COMMUNICATION MEDIA

Q.6 What is meant by communication media? Name the categories of communication media.

Answer

In network communication system, communication media are the links that provide paths communicating devices. Communication media is used to transmit data from one network (also called a node) to another.

Categories of Communication Media

There are two main categories of communication media:

- Guided Communication Media
- Unguided Communication Media

1. Guided Communication Media

Q.7 Describe guided communication media and its types in detail.

Answer

Guided Communication Media

Guided Communication Media is also called physical or bounded communication media. In this type of media, signals pass through a physical path. It uses cables that guide the data signals along a specific path.

Important Guided Media

Following are some important guided media:

- Standard Telephone Cable
- Twisted Pair Cable
- Coaxial Cable
- Fibre Optic Cable

1. Standard telephone cable

Standard telephone cable is widely used as communication lines. Telephone lines are particularly useful to the user of data communication because the complex network of lines that has already been

established allows data to be transmitted to any location in the world.

A telephone line is shown in Fig. 5.7 with four cables.

Fig.5.7 Telephone Line

Disadvantage of Telephone Line

The disadvantage of telephone line is that transmission speed is very slow. Therefore, its use for data communication is slowly declining.

2. Coaxial Cable

Coaxial Cable is mainly used for long distance transmission. It can transmit data at much higher rate of 10 to 100 megabits per second. Telephone companies also use them to transmit data over long distance.

Characteristics of Coaxial cables

Coaxial cables are packed into a very large cable that can handle hundreds of thousands of telephone calls at the same time. Coaxial cable provides high quality data transmission without distortion or loss of signal. Coaxial cables have been laid under the ocean. A coaxial cable is shown in Fig.5.8.

Fig.5.8 Coaxial cable

Both telephone line and coaxial cables are made up of copper.

3. Twisted Pair Cables

Twisted pair cables are twisted together in pairs. It provides shielding from outside interference. Cables with a shield are called Shielded Twisted Pair (STP) cables. Cables without shields are called Unshielded Twisted Pair (UTP) cables.

Twisted pair cables are shown in Fig.5.9.

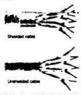


Fig. 5.9 Shielded and Unshielded Twisted Pair

4. Fibre Optic Cable

Fibre optic cable is new technology that is replacing the conventional cable in communication systems. Fibre optic cable is smooth hair-thin strands of transparent material that transmits light waves at high speed.

Fibre optic cables are shown in Fig.5.10.

Fig.5.10 Fibre optic cables

Main Advantage of Fibre Optic Cable

The main advantage of fibre optic cable over wire cables includes weight, size reduction and increased speed of transmission. Fibre optic cable is not affected by electromagnetic interference. Therefore, noise and distortion are reduced. Fibre optic cable can transmit both voice and digital data.

Q.8 Describe unguided communication media and name its types.

Answer

Unguided Media

Unguided Media is also called unbound media. In this type of communication media, transmission

takes place through open air. They are not guided through any specific path.

Important Unguided Media

The following are important unguided media:

- Microwave Transmission
- Communication Satellites

Q.9 Explain the types of unguided communication media.

Answer

Types of unguided communication are as follows:

1. Microwave Transmission

Microwave transmission signals travel through open space much like radio signals as shown in Fig.5.11.

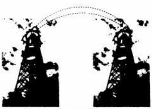


Fig.5.11 Microwave Transmission

Microwave systems transmit information with transmitters, which are normally installed on high buildings, mountains tops or high towers. Long distance microwave channels consist of a series of relay stations (boosters) spaced approximately 30 miles apart. Two stations must be within sight of one another. For transmitting information long distances, signals are amplified and retransmitted from station to station.

2. Satellites Communication

Satellite is a relay station positioned approximately 22,000 miles above the earth. It orbits around the earth with exactly the same speed as the rotation speed of earth. Earth stations beam signals to the satellite as shown in Fig.5.12.

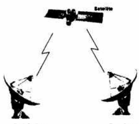


Fig.5.12 Satellite communication

The satellite amplifies and retransmits the signals to another earth station, which can be located thousands of miles away.

Ideal Communication

Satellite communication is ideal for long distance communication. Transmission by satellite allows large amount of data to be sent long distance at rapid speed. Its use has increased dramatically in

recent years.

Major Drawback of Satellite Communication

A major drawback of satellite communication is the high cost of placing the satellite into its orbit. These satellites are launched either by rockets or by space shuttles.

5.1.4 COMMUNICATION DEVICES

Q.10 What is meant by communication device? Explain its classification.

Answer

Communication Device

A device that is used in telecommunication systems for transmitting data from one location to another is known as communication device.

Classification of Communication Devices

Commonly used communication devices can be classified into following devices:

- Switches
- Routers
- Gateways

1. Switch

A switch or network switch (also known as hub) is a small hardware like a box that connects multiple computers together in a local area network (LAN).

A switch inspects data packets as they are received, determines the source and destination device of each packet and forwards them appropriately. A packet is a basic unit of communication over a computer network. When data is transmitted, it is broken down into packets, which are reassembled to the original form once they reach the destination.

Fig.5.13 8 Port Switch

Function of switch

Switches allow computers to communicate directly with one another in a smooth and efficient manner.

2. Router

A router is a communication device, which is used to connect two or more networks. Today, most of the networks are connected to Internet. When the computer is sending data to another computer on the Internet, router receives the data packets, looks for the remote computer address and forwards it to a computer that is closer to the remote computer. It forwards the data packets by selecting the best pathway based on network traffic. Many routers take part in transmitting the data packets from one location to another.

Fig.5.14 Wireless Router

A wireless router is shown in Fig.5.14.

3. Gateway

Gateway is a device that is used to connect a network to another network that uses different protocols. If we have to link different kinds of networks, such as a network of IBM mainframe computers and a network of PCs, we might have to use a gateway. Gateways change the format of the data packets but not the contents of the message, to make it confirm to the application program of the remote computer.

Fig.5.15 Gateway Device

5.1.5 NETWORK ARCHITECTURE

Q.11 Write a note on computer architecture.

Answer

Network Architecture

Network architecture is the design of a communication system. It includes hardware devices (such

as routers and switches), cabling, network topology and physical and wireless connections.

Computer networks consist of server computers and client computers.

Server Computer

A computer on the network that shares resources for others to use is called a server computer or simply server. Shared resources include information, software, printer, plotter, Internet connection, hard disk, etc..

Client Computer

A computer on the network that accesses resources that are shared by other computers is known as client computer or simply client.

Q.12 Explain the commonly used network architecture.

Answer

Commonly Used Network Architectures

The two commonly used network architectures are:

- Client/Server Network
- Peer-to-Peer Network

1. Client/Server Networks

A computer network in which each computer on the network acts as either a server or a client is called client/server or dedicated server network. Each server computer on the network is called a dedicated server. Servers are not used as client computers. Fig.5.16 illustrates how a dedicated server network may be designed.

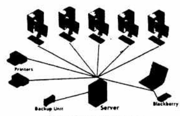


Fig.5.16 Client/Server Network

The computer at the top of the figure is the dedicated server, sharing files and applications. The remaining computers in the illustration are clients that access resources shared by the server. Similarly, in a dedicated server network, client computers never act as servers. Client/Server network includes one or more computers that are dedicated to acting as Servers. The servers are optimized to provide quick access to shared network resources. Servers also provide centralized security to ensure that unauthorized users do not access resources.

Because the client/server approach centralizes control of data and other shared resources, one person or group is typically responsible for administering the network.

2. Peer-to-Peer Networks

In Peer-to-Peer networks, every computer is capable of playing the role of client, server or both at the same time. In this network, each computer on the network is referred to as Peer. In a peer-to-peer network, a peer computer can act as both a server and a client at the same time. A peer computer on your desktop can share files and printers with other computers and it can simultaneously access other shared resources on the network.

A conceptual view of a peer-to-peer network is shown in Fig.5.17.

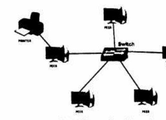


Fig.5.17 Peer-to-Peer Network

Peer-to-peer networks tend to be relatively small. Most of these networks fall to range between two and ten computers. Large peer-to-peer networks become difficult to manage, because so many network administrators control sharing and maintaining shared resources.

5.1.6 TYPES OF NETWORKS

Q.13 Explain each type of network based on the size and physical area.

Answer

Types of Networks Based on the Size and Physical Area

The following are different types of networks based on the size and physical area they cover:

- Local Area Network (LAN)
- Wide Area Network (WAN)
- Metropolitan Area Network (MAN)
- Virtual Private Network (VPN)

1. Local Area Networks

A Local Area Network (LAN) spans a limited physical area. It is confined to a single building or a group of buildings. LANs are used for sharing applications, printers, group scheduling, e-mail, project tracking and other tasks.

A LAN is shown in Fig.5.18.

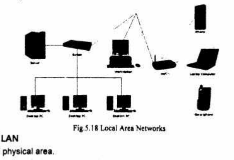


Fig.5.18 Local Area Networks

Characteristics of LAN

- Spans a small physical area.
- Uses high-speed wired/wireless connections between computers.
- It is a very reliable network. Communication errors are very rare.
- It consists of a limited number of computers.

2. Wide Area Networks

A Wide Area Network (WAN) spans a large physical area, connecting several sites of an

organization across cities, countries and continents. Because of the longer distances involved, WANs are sometimes referred to as long-haul networks. A WAN is often made up of two or more LANs connected together as shown in Fig.5.19.

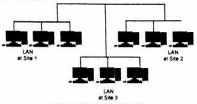


Fig.5.19 A Wide Area Network

Example

You might have a LAN at each site of your organization and each of those LANs might be connected together to form a WAN.

Characteristics of WAN

- Spans a large physical area. It can be worldwide like Internet.
- Communication speed is slow as compared to LAN.
- Connects computers through public networks, leased lines or satellites.
- Connects multiple LANs.
- Sometimes communication errors occur.

3. Metropolitan Area Network

Metropolitan Area Network (MAN) can span from several buildings or a large campus to entire cities. MAN is used by many organizations. It also connects a number of local area networks with high-speed communication lines.

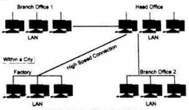


Fig.5.20 Metropolitan Area Network

Characteristics of MAN

- It is larger than a LAN and smaller than a WAN. Covers an area of between 5 to 50 km diameter.
- Uses fiber optic cable or microwave transmission.
- Provides high-speed communication.
- Used by telephone companies, Internet Service Providers (ISP) and cable TV companies.

4. Virtual Private Network

Virtual Private Network (VPN) is a computer network that provides remote access to individuals and offices to their organization's networks. It provides cheap communication by using public telecommunication infrastructure such as Internet instead of expensive leased lines. It allows employees at home or on trip to connect their laptops into the computer as office through public telecommunication networks and do their work.

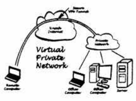


Fig.5.21 Virtual Private Network

Characteristics of VPN

- It uses public networks such as Internet to connect computers.
- Provides secure remote access.
- Enables files sharing, video conferencing and similar network services.
- Provides cheap communication over long distance.

5.1.7 NETWORK TOPOLOGIES

Q.14 Define network's topology and explain its each type in detail.

Answer

Network's Topology

The arrangement of network nodes and connections between them is called the network's topology. A node represents any device on the network. Topology is simply a map of the layout of nodes and connections in the network.

Types of topology

Four network topologies are popular today, which are as follows:

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

1. Star Topology

In a star network topology, each network node is connected to a central device called a hub. Large networks can require many hubs and hubs can be connected to each other to create a single large network. Star network topology is shown in Fig.5.22.

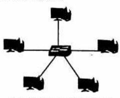


Fig. 5.22 Star network topology

Features of Star Topology

- It is suitable for both small and large networks.
- Easy to install and wire.

- Easy to detect and remove faults.
- Failure of cable does not stop functioning of the entire network.

Limitations of Star Topology

- Failure of the hub causes the entire network to go down.
- Expensive topology to implement. Lengthy cable with a hub is required to install star topology

2. Ring Topology

Ring topology is shaped just like a ring. It is made up of an unbroken circle of network nodes. Ring network topology is shown in Fig.5.23.

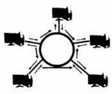


Fig.5.23 Ring network topology

Features of Ring Topology

- Each node is directly connected to the ring.
- Easy to install and wire.
- Data on the network flows in one direction.
- Not costly to implement.

Limitations of Ring Topology

- If the ring is broken at any point, the entire network stops functioning.
- Slower than other network topologies.

3. Bus Topology

Bus network topology connects each node to the network along a single piece of cable, called a bus. Bus network topology is shown in Fig.5.24.

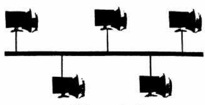


Fig.5.24 Bus network topology

Features of Bus Topology

- Suitable for a small network.
- Easy to connect a computer or a peripheral device to the network.
- Requires less cable to implement.
- Terminator is installed at each end of the cable to prevent signals from reflecting back onto the bus and cause errors. Terminator is a device that is attached to ground.

Limitations of Bus Topology

- If the single cable is severed at any point, the entire network can go down.
- Difficult to identify the problem if the entire network goes down.
- Not suitable for large network.

4. Mesh Topology

In mesh topology, each node is directly connected to all the nodes as shown in Fig.5.25.

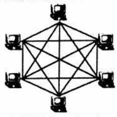


Fig.5.25 Mesh network topology

Features of Mesh Topology

- Most reliable network topology.
- Data can be routed around failed computers or busy ones.
- Can manage high traffic.

Limitations of Mesh Topology

- Most expensive topology to implement.
- Setup and maintenance is very difficult.

5.2 DATA COMMUNICATION STANDARDS

Q.15 What is meant by data communication standards?

Answer

Data Communication Standards

Data communication standards refer to hardware and software specifications that make communication between different computer systems possible.

5.2.1 PURPOSE OF COMMUNICATION STANDARDS

Q.16 Define communication standards and their need.

Answer

Communication Standards

Any computer or device in the network can communicate with any other computer or device by following some rules. These rules are called communication standards.

Need of Communication Standards

Communication standards are needed so that different computer networks can communicate with each other.

5.2.2 OSI MODEL

Q.17 Define OSI model. Explain its layers.

Answer

Open Systems Interconnection (OSI) model

The International Standards Organization (ISO) based in Geneva, developed standards for

---

international and national data communications. In the early 1970s, ISO developed a standard model of a data communication system and called it the Open Systems Interconnection (OSI) model.

Layers of OSI model

The OSI model consists of seven layers. Each layer performs a specific task during data communication.

Control in OSI model

In OSI model, control is passed from one layer to the next, starting at the application layer in one station and proceeding to the bottom layer (the physical layer), over the physical link to the next station and back up to the application layer. This process is shown in Fig.5.26.

The seven layers of OSI model are described below.

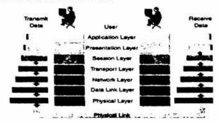


Fig.5.26 Layers of OSI Model

Layer 7 - Application Layer

Application Layer provides services to end-user. It interacts with the operating system or application software whenever the user wants to send files, read messages or perform other network related activities.

Layer 6 - Presentation Layer

Presentation Layer takes the data provided by the Application Layer and converts it in a standard format that the other layers can understand. At the receiving end, it also formats the information, so that it looks in such a way that a user can understand.

Layer 5 - Session Layer

Session Layer performs functions that enable two applications or two pieces of the same application to communicate across the network. It performs security, name recognition, logging and other similar functions. It also establishes, maintains and ends communication with the receiving computer.

Layer 4 - Transport Layer

Transport Layer establishes connections between two computers on the network, handles quality control by making sure that the data received is in the right format and the right order.

Layer 3 - Network Layer

Network Layer decides which physical path-way the data should take to reach the destination.

Layer 2 - Data Link Layer

Data Link Layer defines the format of data on the network. This layer converts the data into packets and checks them before putting them on the pathway.

Layer 1 - Physical Layer

Physical Layer defines cables and signalling. It provides hardware means such as cables and connectors for sending and receiving data.

5.2.3 PROTOCOLS AND DEVICES USED AT VARIOUS LAYERS OF OSI MODEL

Q.18 Define protocol and draw a table of those protocols which are used in OSI layers.

Answer

Protocol

A protocol is a set of rules and conventions that govern how computers exchange information over a network medium. A protocol implements the functions of one or more of the OSI layers as shown in Table 5.1.

Layers of OSI Model	Protocol Name	Protocol Function	Device Used
Physical Layer	X.25 & IEEE 802	Provides hardware such as cables and connectors for sending and receiving data.	Cables and Connectors
Data Link Layer	X.25 & IEEE 802	Places data packets on to the path-way for transmission.	Switches & NICs
Network Layer	Internet Protocol	Controls routing and forwarding of data between the source and destination.	Router
Transport Layer	TCP	Transfers data between source and destination and is responsible for error recovery and flow control.	Router and Gateway
Session Layer	NetBIOS	Starts and stops communication sessions between applications.	Gateway
Presentation Layer	Windows O.S.	Converts data into a format that can be carried by the lower layer or converts data into a form that the application layer can understand at the receiving end.	Gateway
Application Layer	HTTP	Provides interaction between the end user and software	Gateway

Table 5.1 Protocols and devices of OSI Model

5.3 TCP/IP

Q.19 Write a note on TCP/IP.

Answer

TCP/IP

TCP/IP was developed by Department of Defence in USA. It is used on the largest network, the Internet but is available in all the small and big computers. The most important capability of TCP/IP is that it provides communication between two or more computer systems used for communication over the Internet.

5.3.1 TCP/IP PROTOCOL

Q.20 What is meant by internet protocol suite? State the architecture of TCP/IP protocol.

Answer

Internet Protocol Suite

Internet Protocol Suite is a set of communication protocols used on Internet and many other computer networks. It is commonly known as TCP/IP protocol because its most important protocols are Transmission Control Protocol (TCP) and Internet Protocol (IP).

Architecture of TCP/IP Protocol

The architecture of TCP/IP protocol describes the function of its each layer during communication

between computers on the Internet.

Q.21 State the term "IP address"

Answer

IP address

Every computer on Internet has a unique number assigned to it called the IP address. The IP address recognizes a particular computer out of millions of computers connected to the Internet.

Q.22 How many layers of TCP/IP architecture are there?

Answer

Layers of TCP/IP Architecture

TCP/IP protocol architecture has four layers that transmit information from one computer to another over the Internet. These layers pass information from the application layer to the physical network layer. The four layers of TCP/IP protocol architecture are:

- Application Layer
- Transport Layer
- Network Layer
- Network Access Layer

Q.23 Describe the role of TCP/IP ports and applications.

Answer

TCP/IP Ports and Applications

When an application on the computer sends or receives data over the Internet, it sends data to an IP address and a specific port on the remote computer and also receives the data on a port on the receiving computer. There are a total number of 65,535 TCP/IP. The Internet Assigned Numbers Authority (IANA) is a global organization that is responsible for registration of port numbers for common Internet services.

5.3.2 TCP/IP AND OSI MODEL COMPARISON

Q.24 Compare TCP/IP and OSI model.

Answer

OSI model has seven layers, whereas, TCP/IP model has only four layers. Some layers of TCP/IP model represent more than one layer of OSI model as shown in Fig.5.27.

Each individual protocol used in TCP/IP works on a different layer. For example, TCP is a protocol that works on Transport Layer and IP is a protocol that works on the Network Layer. Comparison between TCP/IP Model and OSI Model is shown in Fig.5.27.

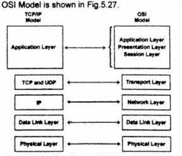


Fig.5.27 Comparison between TCP/IP and OSI Models

5.3.3 CIRCUIT SWITCHING AND PACKET SWITCHING NETWORKS

Q.25 Define and explain circuit switching network and packet switching network.

Answer

Circuit Switching Network

In circuit switching network, a physical connection must be established through the network. The data is transmitted through several switches. When transmitting data over a circuit switched network, a connection is established and kept open for the duration of communication. The circuit switched networks require dedicated point-to-point connection between the subscribers and no other network traffic can use the communication line. It provides a fixed data rate for both transmission and reception.

Example

An example of circuit switched network is the telephone network.

Packet Switching Network

In packet switching network, no physical connection is established between the two subscribers like circuit switching network. All the data that is to be transmitted is broken down into small blocks called packets. These packets include both the source and destination address. The source computer passes them to its local Packet Switching Exchange (PSE). On receipt of each packet, the PSE first stores the packet and then inspects the destination address it contains. Each PSE contains a routing directory specifying the outgoing links transmission paths to be used for each network address. The PSE forwards the packet on the appropriate link. When received, packets are reassembled in the proper sequence to make up the message.

5.3.4 ADDRESSING SCHEMES

Q.26 Describe the parts and composition of IP address.

Answer

All the computers in a network must have a unique IP address to communicate with each other.

Parts of IP addresses

IP addresses have two parts:

1. The first part identifies the network to which the computers are connected.
2. The second part identifies the computers on the given network.

Network Number	Computer Number

Network Number and Computer Number

All the computers on a given network share the same network number but must have a unique computer number. Similarly, any two computers on different networks must have different network number but may have the same computer number.

Octet

An IP address is made up of 32 bits. The 32-bits are broken down into four octets. One octet is equal to 8 bits. Each octet is converted to decimal and separated by a dot. Therefore, an IP address is expressed in dotted-decimal format.

Example

Fig.5.14 shows a Class B internet address that is expressed in dotted-decimal notation.

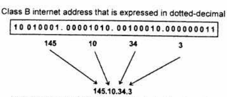


Fig.5.14 An Internet Address expressed in decimal-dotted notation

Q.27 Explain IP addresses classes.

Answer

IP addresses Classes

IP addresses are divided into three address classes (categories or groups), which are as follows:

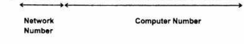
- Class A
- Class B
- Class C

Reason of IP Addresses Classes

The reason for doing so is to provide flexibility to support networks of different sizes.

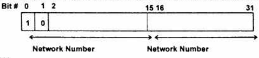
1. **Class A Address**

Class A address starts with "0" as the most significant bit and next seven bits identify the network number. The remaining 24 bits are used to identify a computer number. Therefore, with class A, there can be 224 computers.



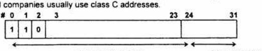
2. **Class B Address**

Class B address starts with "10" as the most significant bits and the next 14 bits identify the network number. The remaining right most 16 bits are used to identify more than 65000 computers.



3. **Class C address**

Class C address starts with "110" as the most significant bits and the next 21 bits identify the network number. The remaining 8 right most bits identify the 256 computers on each 221 possible networks. Small companies usually use class C addresses.



* It is important to note that the bits that identify the network class are also part of network number.

Q.28 Define subnet mask. Explain with the help of an example.

Answer

Subnet Mask

The purpose of using network mask is to know which portion of the IP address identifies the network and which portion identifies the computer number. Class A, B and C networks have default masks as shown below:

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

Explanation

Suppose an IP address is 192.168.123.132. In binary notation:

192 = 11000000

168 = 10101000
123 = 01111011
32 = 10000100

Therefore, the IP address 192.168.123.132 in binary is equal to:

11000000.10101000.01111011.10000100

As an example, suppose the 32-bit subnet mask is 255.255.255.0, which is the default mask of Class C network.

The decimal number 255 in binary is equal to 11111111, so the subnet mask 255.255.255.0 in binary is:

11111111.11111111.11111111.00000000

To separate the network number and the computer number of IP address, 192.168.123.132, we line up the IP address and the subnet mask.

11000000.10101000.01111011.10000100 IP address (192.168.123.132)
11111111.11111111.11111111.00000000 Subnet mask (255.255.255.0)

The first 24 bits, the number of ones in the subnet mask identify the network number and the last 8 bits, the number of zeros identify the computer number. This gives the following.

11000000.10101000.01111011.00000000 Network No. (192.168.123.0)
00000000.00000000.00000000.10000100 Computer No. (0.0.0.132)

KEY POINTS

- A computer network is an interconnection between two or more computers so that they can communicate with each other.
- Data communication consists of three basic components, which are Sender, Medium and Receiver.
- Modes of data communication refer to the method or way information is transmitted from one place to another. There are three types of data communication modes, which are simplex, half-duplex and full-duplex.
- In asynchronous transmission, the time interval between two characters is not fixed, whereas, in synchronous transmission it is fixed.
- Guided transmission media uses cables that guide the data signals along a specific path.
- Unguided transmission media transmits data signals through open air.
- A communication satellite is a relay station in the space that receives signals from ground antennas, amplifies them and then retransmits to another earth station, which can be thousands of miles away.
- A Switch is a small device that connects multiple computers together in a LAN.
- A Router is a device that receives data packets and forwards them to a computer that is closer to the remote computer by selecting the best path-way based on network traffic.
- A Gateway is a device that is used to connect a network to another network that uses different protocols.
- A computer network in which each computer on the network acts as either a server or client is called is Client/Server Network.
- A computer network in which every computer is capable of playing the role of client, server or both at the same time is called Peer-to-Peer Network.
- A network that spans a limited physical area such as a building or a group of buildings called Local Area Network (LAN).
- A network that spans large physical area, connecting several sites of an organization across cities, countries and continents is called Wide Area Network (WAN).
- A network that spans from several building or a large campus to entire city is called Metropolitan Area Network (MAN).

- A network that provides remote access to individuals and offices to their organization network using public telecommunication infrastructure such as Internet is called Virtual Private Network (VPN).
- The arrangement of network nodes and connections between them is called network topology.
- The OSI Model was designed to facilitate creating system in which equipment from different venders can communicate with each other.
- TCP/IP was developed by Department of Defense, USA, to implement Transmission Control Protocol and Internet Protocol. It provides communication between two or more different computer systems.
- In a circuit switched network, a physical connection is established through the network for transmitting data.
- In a packet switched network, all the data that is to be transmitted is broken down into small blocks called packets. These packets are passed from the source computer to the destination computer through several Packet Switching Exchanges.
- IP addressing schemes are used in computer networks to identify a computer for communication.

EXERCISE

Q.1 Select the best answer for the following MCQs.

i. **In which communication mode data can be sent and received in both directions but not simultaneously?**
A. Simplex mode B. Half-duplex mode
C. Full-duplex mode D. Synchronous transmission

ii. **Which of the following network devices connects a network to another network that uses different protocol?**
A. Switch B. Gateway C. Router D. Modem

iii. **Which of the following networks provides remote access to individuals and offices to their organization's network?**
A. LAN B. WAN C. MAN D. VPN

iv. **In which topology a hub (switch) is used?**
A. Star topology B. Ring topology C. Bus topology D. Mesh topology

v. **Which topology is most expensive to implement?**
A. Star topology B. Ring topology C. Bus topology D. Mesh topology

vi. **Which layer of OSI Model decides which physical path-way the data should take to reach the destination?**
A. Data link layer B. Network layer C. Transport layer D. Session layer

vii. **Which network layer performs security, name recognition, logging and similar functions?**
A. Transport layer B. Network layer
C. Presentation layer D. Session layer

viii. **Which of these cables transmits data using light waves?**
A. Twisted pair cable B. Coaxial cable C. Fibre optic cable D. Telephone line

ix. **Which of these uses a start/stop bit for data transmission?**
A. Asynchronous transmission B. Synchronous transmission
C. Half-duplex transmission D. Full-duplex transmission

x. **Which bits are used at the start of a Class B IP address?**
A. 0 B. 10 C. 101 D. 110

- A network that provides remote access to individuals and offices to their organization network using public telecommunication infrastructure such as Internet is called Virtual Private Network (VPN).
- The arrangement of network nodes and connections between them is called network topology.
- The OSI Model was designed to facilitate creating system in which equipment from different venders can communicate with each other.
- TCP/IP was developed by Department of Defense, USA, to implement Transmission Control Protocol and Internet Protocol. It provides communication between two or more different computer systems.
- In a circuit switched network, a physical connection is established through the network for transmitting data.
- In a packet switched network, all the data that is to be transmitted is broken down into small blocks called packets. These packets are passed from the source computer to the destination computer through several Packet Switching Exchanges.
- IP addressing schemes are used in computer networks to identify a computer for communication.

EXERCISE

Q.1 Select the best answer for the following MCQs.

i. **In which communication mode data can be sent and received in both directions but not simultaneously?**
A. Simplex mode B. Half-duplex mode
C. Full-duplex mode D. Synchronous transmission

ii. **Which of the following network devices connects a network to another network that uses different protocol?**
A. Switch B. Gateway C. Router D. Modem

iii. **Which of the following networks provides remote access to individuals and offices to their organization's network?**
A. LAN B. WAN C. MAN D. VPN

iv. **In which topology a hub (switch) is used?**
A. Star topology B. Ring topology C. Bus topology D. Mesh topology

v. **Which topology is most expensive to implement?**
A. Star topology B. Ring topology C. Bus topology D. Mesh topology

vi. **Which layer of OSI Model decides which physical path-way the data should take to reach the destination?**
A. Data link layer B. Network layer C. Transport layer D. Session layer

vii. **Which network layer performs security, name recognition, logging and similar functions?**
A. Transport layer B. Network layer
C. Presentation layer D. Session layer

viii. **Which of these cables transmits data using light waves?**
A. Twisted pair cable B. Coaxial cable C. Fibre optic cable D. Telephone line

ix. **Which of these uses a start/stop bit for data transmission?**
A. Asynchronous transmission B. Synchronous transmission
C. Half-duplex transmission D. Full-duplex transmission

x. **Which bits are used at the start of a Class B IP address?**
A. 0 B. 10 C. 101 D. 110

Answers

i.	B	ii.	B	iii.	D	iv.	A	v.	D
vi.	B	vii.	D	viii.	C	ix.	A	x.	B

Q2. Write short answers of the following questions.

i. **Define computer network.**

Answer

Computer Network

A computer network is an interconnection between two or more computers and/or other network devices so that they can communicate with each other to share network resources (both hardware and software).

ii. **Define network communication and its basic components.**

Answer

Network Communication

In computer networks, networked computing devices exchange data and communicate with each other using a data link. This communication is called network communication.

Basic Components of Network Communication

Network communication consists of five basic components, which are given below:

- Sender
- Message
- Medium
- Receiver
- Protocol

iii. **Briefly describe the modes of network communication.**

Answer

Modes of network communication

Modes of network communication refer to the methods or the ways information is transmitted from one place to another. The following are different modes of data communication:

- Simplex, Half-duplex and Full-duplex
- Synchronous and Asynchronous

Simplex mode

In Simplex mode, the communication takes place in only one direction. In this mode, communication is unidirectional, i.e. the communication can only take place in one direction and it is not possible for the receiver to send data back.

Half-duplex mode

In half-duplex mode, the communication takes place in both the directions but not at the same time. The signal can only be sent or received at one time.

Full-duplex mode

In full-duplex mode, the communication takes place in both the directions at the same time. In this mode, both sender and receiver can send and receive the data simultaneously. It is the fastest bi-directional mode of communication. The full-duplex mode is like a two way street, with traffic flowing in both directions at the same time.

Asynchronous Transmission

In asynchronous transmission, the time interval between two characters is variable and not fixed. The computer devices can exchange information at their own rate, slow or fast. Start and Stop bits are used in asynchronous transmission.

Synchronous Transmission

In synchronous transmission, the time internal between two characters is always the same. In this method, two communicating devices are synchronized and they continue to send characters in order to remain synchronized, even if there is no data to be transmitted.

iv. **Differentiate between asynchronous and synchronous network transmissions.**

Answer

Difference between asynchronous and synchronous network transmissions:

Asynchronous Transmission	Synchronous Transmission
In asynchronous transmission, the time interval between two characters is variable and not fixed. The computer devices can exchange information at their own rate, slow or fast. Start and Stop bits are used in asynchronous transmission.	In synchronous transmission, the time internal between two characters is always the same. In this method, two communicating devices are synchronized and they continue to send characters in order to remain synchronized, even if there is no data to be transmitted.

v. **Differentiate between server and client computers.**

Answer

Difference between server and client computers:

Server Computers	Client Computers
A computer on the network that shares resources for others to use is called a server computer or simply server.	A computer on the network that accesses resources that are shared by other computers is known as client computer or simply client.

vi. **Differentiate between LAN and WAN.**

Answer

Differences between LAN and WAN:

LAN	WAN
1. LAN is a computer network that connects computers in small areas.	1. WAN is a network that covers a broad area using private or public network transports. WAN is a network that covers a broad area using private or public network transports.
2. LAN offers high data transfer rates.	2. WAN has lower data transfer rates due to congestion.
3. LANs use technologies such as Ethernet and Token Ring to connect to other networks.	3. WAN uses technologies such as MPLS, ATM, Frame Relay and X.25 for data connection over greater distances.
4. Set-up costs are low as the devices required to set up the networks are cheap.	4. Set-up costs are high, especially in remote locations where set-up is not done. However, WANs using public networks are cheap.
5. Maintenance costs are low as the area coverage is small.	5. Maintenance costs are high as the area coverage is worldwide.

vii. **What is OSI Model?**

Answer

OSI Model

The International Standards Organization (ISO) based in Geneva, developed standards for international and national data communications. In the early 1970s, ISO developed a standard model of a data communication system and called it the Open Systems Interconnection (OSI) model.

viii. **Compare TCP/IP Model with OSI Model.**

Answer

Following are some major differences between OSI Reference Model and TCP/IP Reference Model:

OSI (Open Systems Interconnection)	TCP/IP(Transmission Control Protocol / Internet Protocol)
1. OSI is a generic, protocol independent standard, acting as a communication gateway between the network and end user.	1. TCP/IP model is based on standard protocols around which the Internet has developed. It is a communication protocol, which allows connection of hosts over a network.
2. In OSI model, the transport layer guarantees the delivery of packets.	2. In TCP/IP model, the transport layer does not guarantees delivery of packets. Still the TCP/IP model is more reliable.
3. Follows vertical approach.	3. Follows horizontal approach.
4. OSI model has a separate Presentation layer and Session layer.	4. TCP/IP does not have a separate Presentation layer or Session layer.
5. OSI is a reference model around which the networks are built. Generally, it is used as a guidance tool.	5. TCP/IP model is in a way implementation of the OSI model.
6. Network layer of OSI model provides both connection oriented and connectionless service.	6. Network layer TCP/IP model provides connectionless service.
7. OSI model has a problem of fitting the protocols into the model.	7. TCP/IP model does not fit in any protocol
8. Protocols are hidden in OSI model and are easily replaced as the technology changes.	8. In TCP/IP replacing protocol is not easy.
9. OSI model is protocol independent.	9. TCP/IP is protocol dependent.
10. It has 7 layers.	10. It has 4 layers.

ix. **Differentiate between circuit switched and packet switched networks.**

Answer

Difference between circuit switched and packet switched networks:

1. Circuit Switching is connection oriented that means a path is established between source and destination before the transmission occurs. On the other hand, Packet Switching is connectionless that means a dynamic route is decided for each packet while transmission.
2. Circuit Switching was originally designed for voice communication, whereas, Packet Switching was originally designed for data communication.
3. Circuit Switching is inflexible as once a path is established for transmission, it does not change during the duration of the session. On the other hand, Packet Switching is flexible as each packet may travel through a different route to reach its destination.
4. In circuit switching, the entire message is received as it is as sent from a sender to receiver. On the other hand, in packet switching, as each packet travels a different path hence, the packet are received out of order at the receiver side and later arranged in order.
5. Circuit Switching is always implemented at physical layer, whereas, Packet Switching is implemented on the network layer.

x. **Briefly describe IP Addressing.**

Answer

IP addressing

Every computer on Internet has a unique number assigned to it called the IP address. The IP address recognizes a particular computer out of millions of computers connected to the Internet.

Q3. Write long answers of the following questions.

i. **Explain different types of guided media.**

Answer

Guided Communication Media

Guided Communication Media is also called physical or bounded communication media. In this type of media, signals pass through a physical path. It uses cables that guide the data signals along a specific path.

Important Guided Media

Following are some important guided media:

- Standard Telephone Cable
- Twisted Pair Cable
- Coaxial Cable
- Fibre Optic Cable

1. Standard telephone cable

Standard telephone cable is widely used as communication lines. Telephone lines are particularly useful to the user of data communication because the complex network of lines that has already been established allows data to be transmitted to any location in the world.

Disadvantage of Telephone Line

The disadvantage of telephone line is that transmission speed is very slow. Therefore, its use for data communication is slowly declining.

A telephone line is shown in Fig. 5.7 with four cables.

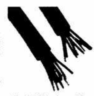


Fig.5.7 Telephone Line

2. Coaxial Cable

Coaxial Cable is mainly used for long distance transmission. It can transmit data at much higher rate of 10 to 100 megabits per second. Telephone companies also use them to transmit data over long distance.

Fig.5.8 Coaxial cable

Characteristics of Coaxial cables

Coaxial cables are packed into a very large cable that can handle hundreds of thousands of telephone calls at the same time. Coaxial cable provides high quality data transmission without distortion or loss of signal. Coaxial cables have been laid under the ocean. A coaxial cable is shown in Fig.5.8.

Both telephone line and coaxial cables are made up of copper.

3. Twisted Pair Cables

Twisted pair cables are twisted together in pairs. It provides shielding from outside interference. Cables with a shield are called Shielded Twisted Pair (STP) cables. Cables without shields are called Unshielded Twisted Pair (UTP) cables.

Twisted pair cables are shown in Fig.5.9.

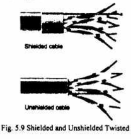


Fig. 5.9 Shielded and Unshielded Twisted Pair

4. Fibre Optic Cable

Fibre optic cable is new technology that is replacing the conventional cable in communication systems. Fibre optic cable is smooth hair-thin strands of transparent material that transmits light waves at high speed.

Fibre optic cables are shown in Fig.5.10.

Fig.5.10 Fibre optic cables

Main Advantage of Fibre Optic Cable

The main advantage of fibre optic cable over wire cables includes weight and size reduction and increased speed of transmission. Fibre optic cable is not affected by electromagnetic interference. Therefore, noise and distortion are reduced. Fibre optic cable can transmit both voice and digital data.

ii. **Explain microwave and satellite communications.**

Answer

Microwave Transmission

Microwave transmission signals travel through open space much like radio signals as shown in Fig.5.11.

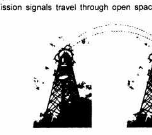


Fig.5.11 Microwave Transmission

Microwave systems transmit information with transmitters, which are normally installed on high buildings, mountains tops or high towers. Long distance microwave channels consist of a series of relay stations (boosters) spaced approximately 30 miles apart. Two stations must be within sight of one another. For transmitting information long distances, signals are amplified and retransmitted from station to station.

Satellites Communication

Satellite is a relay station positioned approximately 22,000 miles above the earth. It orbits around the earth with exactly the same speed as the rotation speed of earth. Earth stations beam signals to the satellite as shown in Fig.5.12.

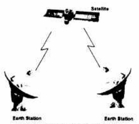


Fig.5.12 Satellite communication

The satellite amplifies and retransmits the signals to another earth station, which can be located

thousands of miles away.

Ideal Communication

Satellite communication is ideal for long distance communication. Transmission by satellite allows large amount of data to be sent long distance at rapid speeds. Its use has increased dramatically in recent years.

Major Drawback of Satellite Communication

A major drawback of satellite communication is the high cost of placing the satellite into its orbit. These satellites are launched either by rockets or by space shuttles.

iii. **Write notes on switch, router and gateway.**

Answer

Switch

A switch or network switch (also known as hub) is a small hardware like a box as that connects multiple computers together in a local area network (LAN).

A switch inspects data packets as they are received, determines the source and destination device of each packet and forwards them appropriately. A packet is a basic unit of communication over a computer network. When data is transmitted, it is broken down into packets, which are reassembled to the original form once they reach the destination.

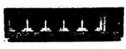


Fig.5.13 8 Port Switch

Function of switch

Switches allow computers to communicate directly with one another in a smooth and efficient manner.

Router

A router is a communication device, which is used to connect two or more networks. Today, most of the networks are connected to Internet. When the computer is sending data to another computer on the Internet, router receives the data packets, looks for the remote computer address and forwards it to a computer that is closer to the remote computer. It forwards the data packets by selecting the best pathway based on network traffic. Many routers take part in transmitting the data packets from one location to another.

A wireless router is shown in Fig.5.14.

Fig.5.14 Wireless Router

Gateway

Gateway is a device that is used to connect a network to another network that uses different protocols. If we have to link different kinds of networks, such as a network of IBM mainframe computers and a network of PCs, we might have to use a gateway. Gateways change the format of the data packets but not the contents of the message, to make it confirm to the application program of the remote computer.

Fig.5.15 Gateway Device

iv. **Explain in detail Client/Server and Peer-to-Peer networks.**

Answer

Client/Server Networks

A computer network in which each computer on the network acts as either a server or a client is called client/server or dedicated server network. Each server computer on the network is called a dedicated server. Servers are not used as client computers. Fig.5.16 illustrates how a Medicated server network may be designed.

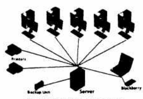


Fig.5.16 Client/Server Network

The computer at the top of the figure is the dedicated server, sharing files and applications. The remaining computers in the illustration are clients that access resources shared by the server. Similarly, in a dedicated server network, client computers never act as servers. Client/Server network includes one or more computers that are dedicated to acting as Servers. The servers are optimized to provide quick access to shared network resources. Servers also provide centralized security to ensure that unauthorized users do not access resources.

Because the client/server approach centralizes control of data and other shared resources, one person or group is typically responsible for administering the network.

Peer-to-Peer Networks

In Peer-to-Peer networks, every computer is capable of playing the role of client, server or both at the same time. In this network, each computer on the network is referred to as Peer. In a peer-to-peer network, a peer computer can act as both a server and a client at the same time. A peer computer on your desktop can share files and printers with other computers and it can simultaneously access other shared resources on the network.

A conceptual view of a peer-to-peer network is shown in Fig.5.17.

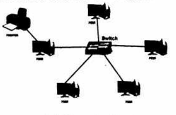


Fig.5.17 Peer-to-Peer Network

Peer-to-peer networks tend to be relatively small. Most of these networks fall to range between two and ten computers. Large peer-to-peer networks become difficult to manage, because so many network administrators control sharing and maintaining shared resources.

v. **Define network topology and explain its types.**

Answer

Network's Topology

The arrangement of network nodes and connections between them is called the network's topology. A node represents any device on the network. Topology is simply a map of the layout of nodes and connections in the network.

Types of topology

Four network topologies are popular today, which are as follows:

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

1. **Star Topology**

In a star network topology, each network node is connected to a central device called a hub. Large networks can require many hubs and hubs can be connected to each other to create a single large network. Star network topology is shown in Fig 5.22.

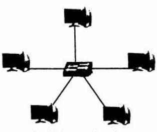


Fig. 5.22 Star network topology

Features of Star Topology

- It is suitable for both small and large networks.
  Easy to install and wire.
- Easy to detect and remove faults.
- Failure of cable does not stop functioning of the entire network.

Limitations of Star Topology

- Failure of the hub causes the entire network to go down.
- Expensive topology to implement. Lengthy cable with a hub is required to install star topology

2. **Ring Topology**

Ring topology is shaped just like a ring. It is made up of an unbroken circle of network nodes. Ring network topology is shown in Fig.5.23.

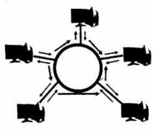


Fig.5.23 Ring network topology

Features of Ring Topology

- Each node is directly connected to the ring.
- Easy to install and wire.
- Data on the network flows in one direction.
- Not costly to implement.

Limitations of Ring Topology

- If the ring is broken at any point, the entire network stops functioning.

- Slower than other network topologies.

3. **Bus Topology**

Bus network topology connects each node to the network along a single piece of cable, called a bus. Bus network topology is shown in Fig.5.24.

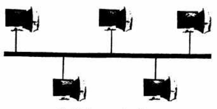


Fig.5.24 Bus network topology

Features of Bus Topology

- Suitable for a small network.
- Easy to connect a computer or a peripheral device to the network.
- Requires less cable to implement.
- Terminator is installed at each end of the cable to prevent signals from reflecting back onto the bus and cause errors. Terminator is a device that is attached to ground.

Limitations of Bus Topology

- If the single cable is severed at any point, the entire network can go down.
- Difficult to identify the problem if the entire network goes down.
- Not suitable for large network.

4. **Mesh Topology**

In mesh topology, each node is directly connected to all the nodes as shown in Fig.5.25.

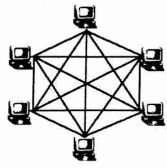


Fig.5.25 Mesh network topology

Features of Mesh Topology

- ➢ Most reliable network topology.
- ➢ Data can be routed around failed computers or busy ones.
- ➢ Can manage high traffic.

Limitations of Mesh Topology

- ➢ Most expensive topology to implement.

Setup and maintenance is very difficult.

vi. Describe briefly the seven layers of OSI Model.

Answer

Layers of OSI model

The OSI model consists of seven layers. Each layer performs a specific task during data communication. In OSI model, control is passed from one layer to the next, starting at the application layer in one station and proceeding to the bottom layer (the physical layer), over the physical link to the next station and back up to the application layer. This process is shown in Fig.5.26.

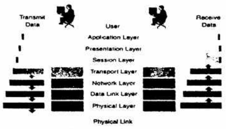


Fig.5.26 Layers of OSI Model

The seven layers of OSI model are described below.

Layer 7 - Application Layer

Application Layer provides services to end-user. It interacts with the operating system or application software whenever the user wants to send files, read messages or perform other network related activities.

Layer 6 - Presentation Layer

Presentation Layer takes the data provided by the Application Layer and converts it in a standard format that the other layers can understand. At the receiving end, it also formats the information, so that it looks in such a way that a user can understand.

Layer 5 - Session Layer

Session Layer performs functions that enable two applications or two pieces of the same application to communicate across the network. It performs security, name recognition, logging and other similar functions. It also establishes, maintains and ends communication with the receiving computer.

Layer 4 - Transport Layer

Transport Layer establishes connections between two computers on the network, handles quality control by making sure that the data received is in the right format and the right order.

Layer 3 - Network Layer

Network Layer decides which physical path-way the data should take to reach the destination.

Layer 2 - Data Link Layer

Data Link Layer defines the format of data on the network. This layer converts the data into packets and checks them before putting them on the pathway.

Layer 1 - Physical Layer

Physical Layer defines cables and signaling. It provides hardware means such as cables and connectors for sending and receiving data.

vii. Describe the four layers of TCP/IP Model.

Answer

TCP/IP means Transmission Control Protocol and Internet Protocol. It is the network model used in the current Internet architecture as well. Protocols are set of rules, which govern every possible communication over a network. These protocols describe the movement of data between the source and destination or the internet. These protocols offer simple naming and addressing schemes.

Layer 4 - Application Layer

Application layer is the top most layer of TCP/IP model. Application layer is present on the top of the Transport layer. Application layer defines TCP/IP application protocols and how host programs interface with Transport layer services to use the network. Application layer includes all the higher-level protocols like:

- ➢ DNS (Domain Naming System)
- ➢ HTTP (Hypertext Transfer Protocol)
- ➢ Telnet
- ➢ SSH (Secure Shell)
- ➢ FTP (File Transfer Protocol)
- ➢ TFTP (Trivial File Transfer Protocol)
- ➢ SNMP (Simple Network Management Protocol)
- ➢ SMTP (Simple Mail Transfer Protocol)
- ➢ DHCP (Dynamic Host Configuration Protocol)
- ➢ X Windows
- ➢ RDP (Remote Desktop Protocol)

Layer 3 - Transport Layer

Transport Layer is the third layer of the TCP/IP model. The position of the transport layer is between application layer and internet layer. The purpose of transport layer is to permit devices on the source and destination hosts to carry on a conversation. Transport layer defines the level of service and status of the connection used when transporting data.

The main protocols included at Transport layer are:

- ➢ TCP (Transmission Control Protocol)
- ➢ UDP (User Datagram Protocol)

Layer 2 - Internet Layer

Internet Layer is the second layer of the TCP/IP model. The position of Internet layer is between Network Access Layer and Transport layer. Internet layer pack data into data packets known as IP datagrams, which contain source and destination address (logical address or IP address) information that is used to forward the datagrams between hosts and across networks. The Internet layer is also responsible for routing of IP datagrams.

Packet switching network depends upon a connectionless internetwork layer. This layer is known as Internet layer. Its job is to allow hosts to insert packets into any network and have them to deliver independently to the destination. At the destination side data packets may appear in a different order than they were sent. It is the job of the higher layers to rearrange them in order to deliver them to proper network applications operating at the Application layer.

The main protocols included at Internet layer are:

- ➢ IP (Internet Protocol)
- ➢ ICMP (Internet Control Message Protocol)
- ➢ ARP (Address Resolution Protocol)
- ➢ RARP (Reverse Address Resolution Protocol)
- ➢ IGMP (Internet Group Management Protocol)

Layer 1 - Network Access Layer

Network Access Layer is the first layer of the TCP/IP model. Network Access Layer defines details of how data is physically sent through the network, including how bits are electrically or optically signaled by hardware devices that interface directly with a network medium, such as coaxial cable, optical fiber, or twisted pair copper wire.

The protocols included in Network Access Layer are:

- ➢ Ethernet
- ➢ Token Ring
- ➢ FDDI
- ➢ X.25
- ➢ Frame Relay

LAB ACTIVITIES

Following lab activities are to be carried out during the practical periods.

1) Client-Server and Peer-to-Peer networks should be demonstrated through video/animation.

Answer

Practical Work

2) Sharing of files/folders, printers and Internet connection should be demonstrated.

Answer

Practical Work

3) Use of switch and router is to be demonstrated.

Answer

Practical Work

4) Use of TCP/IP protocol and IP addressing is to be demonstrated through video/animation.

Answer

Practical Work

- A network that provides remote access to individuals and offices to their organization network using public telecommunication infrastructure such as Internet is called Virtual Private Network (VPN).
- The arrangement of network nodes and connections between them is called network topology.
- The OSI Model was designed to facilitate creating system in which equipment from different venders can communicate with each other.
- TCP/IP was developed by Department of Defense, USA, to implement Transmission Control Protocol and Internet Protocol. It provides communication between two or more different computer systems.
- In a circuit switched network, a physical connection is established through the network for transmitting data.
- In a packet switched network, all the data that is to be transmitted is broken down into small blocks called packets. These packets are passed from the source computer to the destination computer through several Packet Switching Exchanges.
- IP addressing schemes are used in computer networks to identify a computer for communication.

EXERCISE

Q.1 Select the best answer for the following MCQs.

i. **In which communication mode data can be sent and received in both directions but not simultaneously?**
A. Simplex mode B. Half-duplex mode
C. Full-duplex mode D. Synchronous transmission

ii. **Which of the following network devices connects a network to another network that uses different protocol?**
A. Switch B. Gateway C. Router D. Modem

iii. **Which of the following networks provides remote access to individuals and offices to their organization's network?**
A. LAN B. WAN C. MAN D. VPN

iv. **In which topology a hub (switch) is used?**
A. Star topology B. Ring topology C. Bus topology D. Mesh topology

v. **Which topology is most expensive to implement?**
A. Star topology B. Ring topology C. Bus topology D. Mesh topology

vi. **Which layer of OSI Model decides which physical path-way the data should take to reach the destination?**
A. Data link layer B. Network layer C. Transport layer D. Session layer

vii. **Which network layer performs security, name recognition, logging and similar functions?**
A. Transport layer B. Network layer
C. Presentation layer D. Session layer

viii. **Which of these cables transmits data using light waves?**
A. Twisted pair cable B. Coaxial cable C. Fibre optic cable D. Telephone line

ix. **Which of these uses a start/stop bit for data transmission?**
A. Asynchronous transmission B. Synchronous transmission
C. Half-duplex transmission D. Full-duplex transmission

x. **Which bits are used at the start of a Class B IP address?**
A. 0 B. 10 C. 101 D. 110

Answers

i.	B	ii.	B	iii.	D	iv.	A	v.	D
vi.	B	vii.	D	viii.	C	ix.	A	x.	B

Q2. Write short answers of the following questions.

i. **Define computer network.**

Answer

Computer Network

A computer network is an interconnection between two or more computers and/or other network devices so that they can communicate with each other to share network resources (both hardware and software).

ii. **Define network communication and its basic components.**

Answer

Network Communication

In computer networks, networked computing devices exchange data and communicate with each other using a data link. This communication is called network communication.

Basic Components of Network Communication

Network communication consists of five basic components, which are given below:

- Sender
- Message
- Medium
- Receiver
- Protocol

iii. **Briefly describe the modes of network communication.**

Answer

Modes of network communication

Modes of network communication refer to the methods or the ways information is transmitted from one place to another. The following are different modes of data communication:

- Simplex, Half-duplex and Full-duplex
- Synchronous and Asynchronous

Simplex mode

In Simplex mode, the communication takes place in only one direction. In this mode, communication is unidirectional, i.e. the communication can only take place in one direction and it is not possible for the receiver to send data back.

Half-duplex mode

In half-duplex mode, the communication takes place in both the directions but not at the same time. The signal can only be sent or received at one time.

Full-duplex mode

In full-duplex mode, the communication takes place in both the directions at the same time. In this mode, both sender and receiver can send and receive the data simultaneously. It is the fastest bi-directional mode of communication. The full-duplex mode is like a two way street, with traffic flowing in both directions at the same time.

Asynchronous Transmission

In asynchronous transmission, the time interval between two characters is variable and not fixed. The computer devices can exchange information at their own rate, slow or fast. Start and Stop bits are used in asynchronous transmission.

Synchronous Transmission

In synchronous transmission, the time internal between two characters is always the same. In this method, two communicating devices are synchronized and they continue to send characters in order to remain synchronized, even if there is no data to be transmitted.

iv. **Differentiate between asynchronous and synchronous network transmissions.**

Answer

Difference between asynchronous and synchronous network transmissions:

Asynchronous Transmission	Synchronous Transmission
In asynchronous transmission, the time interval between two characters is variable and not fixed. The computer devices can exchange information at their own rate, slow or fast. Start and Stop bits are used in asynchronous transmission.	In synchronous transmission, the time internal between two characters is always the same. In this method, two communicating devices are synchronized and they continue to send characters in order to remain synchronized, even if there is no data to be transmitted.

v. **Differentiate between server and client computers.**

Answer

Difference between server and client computers:

Server Computers	Client Computers
A computer on the network that shares resources for others to use is called a server computer or simply server.	A computer on the network that accesses resources that are shared by other computers is known as client computer or simply client.

vi. **Differentiate between LAN and WAN.**

Answer

Differences between LAN and WAN:

LAN	WAN
1. LAN is a computer network that connects computers in small areas.	1. WAN is a network that covers a broad area using private or public network transports. WAN is a network that covers a broad area using private or public network transports.
2. LAN offers high data transfer rates.	2. WAN has lower data transfer rates due to congestion.
3. LANs use technologies such as Ethernet and Token Ring to connect to other networks.	3. WAN uses technologies such as MPLS, ATM, Frame Relay and X.25 for data connection over greater distances.
4. Set-up costs are low as the devices required to set up the networks are cheap.	4. Set-up costs are high, especially in remote locations where set-up is not done. However, WANs using public networks are cheap.
5. Maintenance costs are low as the area coverage is small.	5. Maintenance costs are high as the area coverage is worldwide.

vii. **What is OSI Model?**

Answer

OSI Model

The International Standards Organization (ISO) based in Geneva, developed standards for international and national data communications. In the early 1970s, ISO developed a standard model of a data communication system and called it the Open Systems Interconnection (OSI) model.

viii. **Compare TCP/IP Model with OSI Model.**

Answer

Following are some major differences between OSI Reference Model and TCP/IP Reference Model:

OSI (Open Systems Interconnection)	TCP/IP(Transmission Control Protocol / Internet Protocol)
1. OSI is a generic, protocol independent standard, acting as a communication gateway between the network and end user.	1. TCP/IP model is based on standard protocols around which the Internet has developed. It is a communication protocol, which allows connection of hosts over a network.
2. In OSI model, the transport layer guarantees the delivery of packets.	2. In TCP/IP model, the transport layer does not guarantees delivery of packets. Still the TCP/IP model is more reliable.
3. Follows vertical approach.	3. Follows horizontal approach.
4. OSI model has a separate Presentation layer and Session layer.	4. TCP/IP does not have a separate Presentation layer or Session layer.
5. OSI is a reference model around which the networks are built. Generally, it is used as a guidance tool.	5. TCP/IP model is in a way implementation of the OSI model.
6. Network layer of OSI model provides both connection oriented and connectionless service.	6. Network layer TCP/IP model provides connectionless service.
7. OSI model has a problem of fitting the protocols into the model.	7. TCP/IP model does not fit in any protocol
8. Protocols are hidden in OSI model and are easily replaced as the technology changes.	8. In TCP/IP replacing protocol is not easy.
9. OSI model is protocol independent.	9. TCP/IP is protocol dependent.
10. It has 7 layers.	10. It has 4 layers.

ix. **Differentiate between circuit switched and packet switched networks.**

Answer

Difference between circuit switched and packet switched networks:

1. Circuit Switching is connection oriented that means a path is established between source and destination before the transmission occurs. On the other hand, Packet Switching is connectionless that means a dynamic route is decided for each packet while transmission.
2. Circuit Switching was originally designed for voice communication, whereas, Packet Switching was originally designed for data communication.
3. Circuit Switching is inflexible as once a path is established for transmission, it does not change during the duration of the session. On the other hand, Packet Switching is flexible as each packet may travel through a different route to reach its destination.
4. In circuit switching, the entire message is received as it is as sent from a sender to receiver. On the other hand, in packet switching, as each packet travels a different path hence, the packet are received out of order at the receiver side and later arranged in order.
5. Circuit Switching is always implemented at physical layer, whereas, Packet Switching is implemented on the network layer.

x. **Briefly describe IP Addressing.**

Answer

IP addressing

Every computer on Internet has a unique number assigned to it called the IP address. The IP address recognizes a particular computer out of millions of computers connected to the Internet.

Q3. Write long answers of the following questions.

i. **Explain different types of guided media.**

Answer

Guided Communication Media

Guided Communication Media is also called physical or bounded communication media. In this type of media, signals pass through a physical path. It uses cables that guide the data signals along a specific path.

Important Guided Media

Following are some important guided media:

- Standard Telephone Cable
- Twisted Pair Cable
- Coaxial Cable
- Fibre Optic Cable

1. Standard telephone cable

Standard telephone cable is widely used as communication lines. Telephone lines are particularly useful to the user of data communication because the complex network of lines that has already been established allows data to be transmitted to any location in the world.

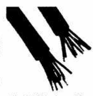


Fig.5.7 Telephone Line

Disadvantage of Telephone Line

The disadvantage of telephone line is that transmission speed is very slow. Therefore, its use for data communication is slowly declining.

A telephone line is shown in Fig. 5.7 with four cables.

2. Coaxial Cable

Coaxial Cable is mainly used for long distance transmission. It can transmit data at much higher rate of 10 to 100 megabits per second. Telephone companies also use them to transmit data over long distance.

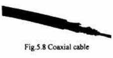


Fig.5.8 Coaxial cable

Characteristics of Coaxial cables

Coaxial cables are packed into a very large cable that can handle hundreds of thousands of telephone calls at the same time. Coaxial cable provides high quality data transmission without distortion or loss of signal. Coaxial cables have been laid under the ocean. A coaxial cable is shown in Fig.5.8.

Both telephone line and coaxial cables are made up of copper.

3. Twisted Pair Cables

Twisted pair cables are twisted together in pairs. It provides shielding from outside interference. Cables with a shield are called Shielded Twisted Pair (STP) cables. Cables without shields are called Unshielded Twisted Pair (UTP) cables.

Twisted pair cables are shown in Fig.5.9.

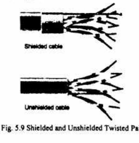


Fig. 5.9 Shielded and Unshielded Twisted Pair

4. Fibre Optic Cable

Fibre optic cable is new technology that is replacing the conventional cable in communication systems. Fibre optic cable is smooth hair-thin strands of transparent material that transmits light waves at high speed.

Fibre optic cables are shown in Fig.5.10.

Fig.5.10 Fibre optic cables

Main Advantage of Fibre Optic Cable

The main advantage of fibre optic cable over wire cables includes weight and size reduction and increased speed of transmission. Fibre optic cable is not affected by electromagnetic interference. Therefore, noise and distortion are reduced. Fibre optic cable can transmit both voice and digital data.

ii. Explain microwave and satellite communications.

Answer

Microwave Transmission

Microwave transmission signals travel through open space much like radio signals as shown in Fig.5.11.

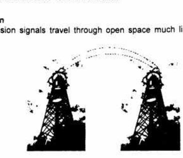


Fig.5.11 Microwave Transmission

Microwave systems transmit information with transmitters, which are normally installed on high buildings, mountains tops or high towers. Long distance microwave channels consist of a series of relay stations (boosters) spaced approximately 30 miles apart. Two stations must be within sight of one another. For transmitting information long distances, signals are amplified and retransmitted from station to station.

Satellites Communication

Satellite is a relay station positioned approximately 22,000 miles above the earth. It orbits around the earth with exactly the same speed as the rotation speed of earth. Earth stations beam signals to the satellite as shown in Fig.5.12.

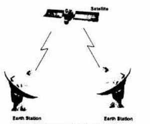


Fig.5.12 Satellite communication

The satellite amplifies and retransmits the signals to another earth station, which can be located

thousands of miles away.

Ideal Communication

Satellite communication is ideal for long distance communication. Transmission by satellite allows large amount of data to be sent long distance at rapid speeds. Its use has increased dramatically in recent years.

Major Drawback of Satellite Communication

A major drawback of satellite communication is the high cost of placing the satellite into its orbit. These satellites are launched either by rockets or by space shuttles.

iii. Write notes on switch, router and gateway.

Answer

Switch

A switch or network switch (also known as hub) is a small hardware like a box as that connects multiple computers together in a local area network (LAN).

A switch inspects data packets as they are received, determines the source and destination device of each packet and forwards them appropriately. A packet is a basic unit of communication over a computer network. When data is transmitted, it is broken down into packets, which are reassembled to the original form once they reach the destination.

Fig.5.13 8 Port Switch

Function of switch

Switches allow computers to communicate directly with one another in a smooth and efficient manner.

Router

A router is a communication device, which is used to connect two or more networks. Today, most of the networks are connected to Internet. When the computer is sending data to another computer on the Internet, router receives the data packets, looks for the remote computer address and forwards it to a computer that is closer to the remote computer. It forwards the data packets by selecting the best pathway based on network traffic. Many routers take part in transmitting the data packets from one location to another.

A wireless router is shown in Fig.5.14.

Fig.5.14 Wireless Router

Gateway

Gateway is a device that is used to connect a network to another network that uses different protocols. If we have to link different kinds of networks, such as a network of IBM mainframe computers and a network of PCs, we might have to use a gateway. Gateways change the format of the data packets but not the contents of the message, to make it confirm to the application program of the remote computer.

Fig.5.15 Gateway Device

iv. Explain in detail Client/Server and Peer-to-Peer networks.

Answer

Client/Server Networks

A computer network in which each computer on the network acts as either a server or a client is called client/server or dedicated server network. Each server computer on the network is called a dedicated server. Servers are not used as client computers. Fig.5.16 illustrates how a Medicated server network may be designed.

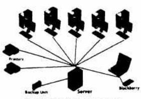


Fig.5.16 Client/Server Network

The computer at the top of the figure is the dedicated server, sharing files and applications. The remaining computers in the illustration are clients that access resources shared by the server. Similarly, in a dedicated server network, client computers never act as servers. Client/Server network includes one or more computers that are dedicated to acting as Servers. The servers are optimized to provide quick access to shared network resources. Servers also provide centralized security to ensure that unauthorized users do not access resources.

Because the client/server approach centralizes control of data and other shared resources, one person or group is typically responsible for administering the network.

Peer-to-Peer Networks

In Peer-to-Peer networks, every computer is capable of playing the role of client, server or both at the same time. In this network, each computer on the network is referred to as Peer. In a peer-to-peer network, a peer computer can act as both a server and a client at the same time. A peer computer on your desktop can share files and printers with other computers and it can simultaneously access other shared resources on the network.

A conceptual view of a peer-to-peer network is shown in Fig.5.17.

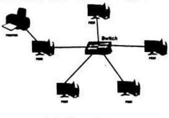


Fig.5.17 Peer-to-Peer Network

Peer-to-peer networks tend to be relatively small. Most of these networks fall to range between two and ten computers. Large peer-to-peer networks become difficult to manage, because so many network administrators control sharing and maintaining shared resources.

v. Define network topology and explain its types.

Answer

Network's Topology

The arrangement of network nodes and connections between them is called the network's topology. A node represents any device on the network. Topology is simply a map of the layout of nodes and connections in the network.

Types of topology

Four network topologies are popular today, which are as follows:

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

1. Star Topology

In a star network topology, each network node is connected to a central device called a hub. Large networks can require many hubs and hubs can be connected to each other to create a single large network. Star network topology is shown in Fig 5.22.

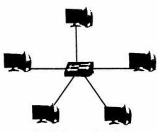


Fig. 5.22 Star network topology

Features of Star Topology

- It is suitable for both small and large networks.
  Easy to install and wire.
- Easy to detect and remove faults.
- Failure of cable does not stop functioning of the entire network.

Limitations of Star Topology

- Failure of the hub causes the entire network to go down.
- Expensive topology to implement. Lengthy cable with a hub is required to install star topology

2. Ring Topology

Ring topology is shaped just like a ring. It is made up of an unbroken circle of network nodes. Ring network topology is shown in Fig.5.23.

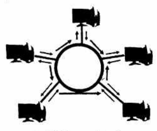


Fig.5.23 Ring network topology

Features of Ring Topology

- Each node is directly connected to the ring.
- Easy to install and wire.
- Data on the network flows in one direction.
- Not costly to implement.

Limitations of Ring Topology

- If the ring is broken at any point, the entire network stops functioning.

- Slower than other network topologies.

3. Bus Topology

Bus network topology connects each node to the network along a single piece of cable, called a bus. Bus network topology is shown in Fig.5.24.

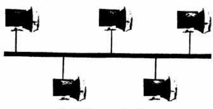


Fig.5.24 Bus network topology

Features of Bus Topology

- Suitable for a small network.
- Easy to connect a computer or a peripheral device to the network.
- Requires less cable to implement.
- Terminator is installed at each end of the cable to prevent signals from reflecting back onto the bus and cause errors. Terminator is a device that is attached to ground.

Limitations of Bus Topology

- If the single cable is severed at any point, the entire network can go down.
- Difficult to identify the problem if the entire network goes down.
- Not suitable for large network.

4. Mesh Topology

In mesh topology, each node is directly connected to all the nodes as shown in Fig.5.25.

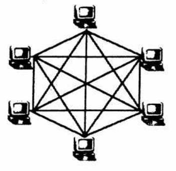


Fig.5.25 Mesh network topology

Features of Mesh Topology

- Most reliable network topology.
- Data can be routed around failed computers or busy ones.
- Can manage high traffic.

Limitations of Mesh Topology

- Most expensive topology to implement.

Setup and maintenance is very difficult.

vi. Describe briefly the seven layers of OSI Model.

Answer

Layers of OSI model

The OSI model consists of seven layers. Each layer performs a specific task during data communication. In OSI model, control is passed from one layer to the next, starting at the application layer in one station and proceeding to the bottom layer (the physical layer), over the physical link to the next station and back up to the application layer. This process is shown in Fig.5.26.

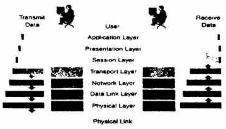


Fig.5.26 Layers of OSI Model

The seven layers of OSI model are described below.

Layer 7 - Application Layer

Application Layer provides services to end-user. It interacts with the operating system or application software whenever the user wants to send files, read messages or perform other network related activities.

Layer 6 - Presentation Layer

Presentation Layer takes the data provided by the Application Layer and converts it in a standard format that the other layers can understand. At the receiving end, it also formats the information, so that it looks in such a way that a user can understand.

Layer 5 - Session Layer

Session Layer performs functions that enable two applications or two pieces of the same application to communicate across the network. It performs security, name recognition, logging and other similar functions. It also establishes, maintains and ends communication with the receiving computer.

Layer 4 - Transport Layer

Transport Layer establishes connections between two computers on the network, handles quality control by making sure that the data received is in the right format and the right order.

Layer 3 - Network Layer

Network Layer decides which physical path-way the data should take to reach the destination.

Layer 2 - Data Link Layer

Data Link Layer defines the format of data on the network. This layer converts the data into packets and checks them before putting them on the pathway.

Layer 1 - Physical Layer

Physical Layer defines cables and signaling. It provides hardware means such as cables and connectors for sending and receiving data.

vii. Describe the four layers of TCP/IP Model.

Answer

TCP/IP means Transmission Control Protocol and Internet Protocol. It is the network model used in the current Internet architecture as well. Protocols are set of rules, which govern every possible communication over a network. These protocols describe the movement of data between the source and destination or the internet. These protocols offer simple naming and addressing schemes.

Layer 4 - Application Layer

Application layer is the top most layer of TCP/IP model. Application layer is present on the top of the Transport layer. Application layer defines TCP/IP application protocols and how host programs interface with Transport layer services to use the network. Application layer includes all the higher-level protocols like:

- DNS (Domain Naming System)
- HTTP (Hypertext Transfer Protocol)
- Telnet
- SSH (Secure Shell)
- FTP (File Transfer Protocol)
- TFTP (Trivial File Transfer Protocol)
- SNMP (Simple Network Management Protocol)
- SMTP (Simple Mail Transfer Protocol)
- DHCP (Dynamic Host Configuration Protocol)
- X Windows
- RDP (Remote Desktop Protocol)

Layer 3 - Transport Layer

Transport Layer is the third layer of the TCP/IP model. The position of the transport layer is between application layer and internet layer. The purpose of transport layer is to permit devices on the source and destination hosts to carry on a conversation. Transport layer defines the level of service and status of the connection used when transporting data.

The main protocols included at Transport layer are:

- TCP (Transmission Control Protocol)
- UDP (User Datagram Protocol)

Layer 2 - Internet Layer

Internet Layer is the second layer of the TCP/IP model. The position of Internet layer is between Network Access Layer and Transport layer. Internet layer pack data into data packets known as IP datagrams, which contain source and destination address (logical address or IP address) information that is used to forward the datagrams between hosts and across networks. The Internet layer is also responsible for routing of IP datagrams.

Packet switching network depends upon a connectionless internetwork layer. This layer is known as Internet layer. Its job is to allow hosts to insert packets into any network and have them to deliver independently to the destination. At the destination side data packets may appear in a different order than they were sent. It is the job of the higher layers to rearrange them in order to deliver them to proper network applications operating at the Application layer.

The main protocols included at Internet layer are:

- IP (Internet Protocol)
- ICMP (Internet Control Message Protocol)
- ARP (Address Resolution Protocol)
- RARP (Reverse Address Resolution Protocol)
- IGMP (Internet Group Management Protocol)

Layer 1 - Network Access Layer

Network Access Layer is the first layer of the TCP/IP model. Network Access Layer defines details of how data is physically sent through the network, including how bits are electrically or optically signaled by hardware devices that interface directly with a network medium, such as coaxial cable, optical fiber, or twisted pair copper wire.

The protocols included in Network Access Layer are:

- Ethernet
- Token Ring
- FDDI
- X.25
- Frame Relay

LAB ACTIVITIES

Following lab activities are to be carried out during the practical periods.

1) Client-Server and Peer-to-Peer networks should be demonstrated through video/animation.

Answer

Practical Work

2) Sharing of files/folders, printers and Internet connection should be demonstrated.

Answer

Practical Work

3) Use of switch and router is to be demonstrated.

Answer

Practical Work

4) Use of TCP/IP protocol and IP addressing is to be demonstrated through video/animation.

Answer

Practical Work

11.	Simplex transmission mode	**12.**	Simplex transmission mode
13.	Simplex transmission mode	**14.**	Half duplex transmission mode
15.	Half duplex transmission mode	**16.**	Full duplex transmission mode
17.	Full duplex transmission mode	**18.**	Local Area Network
19.	Wide Area Network	**20.**	Metropolitan Area Network
21.	Bounded Media	**22.**	Fiber Optic Cable
23.	100 Mbps	**24.**	layer of glass
25.	WAN	**26.**	Local Area Network
27.	LANs	**28.**	Coaxial cable
29.	Fiber optic cable	**30.**	Switch
31.	Router	**32.**	Gateway
33.	Client/server and peer-to-peer	**34.**	Workgroups
35.	any computer that is hooked up to a computer network	**36.**	Relationship to all other computers
37.	Software	**38.**	All other nodes attached to that network
39.	Star topology	**40.**	Ring topology
41.	Bus topology	**42.**	Mesh topology
43.	Application Layer	**44.**	Presentation Layer
45.	Session Layer	**46.**	Transport Layer
47.	Network Layer	**48.**	Data Link Layer
49.	Physical Layer	**50.**	65,535
51.	32 bits	**52.**	8 bits
53.	224		

Q.2 Give short answers of the following questions.

Q1: Define computer network.

Ans. A computer network is an interconnection between two or more computers and/or other network devices so that they can communicate with each other to share network resources (both hardware and software). A network is made up of collection of computers and other network devices that allow information exchange to take place. While most networks connect computers using some form of cable, the connections can also be wireless, for example radio or microwave communication.

Q2: Why we need network communication?

Ans. People use computer networks almost daily to conduct personal and professional business. This trend is accelerating as more people discover the power of computers and communication networks both for businesses and for homes. The day-to-day transactions at departmental stores, banks, reservation counters and other businesses are all dependent upon computer networks.

Q3: Define data communication.

Ans. Data communication is the process of transferring information from one point to another in a network environment.

Q4: What are the basic components of network communication?

Ans. Network communication consists of five basic components, which are as follows:

⇨ Sender
⇨ Message
⇨ Medium
⇨ Receiver
⇨ Protocol

Q5: Define modes of network communication.

Ans. Modes of network communication refer to the methods or the ways information is transmitted from one place to another.

Q6: What are the different modes of data communication?

Ans. The following are different modes of data communication:

⇨ Simplex, Half-duplex and Full-duplex

⇨ Synchronous and Asynchronous

Q7: Define simplex communication.

Ans. In Simplex mode, the communication takes place in only one direction. In this mode, communication is unidirectional, i.e. the communication can only take place in one direction and it is not possible for the receiver to send data back.

Q8: Give three examples of simplex communication.

Ans.

1. Data being sent to an electronic notice board found in train stations and Airports.
2. Radio and television broadcastings are also examples of simplex transmission.
3. Transmission of information from a computer to a printer is also in one direction.

Q9: Define half-duplex communication.

Ans. In half-duplex mode, the communication takes place in both the directions but not at the same time. The signal can only be sent or received at one time.

Q10: Give two examples of half-duplex communication.

Ans.

1. The use of walkie-talkies, where each of the persons communicating must indicate when they have finished speaking.
2. Communication between a computer and credit card machine.

Q11: Give an example of full-duplex communication.

Ans. One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.

Q12: How characters are transmitted between the components?

Ans. Asynchronous and Synchronous Transmissions are the two different methods, which are used for transmitting characters between components within a computer or from computer to other devices such as printer, modem, etc..

Q13: Which transmission is faster? Synchronous or asynchronous.

Ans. Synchronous transmission is faster than asynchronous because fewer bits have to be transmitted; i.e. only data bits and no extra control bits are sent.

Q14: State the use of communication media.

Ans. In network communication system, communication media are the links that provide paths communicating devices. Communication media is used to transmit data from one network (also called a node) to another.

Q15: Name the categories of communication media.

Ans. There are two main categories of communication media:

⇨ Guided Communication Media
⇨ Unguided Communication Media

Q16: Define guided communication media.

Ans. Guided Communication Media is also called physical or bounded communication media. In this type of media, signals pass through a physical path. It uses cables that guide the data signals along a specific path.

Q17: Which are important guided media?

Ans. Following are some important guided media:

⇨ Telephone Cable
⇨ Twisted Pair Cable
⇨ Coaxial Cable
⇨ Fibre Optic Cable

Q18: What is the disadvantage of telephone line?

Ans. The disadvantage of telephone line is that transmission speed is very slow. Therefore, its use for data communication is slowly declining.

Q19: State the characteristics of coaxial cables.

Ans. Coaxial cables are packed into a very large cable that can handle hundreds of thousands of telephone calls at the same time. Coaxial cable provides high quality data transmission without distortion or loss of signal. Coaxial cables have been laid under the ocean.

Q20: What is meant by STP and UTP?

Ans. **STP:** Cables with a shield are called Shielded Twisted Pair (STP) cables.

UTP: Cables without shields are called Unshielded Twisted Pair (UTP) cables.

Q21: What is the main advantage of fibre optic cable?

Ans. The main advantage of fibre optic cable over wire cables includes weight and size reduction and increased speed of transmission. Fibre optic cable is not affected by electromagnetic interference. Therefore, noise and distortion are reduced. Fibre optic cable can transmit both voice and digital data.

Q22: Define unguided media.

Ans. Unguided Media is also called unbound media. In this type of communication media, transmission takes place through open air. They are not guided through any specific path.

Q23: What are the important unguided media?

Ans. The following are important unguided media:

⇨ Microwave Transmission
⇨ Communication Satellites

Q24: What is the major drawback of satellite communication?

Ans. A major drawback of satellite communication has been the high cost of placing the satellite into its orbits. These satellites are launched either by rockets or by space shuttles.

Q25: What is a communication device?

Ans. A device that is used in telecommunication systems for transmitting data from one ion to another is known as communication device.

Q26: State the classification of communication devices.

Ans. Commonly used communication devices can be classified into:

⇨ Switches
⇨ Routers
⇨ Gateways

Q27: What is a network switch?

Ans. A switch or network switch (also known as hub) is a small hardware like a box that connects multiple computers together in a local area network (LAN).

Q28: What is the function of a switch?

Ans. Switches allow computers to communicate directly with one another in a smooth and efficient manner.

Q29: Define router.

Ans. A router is a communication device, which is used to connect two or more networks.

Q30: What is gateway?

Ans. Gateway is a device that is used to connect a network to another network that uses different protocols. Gateways change the format of the data packets but not the contents of the message, to make it conform to the application program of the remote computer.

Q31: What is meant by Network Architecture?

Ans. Network architecture is the design of a communication system. It includes hardware devices (such as routers and switches), cabling, network topology and physical and wireless connections.

Q32: Define Server.

Ans. A computer on the network that shares resources for others to use is called a server computer or simply server. Shared resources include information, software, printer, plotter, Internet connection, hard disk, etc..

Q33: Define Client.

Ans. A computer on the network that accesses resources that are shared by other computers is known as client computer or simply client.

Q34: Which are the commonly used network architectures?

Ans. The two commonly used network architectures are:

⇨ Client/Server Network
⇨ Peer-to-Peer Network

Q35: Define Peer-to-Peer Networks.

Ans. In Peer-to-Peer networks, every computer is capable of playing the role of client, server or both at the same time.

Q36: What is meant by peer or peer computer?

Ans. In Peer-to-Peer networks, each computer on the network is referred to as Peer. In a peer-to-peer network, a peer computer can act as both a server and a pent at the same time. A peer computer on your desktop can share files and printers with other computers and it can simultaneously access other shared resources on the network.

Q37: Name the types of networks based on the size and physical area.

Ans. The following are different types of networks based on the size and physical area they cover:

⇨ Local Area Network
⇨ Wide Area Network
⇨ Metropolitan Area Network
⇨ Virtual Private Network

Q38: Make a list of the characteristics of LAN.

Ans.

⇨ Spans a small physical area.
⇨ Uses high-speed wired/wireless connections between computers.
⇨ It is a very reliable network. Communication errors are very rare.
⇨ It consists of a limited number of computers.

Q39: Make a list of the characteristics of WAN.

Ans.

⇨ Spans a large physical area. It can be worldwide like Internet.
⇨ Communication speed is slow as compared to LAN.
⇨ Connects computers through public networks, leased lines or satellites.
⇨ Connects multiple LANs.
⇨ Sometimes communication errors occur.

Q40: Make a list of the characteristics of MAN.

Ans.

⇨ It is larger than a LAN and smaller than a WAN. Covers an area of between 5 to 50 km diameter.
⇨ Uses fiber optic cable or microwave transmission.
⇨ Provides high-speed communication.
⇨ Used by telephone companies, Internet Service Providers and cable TV companies.

Q41: Make a list of the characteristics of VPN.

Ans.

⇨ It uses public networks such as Internet to connect computers.
⇨ Provides secure remote access.
⇨ Enables files sharing, video conferencing and similar network services.
⇨ Provides cheap communication over long distance.

Q42: What are the types of network topologies?

Ans. Four network topologies are popular today, which are as follows:

⇨ Star Topology
⇨ Ring Topology
⇨ Bus Topology
⇨ Mesh Topology

Q43: Write down a short note on star topology.

Ans. In a star network topology, each network node is connected to a central device called a hub.

Large networks can require many hubs and hubs can be connected to each other to create a single large network.

Q44: State the features of star topology.

Ans.

⇨ It is suitable for both small and large networks.
⇨ Easy to install and wire.
⇨ Easy to detect and remove faults.
⇨ Failure of cable does not stop functioning of the entire network.

Q45: Write down the limitations of star topology.

Ans.

⇨ Failure of the hub causes the entire network to go down.
⇨ Expensive topology to implement. Lengthy cable with a hub is required to install star topology

Q46: What is ring topology?

Ans. Ring topology is shaped just like a ring. It is made up of an unbroken circle of network nodes.

Q47: State the features of ring topology.

Ans.

⇨ Each node is directly connected to the ring.
⇨ Easy to install and wire.
⇨ Data on the network flows in one direction.
⇨ Not costly to implement.

Q48: What are the limitations of ring topology?

Ans.

⇨ If the ring is broken at any point, the entire network stops functioning.
⇨ Slower than other network topologies.

Q49: Define bus topology.

Ans. Bus network topology connects each node to the network along a single piece of cable, called a bus.

Q50: What are the features of bus topology?

Ans.

⇨ Suitable for a small network.
⇨ Easy to connect a computer or a peripheral device to the network.
⇨ Requires less cable to implement.
⇨ Terminator is installed at each end of the cable to prevent signals from reflecting back onto the bus and cause errors. Terminator is a device that is attached to ground.

Q51: What are the limitations of bus topology?

Ans.

⇨ If the single cable is severed at any point, the entire network can go down.
⇨ Difficult to identify the problem if the entire network goes down.
⇨ Not suitable for large network.

Q52: Define mesh topology.

Ans. In mesh topology, each node is directly connected to all the nodes.

Q53: State the features of mesh topology.

Ans.

⇨ Most reliable network topology.
⇨ Data can be routed around failed computers or busy ones.
⇨ Can manage high traffic.

Q54: Make a list of the limitations of Mesh Topology.

Ans.

⇨ Most expensive topology to implement.
⇨ Setup and maintenance is very difficult.

Q55: Define data communication standards.
Ans. Data communication standards refer to hardware and software specifications that make communication between different computer systems possible.

Q56: Define communication standards.
Ans. Any computer or device in the network can communicate with any other computer or device by following some rules. These rules are called communication standards.

Q57: Why communication standards are needed?
Ans. Communication standards are needed so that different computer networks can communicate with each other.

Q58: Define OSI model.
Ans. The International Standards Organization (ISO) based in Geneva, developed standards for international and national data communications. In the early 1970s, ISO developed a standard model of a data communication system and called it the Open Systems Interconnection (OSI) model.

Q59: How control is passed in OSI model?
Ans. In OSI model, control is passed from one layer to the next, starting at the application layer in one station and proceeding to the bottom layer (the physical layer), over the physical link to the next station and back up to the application layer.

Q60: Describe the application layer of OSI model.
Ans. Application Layer provides services to end-user. It interacts with the operating system or application software whenever the user wants to send files, read messages or perform other network related activities.

Q61: Describe the presentation layer of OSI model.
Ans. Presentation Layer takes the data provided by the Application Layer and converts it in a standard format that the other layers can understand. At the receiving end, it also formats the information, so that it looks in such a way that a user can understand.

Q62: Describe the session layer of OSI model.
Ans. Session Layer performs functions that enable two applications or two pieces of the same application to communicate across the network. It performs security, name recognition, logging and other similar functions. It also establishes, maintains and ends communication with the receiving computer.

Q63: Describe the transport layer of OSI model.
Ans. Transport Layer establishes connections between two computers on the network, handles quality control by making sure that the data received is in the right format and the right order.

Q64: Describe the network layer of OSI model.
Ans. Network Layer decides which physical pathway the data should take to reach the destination.

Q65: Describe the data link layer of OSI model.
Ans. Data Link Layer defines the format of data on the network. This layer converts the data into packets and checks them before putting them on the pathway.

Q66: Describe the physical layer of OSI model.
Ans. Physical Layer defines cables and signaling. It provides hardware means such as cables and connectors for sending and receiving data.

Q67: Define protocol.
Ans. A protocol is a set of rules and conventions that govern how computers exchange information over a network medium. A protocol implements the functions of one or more of the OSI layers.

Q68: Write down a short note on TCP/IP.
Ans. TCP/IP was developed by Department of Defense in USA. It is used on the largest network, the Internet but is available in all the small and big computers. The most important capability of TCP/IP is that it provides communication between two or more computer systems used for communication over the Internet.

Q69: Define internet protocol suite.
Ans. Internet Protocol Suite is a set of communication protocols used on Internet and many other computer networks. It is commonly known as TCP/IP protocol because its most important

protocols are Transmission Control Protocol (TCP) and Internet Protocol (IP).

Q70: What is the architecture of TCP/IP protocol?
Ans. The architecture of TCP/IP protocol describes the function of its each layer during communication between computers on the Internet.

Q71: Describe the Layers of TCP/IP Architecture.
Ans. The four layers of TCP/IP protocol architecture are:

- ⇨ Application Layer
- ⇨ Transport Layer
- ⇨ Network Layer
- ⇨ Network Access Layer

Q72: What is meant by IANA?
Ans. The Internet Assigned Numbers Authority (IANA) is a global organization that is responsible for registration of port numbers for common Internet services.

Q73: What is meant by packets?
Ans. All the data that is to be transmitted is broken down into small blocks called packets.

Q74: State the parts of IP addresses.
Ans. IP addresses have two parts:

1. The first part identifies the network to which the computers are connected.
2. The second part identifies the computers on the given network.

Q75: Define Octet.
Ans. An IP address is made up of 32 bits. The 32-bits are broken down into four octets. One octet is equal to 8 bits. Each octet is converted to decimal and separated by a dot. Therefore, an IP address is expressed in dotted-decimal format.

Q76: Into how many address classes, IP addresses are divided?
Ans. IP addresses are divided into three address classes (categories or groups), that is:

1. Class A
2. Class B
3. Class C.

Q77: Write down a short note on Class A address.
Ans. Class A address starts with "0" as the most significant bit and next seven bits identify the network number. The remaining 24 bits are used to identify a computer number. Therefore, with class A, there can be 224 computers.

Q78: Write down a short note on Class B address.
Ans. Class B address starts with "10" as the most significant bits and the next 14 bits identify the network number. The remaining right most 16 bits are used to identify more than 65000 computers.

Q79: Write down a short note on Class C address.
Ans. Class C address starts with "110" as the most significant bits and the next 21 bits identify the network number. The remaining 8 right most bits identify the 256 computers on each 221 possible networks. Small companies usually use class C addresses. It is important to note that the bits that identify the network class are also part of network number.

Q80: What is the purpose of using network mask?
Ans. The purpose of using network mask is to know which portion of the IP address identifies the network and which portion identifies the computer number.

Q81: Make a table of the default masks of Class A, B and C.
Ans. Class A, B and C networks have default masks as shown below:

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0