UNIT 1 : INTRODUCTION TO COMPUTER NETWORK

UNIT STRUCTURE

1.1 LEARNING OBJECTIVES

After going through this unit, you will be able to :

- define the goals of computer network
- learn about broadcast and point-to-point networks
- describe connection-less and connection-oriented services
- describe the functionality and use of various network devices
- learn about various kinds of network topologies
- describe the types of computer network
- differentiate server-based and peer-to-peer LANs
- learn about tranmission types and modes of communication
- learn about different switching techniques

1.2 INTRODUCTION

A computer network is a collection of several computers and terminals that shares information across wireless or wired technology. The main goal of a network system is the transfer and exchange of data between the computers and terminals.

In this unit, we will begin our discussion with the goals of computer network. We will introduce various concepts associated with computer network such as the concept of broadcast and point-to-point network, connection-less and connection oriented services, various internetrking devices etc. We will further discuss the various types of network together with the concept of network topology. At the end, we will briefly discuss the different transmission types and communication modes followed by various switching techniques.

Before discussing the technical issues in detail, it is worth devoting some time to pointing out why people are interested in computer networks

and what they can be used for.

1.3 GOALS OF COMPUTER NETWORKS

Before the advent of computer networks, papers and diskettes were the only means to share information. Now a days, computer networks which comprise a number of computers as well as other devices like printers, scanners etc. are widely used to share resources in a more efficient and faster way

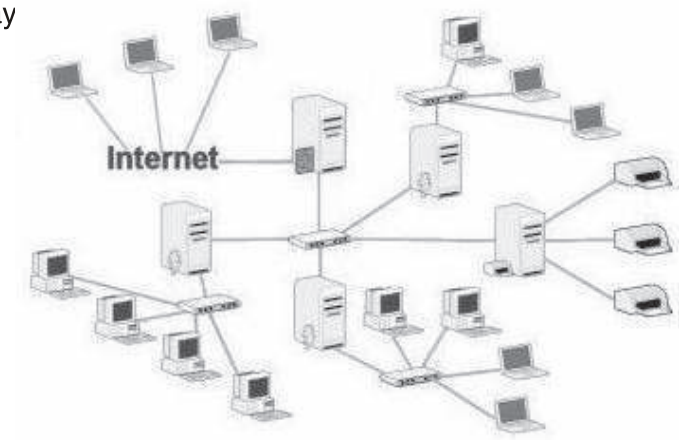


Fig. 1.1 : A typical computer network

In a network, whether big or small, all the devices are interconnected to transmit and receive data from one another. These connections are usually made not only by copper wires; instead, fiber optics, microwaves, infrared, and communication satellites are also used for efficient communication. The main goals of these networks can be summarized as follows :

- **Resource Sharing :** Using computer networks, it is possible to share programs, data and other resources among several users on the network. The sharing of resources is independent of the physical location of the user and the resource. Files on a particular user's computer can be shared on the network or files can be placed on a file server which provides a central location for all files needed by the users on the network. Users can also share devices such as printers, CD-ROM drives, and hard drives etc. It also makes upgrading an application easier because the upgrade only has to be performed only on the server itself. Thus,

we don't need seperate resource for each computer.

- **High Reliablity :** A second goal is to provide high reliability by having alternative sources of supply. For example, all files could be replicatied on two or three machines; so if one of them is unavailable, the other copies could be available.
- **Cost Reduction :** Resource sharing automatically reduces cost and hence money can be saved. For example, let us suppose, there are ten users and each user requires a printer. If they could have been working indivually, then ten printers would have to be purchased. If these ten users are allowed to work in a network, then only two or three printers would be sufficient.
- **Communication Medium :** Computer networks provide a powerful communication medium among the people who are in a geographically same or different location. A file that was updated or modified on a network, can be seen by the other users on the network immediately. Thus, it becomes easy for two or more peoples living far apart to work on a same project by dividing it using a network. They can write programs, can discuss or can even change or modify some data using a network while they are far off. Otherwise, they will have to wait for several days for communication through letters or some other media. Thus, it makes speedy co-operations and enhances human to human communication.

1.4 BROADCAST AND POINT-TO-POINT NETWORKS

On the basis of *transmission technology*, computer networks can be divided into two categories: *broadcast* and *point-to-point*.

- ***Broadcast networks*** have a single communication channel which is shared by all the machines on the network. Here, messages are broken into *packets* which are then broadcast to all machines in the channel. A packet sent by any machine is received by all the machines but only that machine processes

the packet for which it is intended. An address field (destination address), within the packet specifies for whom it is intended. Upon receiving a packet, a machine checks the address field. If the packet is intended for itself, it processes the packet; if it is intended for some other machine, it is just ignored. However, in broadcast networks, we have the problem of deciding who uses the channel, if there is competition for it. For this, *medium access control* (MAC) is used to determine who goes next.

As an analogy, let us imagine a scenario where a teacher is taking the attendance in a particular class. He/she will call every roll number in the classroom, all will listen but only the respective student will respond. Broadcast implies "*sending a signal where multiple parties may hear a single sender*".

Fig. 1.2 : A Broadcast Network

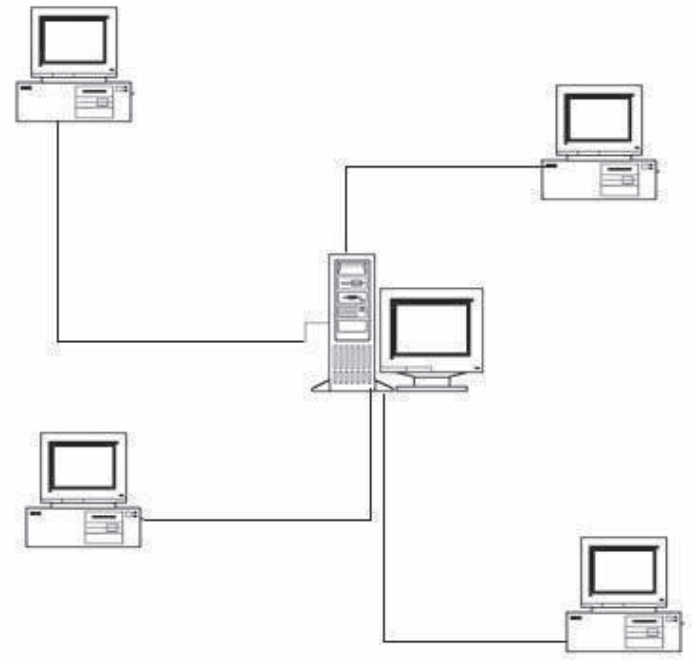


Fig. 1.3 : Point-to-Point Network

- Again, let us imagine a scenario that a teacher is taking the attendance in an examination hall. He/she will go to each member of the room and will take the attendance individually. Here, only one person listen and he only responds to the call. ***Point-to-point network*** is a method of communication where one "point" (person or device or entity) speaks to another entity. Point-to-point network consists of many connections between individual pairs of machines. Packet, on this type of network, may have to visit one or more intermediate machines to reach from the source to the destination. Often multiple routes of different lengths are possible in point-to-point networks. Therefore, routing algorithms are required to determine the best routes out of multiple available routes.

1.5 CONNECTION-ORIENTED AND CONNECTION-LESS SERVICES

On the basis of *acknowledgement sent by the receiver*, there are two distinct techniques used in data communications to transfer data. These are: *connection-oriented* and *connection-less services*. Each service can be characterized by a quality of service. In general, a reliable service is implemented by having the receiver acknowledge the receipt of each message; so the sender is sure that it has arrived.

- ***Connection-oriented service*** is modelled after the telephone system. For making a call to someone, first we have to pick up the phone and dial the number. After the connection is established, we talk, and then hang up.

  Connection-oriented service requires a connection to be established before any data can be sent. It sets up virtual links between the end systems through a network. After the connection is established, the data is transferred. As soon as the transmission is completed, the service user releases the connection. This procedure requires a specific acknowledgement

for the information whether the connection is established or not. This method is often called a "reliable" network service. In some cases, when the connection is established, the sender, receiver, and subnet conduct a negotiation about the parameters to be used such as maximum message size, quality of service required, and other issues. Typically, one side makes a proposal and the other side can accept it, reject it, or make a proposal as an alternative to the earlier proposal.

- The analogy of sending letters and postcards best explains the ***connection-less service.*** Each message (letter) carries a full destination address, and each one is routed through the system independent of all the others. Normally, when two messages are sent to the same destination, the first one sent will be the first one to arrive. But it is also possible that the first one sent can be delayed so that the second one arrives first. In a connection-less service, there is no initial end-to-end setup for a session; each packet is independently routed to its destination. The sender simply starts sending packets (called datagrams) to the destination. This service does not have the reliability of the connection-oriented method, but it is useful for periodic burst transfers. Neither system must maintain state information for the systems that they send transmission to or receive transmission from.

1.6 NETWORK DEVICES

The internetworking devices are the vital tools for communication. Here, we will gain some information about the various hardware that is used to maintain connections between the network.

- ***Network Interface Card (NIC) :*** A ***network interface card***, also known as a ***network adapter***, is a very important hardware which is responsible for connecting a particular computer to a network. The NIC mediates between the computer(and its user) and the network. Usually, an NIC consists of a printed circuit

boardcontaining different electronic components. It possesses a ROM chip that contains a unique number, known as the Media Access Controll (MAC) address. The MAC address identifies the device uniquely on the LAN. It also contains DMA (Direct Memory Access) circuit that allows the NIC to transmit or receive bits from memory without the involvement of the CPU. A NIC contains connector which provides plug-in facility to the network cable. It exists on the Data Link Layer of the ISO-OSI reference model. NIC handles all the details of packet transmission and reception.

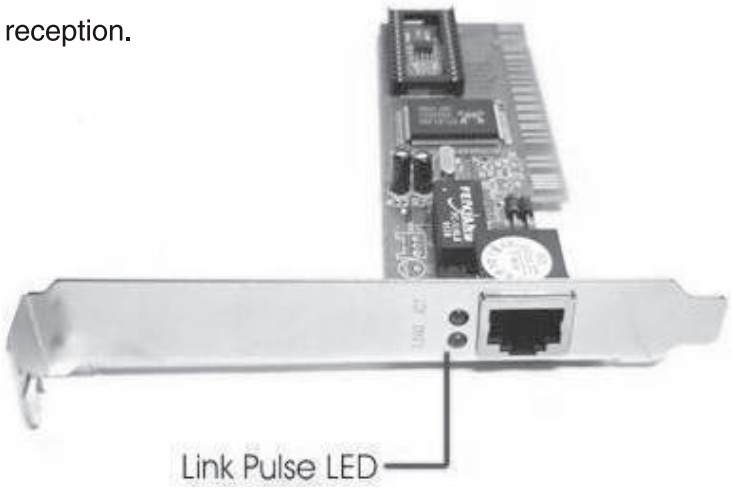


Fig. 1.4 : A Network Interface Card

- ***Modem :*** A modem (***mo***dulation-***dem***odulation) is a communication device that converts binary electrical signals into analog signals for transmission over telephone lines and converts these signals back into binary form at the receiving end. Conversion to analog form is called *modulation;* and the reverse process is known as *demodulation.*

Fig. 1.5 : A Modem

At the transmitting end, a bits stream arrives at the modem from computer's serial port. These bits are converted into analog form (modulation) using a predefined modulation technique. This analog signal is transmitted along telephone lines. At the receiving end, the analog signal is converted back to digital form(demodulation). The resulting serial stream is sent on to the computer at the receiving end.

- ***Repeater :*** Signals can only travel so far through media before they weaken and become garbled. This weakening of signals is called *attennuation*. Repeaters are used to regenerate the analog as well as the digital signals which are distorted by transmission loss. These are Layer 1(Physical layer) internetworking devices used to combat attenuation. Repeaters take in weakened signals, clean them up, regenerates them, and send them on their way along the network. By using repeaters, the distance over which a network can operate is extended.

  For example, 10Base-T (a wiring standard) is allowed to run 100 meters. One repeater can double this distance to 200 meters, as decpicted in Fig.1.6.

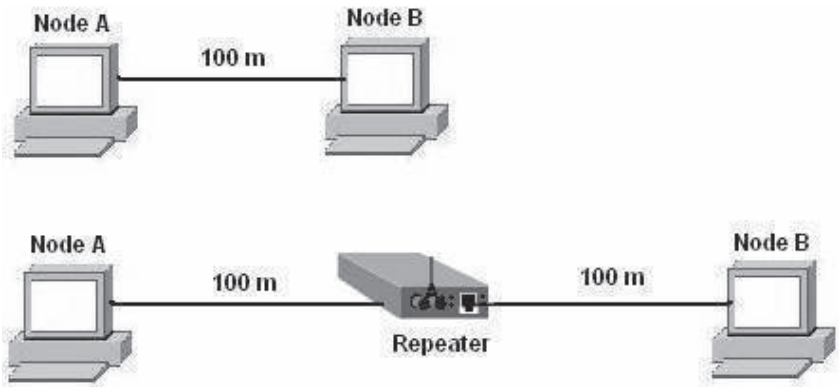


Fig. 1.6 : A repeater extending network without attenuation

- **Bridges and Gateways :** As the size of local area networks grew, the management of the networks became more difficult. Controlling traffic flow, maintaining fault monitoring, and adding and deleting stations from the system required more and more sophisticated system management. An alternate method to

handling larger networks is to divide them into smaller networks that are interconnected using hardware/software systems called *bridges* and *gateways*.

Bridges are mainly used to coonect multiple LANs which operate in the Data Link Layer to construct a larger LAN. The type of data transferred between the LANs must have the same format. A bridge can regenerate a signal it receives like a repeater. The basic function of a bridge is to transfer the frames from one LAN to another LAN. Bridge also has the capacity of frame filtering. It examines the header of each incloming frame frame and based on this information bridge decides whether to discard or forward this frame. Bridge stores the MAC address of received frame, keeps record on which port it has received, and which address belongs to which computer on the LAN.

Fig. 1.7(a) : A typical bridge

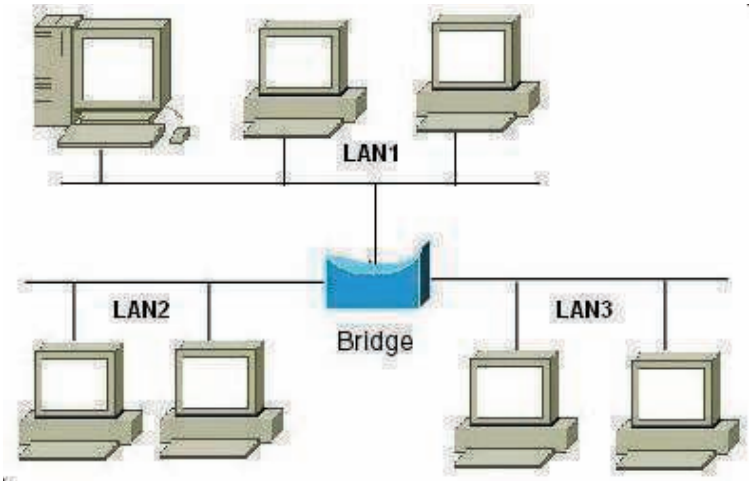


Fig. 1.7(b) : A bridge connecting 3 LANs

Gateways are similar in functions to bridges in that they connect more than one networks. The main difference between bridges and gateways is that the latter can interconnect networks with

differing message formats. A bridge does not perform any protocol translation in transferring packets between networks. whereas gateway takes an application message, reads it and interprets it. Hence, it can be used as a connecting device between two inter networks that use different model of references. One of them may use OSI model whereas the other uses TCP/IP model. A gateway is capable of receiving a frame coming from one model, makes necessary conversions and sends it to the other system of model. Thus, gateway relays packets among networks that have different protocols (e.g., between a LAN and a WAN). A gateway can provide security also.

- ***Hub :*** Hubs are Physical layer(Layer 1) devices. Data that comes in one port is sent out to all other ports, except for the port it came in on. Hub does not read data passing through it and does not know the source and destination points. It simply receives the data packets, amplifes the electrical signal and then retransmit data packets on the network. Hubs usually accomodate four or eight nodes, and many hubs include connectors for linking to other hubs. A hub connects nodes that have a common network architecture.

  The types of hubs that exist in the network are: *Passive hub* and *active hub*. *Passive hub* receives data packet and retransmits them on the network without amplifying the electrical signal. A multiport repeater is called an *active hub*. They receives the data packets, amplify them and retransmit on the network. For

Fig. 1.8 : A hub

- ***Switch :*** Switches are the core devices in today's modern LANs. A network ***switch*** is a hardware device that is used to connect computers that require high bandwidth and is also used to connect hubs to form large network. Switches are more expensive but provide better performance to hubs. Unlike hubs, network switches are capable of inspecting data packets as they are received, determining the source and destination device of each packet, and forwarding them appropriately. By delivering messages only to the connected device intended, a network switch conserves network bandwidth and offers generally better performance than a hub.

Fig. 1.9 : A Switch

Two types of switches exist, which are :

Layer- 2 switches : These types of switches are based on the bridging technology. They establish connection between the ports based on the MAC address stored in the address table.

Layer-3 switches : These types of switches are based on the routing technology and are responsible for seting up connection between the ports based on the network address.

- ***Router :*** A router is the primary device responsible for connecting multiple networks together. The function of a router is to provide a path from a node on one network to a node on another network. The two networks may be separated by several intervening networks and possibly, by many miles. The purpose of a router is to forward data packets between networks. It examine incoming packets, chooses the best path for them through the network, and then switches them to the proper outgoing port. Routers are normally used to connect LANs and WANs in the

Internet. It performs routing of packets based on their logical addresses. It has a routing table to take decision about the routes of packets. The table is constructed and updated dynamically by following some routing algorithm. Routers work at Layer 3, the Network Layer. In the Fig.1.9(b), routers connect nodes on different networks.

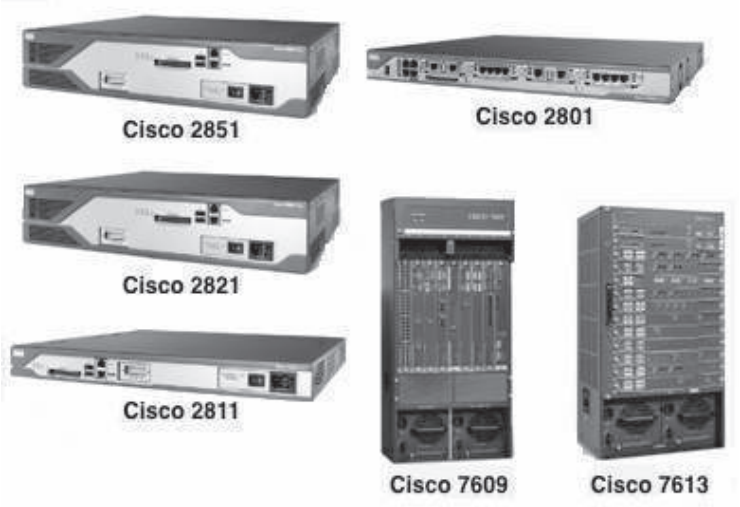


Fig. 1.9(a) : Some images of Cisco routers

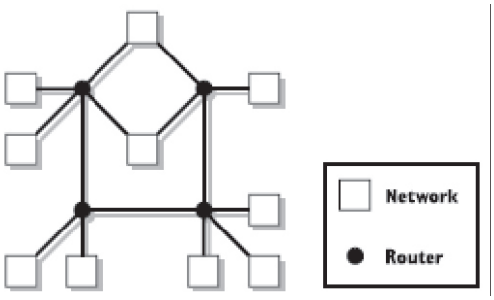


Fig. 1.9 (b) : Networks connected with routers

CHECK YOUR PROGRESS

Q.1. State True or False :

i) Conversion of analog signals to digital form is called modulation; and the reverse process is known as demodulation.

ii) A hub connects nodes that have a common network architecture.

iii) Routers operates at physical layer.

iv) Broadcast networks share a single communication channel.

LET US KNOW

The terms DTE and DCE are very common in the field of networking. ***DTE*** stands for ***data terminal equipment*** and ***DCE*** stands for ***data -communication equipment***. **DTE** is an end instrument that converts user information into signals or reconverts received signals. It is used to describe the end user machine, which is usually a computer or terminal. The function of communication network is to interconnect DTEs so that they can share resources, exchange data, provide backup for each other, and allow users to perform their work from any location. The DCE is used to connect the DTEs into the communications line or channel. It also contains a portion of an application process but the primary function of the DCE remains to provide an interface to the DTE with the communication network.

1.7 NETWORK TOPOLOGY

In this section we will discuss how computers and others devices are connected in a network.

In computer networking, ***topology*** refers to the layout of connected devices. Network topologies can be *physical* or *logical*. ***Physical topology*** means the physical design of a network including the devices, location and cable installation. It defines how the systems are physically connected. Several physical topologies are in use for networks today. Some of the

common topologies include the *bus*, *ring*, *star*, *tree* and *mesh*. More complex networks can be built as *hybrids* of two or more of the above basic topologies. The ***logical topology*** defines how the systems communicate across the physical topologies. The two most common types of logical topologies are ***broadcast*** and ***token passing***.

When we decide which topology we should choose for our network, then there are few basic points that we need to take cares of. The factors that decide which topology we should choose are:

- ***Cost*** : Cost is a factor that plays an important role for the decision of topology. If we want to create a network for 4-5 computers, we should not expense very much in network.
- ***Scalability***: What is the size of the network that we need to make and is it possible in that kind of topology
- ***Bandwidth capacity****:* The required speed of the network that can be taken care of by any particular topology.
- ***Ease of installation***: Is it easy to install the network using selected topology.
- ***Ease of fault finding and maintenance***: If we have a network we will definitely get the problem also; so will it be easy for network administrator to identify the problem and give the solution with ease and in least possible time.

1.7.1 Bus Topology

A network of bus topology consists of a long single cable to which all the computers and other devices are connected. Any node attached to the bus can send signals down the cable to all the nodes of the network; that means, a bus is a broadcast medium. When more than one node start sending data through the bus, they mix with each other and the sent data becomes a garbage. This is called *collision.* To avoid collision there must be some agreement between the nodes so that when one computer starts to send data, others refrain themselves from sending data. To ensure correct data

communication, both ends of the cable are terminated by a special device called end terminator.

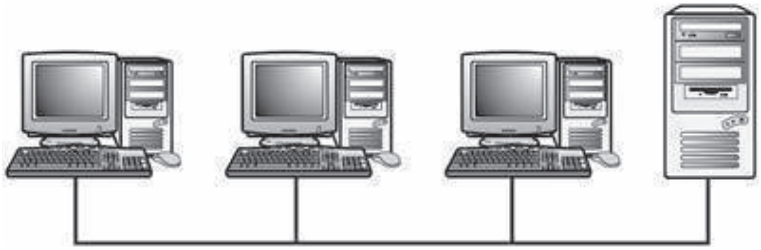


Fig. 1.10(a) : A Bus Topology

Ethernet bus topologies are relatively easy to install and don't require much cabling compared to the alternatives. 10Base-2 (Thin) and 10Base-5 (Thick) both were popular Ethernet cabling options for bus topologies. Some advantages and disadvantages of the bus topology are listed below:

Advantages :

- Bus topology is inexpensive in installation
- It requires less cable than other topologies
- Good for smaller networks not requiring higher speed.
- Easy to add systems to network.

Disadvantage :

- Out-of-date technology. Bus topology was used in the early days of networking because it was inexpensive to use and relatively easy to set up.
- If the backbone cable fails, the entire network effectively becomes unusable.
- Unmanageable in a large network. If more than a few dozen computers are added to a network bus, performance problems are likely to occur.
- Difficult to troubleshoot.

1.7.2 Ring Topology

In ring topology the computers are connected between each other in a way that forms a close loop. In practice, a cable connects

the first computer to the second computer, another cable connect the second computer to the third and so on until the last computer is connected back to the first to complete the loop. It should be noted that the topology may not physically look like a circle. The ring means the computers are connected with each other in a logical ring. The interconnecting cables may take any shape in practice. All messages travel through a ring in the same direction (either "clockwise" or "counterclockwise").

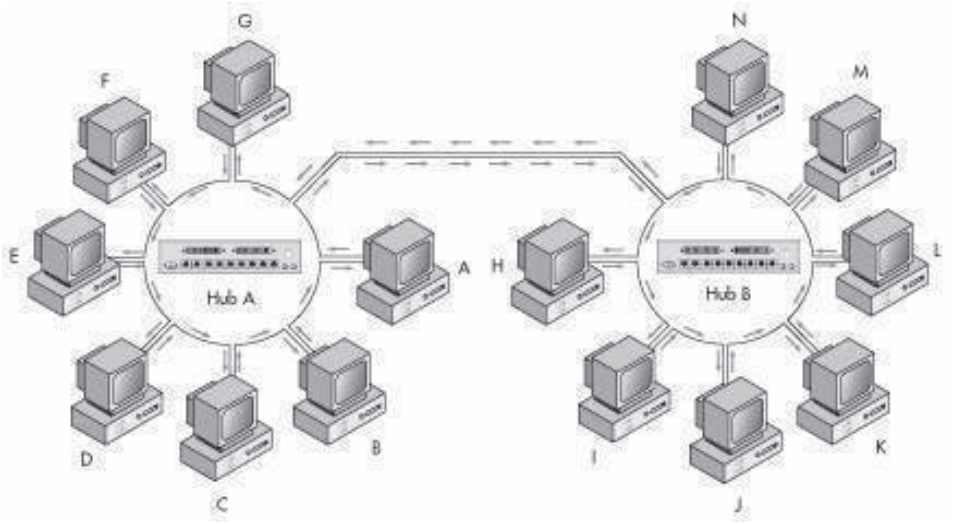


Fig. 1.10(b) : A Dual Ring Topology

In ring topology the communicating computers must follow some agreement between them to avoid collision as it is also a broadcast network. The main difference between the bus and ring is that the ring topology does not require termination. Because the systems are connected all together in a loop, there are no beginning and end point as there is with the bus topology. A failure in any cable or device breaks the loop and can take down the entire network.

Two major network types that use the ring topology are :

i) *Fiber Distributed Data Interface* (FDDI) where a large, high speed networks use fiber optic cables in a physical ring topology.

ii) *Token-Ring networks* that use logical ring topology.

Advantages :

- No collision of data as data travel in one direction only.

- Easier to fault find. If any point gets broken we can trace that easily.
- No terminator required.

Disadvantages :

- Ring topology requires more cable than bus topology
- A break in ring will take the whole network down.
- Addition or removal of any node can affect the entire network.

1.7.3 Star Topology

In the *star* topology, all computers and other network devices connect to a central device(controller) called a ***hub*** as depicted in the figure.1.11. Each connected device requires a single cable to be connected to the hub. A hub normally accepts data from a sending computer and delivers it to the computer for which the data is addressed. Hence, a star network is not a broadcast network, rather a point-to-point network. Using a separate cable to connect to the hub allows the network to be expanded without disruption to the network. Because each computer uses a separate cable to connect to the hub, the failure of a network connection affects only the single machine concerned. The other computers can continue to function normally.

Fast Ethernet (100Base-TX & 100Base-FX) in a star topology is the most commonly used LAN today. *10Base-T Ethernet* and *1000Base-TX Gigabit Ethernet* also use star topology.

Fig. 1.11 : A Star Topology

Adavntages :

- Star networks are easily expanded without disruption to the network.
- Easy to add/remove devices to/from network
- One break does not bring the whole network down. Cable failure affects only a single user.
- Easy to troubleshoot and isolate problems.
- Widely used centralized management

Disadvantages :

- Costs are usually higher than with bus or ring networks.
- Requires more cable than most of the other topologies.
- If the hub fails, any device connected to it will not be able to access the network.

In the following table, various networks with their cable types, topologies are shown:

Network Type	Standard	Cable Type	Topology
Ethernet	10Base-2	Thin(RG-58)	Bus
Ethernet	10Base-5	Thick(RG-59)coaxial	Bus
Ethernet	10Base-T	CAT3 or CAT5 UTP	Star
Fast Ethernet	100Base-TX	CAT5 UTP	Star
Gibabit Ethernet	1000BaseTX	CAT5, 5e or UTP	Star
Token Ring	all	UTP or STP	Logical Ring

Table 1.1 : Network cable types and topologies

1.7.4 Mesh Topology

The mesh topology incorporates a unique network design in which each computer on the network connects to every other, creating a point-to-point connection between every device on the network. A mesh topology is used when there can be absolutely no break in communications; for example, the control systems of a

nuclear power plant. The purpose of the mesh topology is to provide a high level of redundancy. If a network cable, computers or other components fail, the data always has an alternative path to get to its destination.

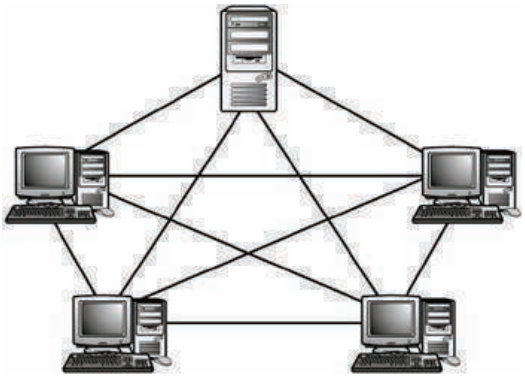


Fig. 1.12 : A Mesh Topology

A fully connected mesh network has n(n-1)/2 cables to link 'n' devices. Therefore, every device on the network must have 'n-1' input/output (I/O) ports. For example, in the Fig.1.12, we have five systems that require 10 cables to create a mesh network. This topology is mainly used in environments where high availability outweighs the costs associated with this amount of interconnection. We can see in the figure that the wiring for a mesh network can be very complicated. Further, troubleshooting a failed cable can be tricky. Because of this, the mesh topology is rarely used.

Advantages :

- Provides alternative paths between devices in the network.
- The network can be expanded without disruption to current users.

Disadvantages :

- It is expensive as because a large amount of cabling are required.
- Routing network traffic can be difficult because of all the different possible paths between nodes.
- It is very expensive to wire up.

There are also partial-mesh networks where some of the nodes are connected to all the others, but others are only connected to nodes with which they exchange the most of the data.

1.7.5 Tree Topology

A tree topology combines the characteristics of bus and star topologies. It consists of groups of star-configured workstations connected to a linear bus backbone cable (Fig. 1.13). This bus/star hybrid approach supports future expandability of the network much better than a bus (limited in the number of devices due to the broadcast traffic it generates) or a star (limited by the number of hub connection points) alone.

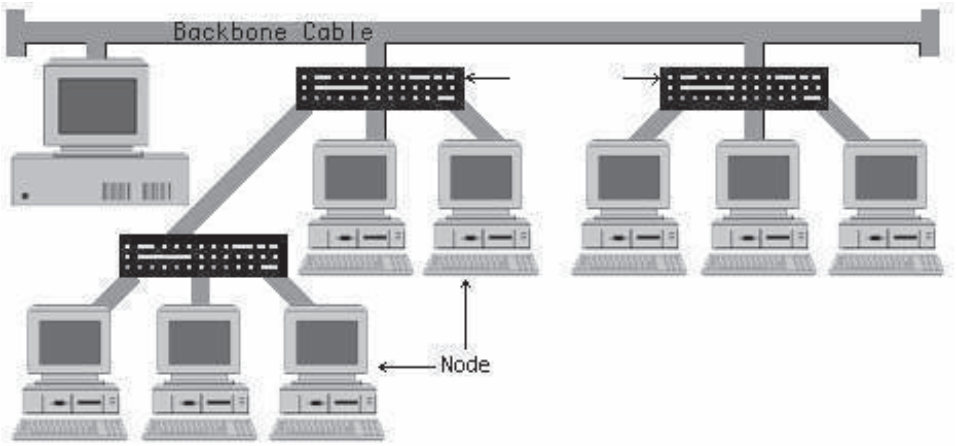


Fig. 1.13 : A Tree Topology

Advantages of Tree Topology :

- The network is easy to extend by just adding another branch.
- Fault isolation is relatively easy.

Disadvantages of Tree Topology :

- If the backbone cable breaks, the entire network goes down.
- More difficult to configure and wire than other topologies.
- If any hub goes down, all branches of that hub go down.

1.8 TYPES OF NETWORK

Whenever we have a set of computers or networking devices to be connected, we make the connections, depending on the physical layout and our requirements. On the basis of geographical area covered, computer networks can be classified under the following three categories:

- Local Area Network
- Metropolitan Area Network
- Wide Area Network

1.8.1 Local Area Network (LAN)

A ***local area network*** or **LAN**, is a high-speed data network that covers a relatively small geographic area such as a building, a laboratory, or a school. It typically connects workstations, personal computers, printers, servers, and other devices. LANs offer computer users many advantages, including shared access to devices and applications, file exchange between connected users, and communication between users via electronic mail and other applications. LANs differ in the way the computers are connected (i.e., their topology), how information moves around the network (i.e., their transmission technology) and their size.

IEEE (Institute of Electrical and Electronic Engineers) is a US publishing and standards organization responsible for many LAN standards such as the 802 series. *IEEE 802.3,* popular called *Ethernet,* is the most popular LAN, usually operating at 10 Mbps to 10 Gbps and is present in most large organizations and offices. In a typical LAN configuration, one computer is designated as the *server*. It stores all of the software that controls the network as well as the software that can be shared by the computers attached to the network. Computers connected to the server are called *workstations*. Two most commonly used LAN implementations are depicted below:

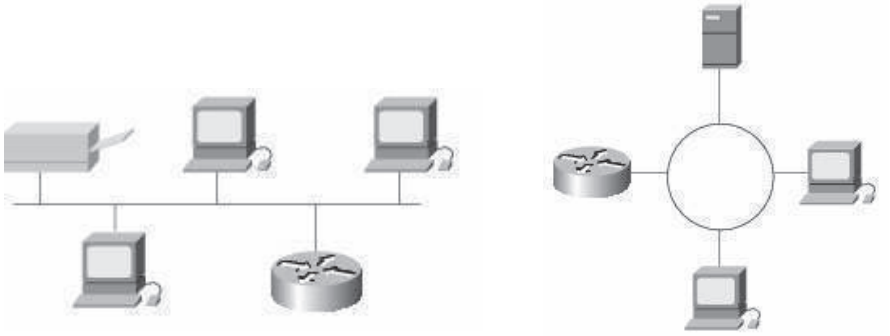


Fig.1.14 : (a) Ethernet or IEEE 802.3 (b) Token Ring or IEEE 802.5

LAN protocols function at the lowest two layers, i.e., the *physical* and the *data link layer* of the OSI reference model. We will discuss the layer concept of ISO-OSI reference model in the next unit which is “Network models”.

1.8.1.1 LAN Transmission Methods

LAN data transmissions fall into three classifications: *unicast*, *multicast*, and *broadcast*. In each type of transmission, a single packet is sent to one or more nodes.

- ***Unicast :*** Unicast is a one-to-one transmission method in which the network carries a message to one receiver, such as from a server to a LAN workstation. In a unicast environment, even though multiple users might ask for the same information from the same server at the same time, such as a video clip, duplicate data streams are sent. Unicast sends separate data streams to each computer requesting the data, thereby flooding the network with traffic.
- ***Multicast :*** Multicast is a one-to-many transmission method in which the network carries a message to multiple receivers at the same time. Multicast is similar to broadcasting, except that multicasting means sending to a specific group, whereas broadcasting implies sending to everybody, whether they want the traffic or not. When sending large amounts of data, multicast saves considerable network bandwidth because the bulk of the data is sent only once. The data travels from its source through major backbones and is then multiplied, or distributed out, at switching points closer to the end users. This is more efficient than a unicast system, in which the data is copied and forwarded to each recipient.
- ***Broadcast :*** Concept of broadcast is already discussed in previous section. *Broadcast* is a one-to-all transmission method in which the network carries a packet to all devices

at the same time, but a particular machice for which the packet is intended accepts it.

1.8.1.2 Peer-to-Peer LAN & Server Based LAN

On a LAN, we expect to share files, programs, or printers, all without being particularly aware of where the physical resources we're using are actually located. LANs providing these types of services are typically set up either as "*peer-to-peer*" or "*client-server*" LANs, or perhaps as a combination of the two.

- **Peer-to-Peer LAN**

  All the machines on a peer-to-peer LAN are equal. Provided that the file's owners give permission, a file on machine A can be accessed from machine B, and vice versa. Peer-to-peer LANs do not require any one machine to be a dedicated, high-performance server; service by a peer-to-peer LAN is often cheaper for this reason. Peer-to-peer LANs work well when only a small number of machines are connected to it. But as the size of the LAN grows, peer-to-peer services can become quite disorganized. To serve all its peers, each machine on the LAN must be powerful enough and for this reason its cost increases. For larger LANs, the dedicated client-server LAN architecture becomes more cost effective.

  Advantages :

  Less initial expense – No need for a dedicated server.

  Setup – An existing operating system (such as Windows XP) of the machine may only need to be reconfigured for peer-to-peer operations.

  Disadvantages :

  Decentralized – No central repository for files and applications.

  Security – Does not provide the security available on a client/server.

- **Client-Server LAN**

  A client-server LAN consists of one or more server machines on which shared files and programs reside and many client machines where people do their task. The LAN server machines usually have higher configuration and are fast because they must serve many users, while the client machines need only to be fast enough for one person to use at a time. Shared printers are either attached directly to a server, or to a print server (a specialized computer attached to the network), or to a personal computer on network that acts as a print server.

  Advantages :

  Centralized – In case of client-server architecture, resources and data security are controlled through the server.

  Scalability – Any or all elements can be replaced individually as needs increase.

  Flexibility – New technology can be easily integrated into system.

  Accessibility – Server can be accessed remotely and across multiple platforms.

  Disadvantages :

  Expense – Requires initial investment in dedicated server.

  Maintenance – Large networks will require a staff to ensure efficient operation.

  Dependence – When server goes down, operations will cease across the network.

Fig.1.15 : Peer-to-Peer

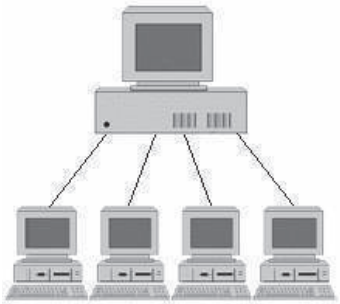


Fig. 1.16 : Client-Server

1.8.2 Metropolitan Area Network (MAN)

A ***metropolitan area network,*** or **MAN**, is basically a bigger version of a LAN and normally uses similar technology. It might cover a group of nearby corporate offices or a city and might be either private or public.

A MAN often provides efficient connections as it has high-speed transmission capabilities which uses some types of telecomminication components to handle long-distance transmission. One very common example of MAN is the cable television network. Another important example is the high-speed wireless Internet access, which has been standardized as *IEEE 802.16.*

1.8.3 Wide Area Network (WAN)

A ***wide area network*** or **WAN** is a computer network covering multiple distance areas, which may spread across the entire world. WANs often connect multiple smaller networks, such as local area networks (LANs) or metropolitan area networks (MANs).

Typically, a WAN consists of a number of interconnected switching nodes. A transmission from any one device is routed through these internal nodes to the specified destination device. These nodes are not concerned with the content of the data; rather, their purpose is to provide a switching facility that will move the data from node to node until they reach their destination. Traditionally, WANs have been implemented using either *circuit switching* or *packet switching* technologies. More recently, frame relay and *ATM* (*Asynchronous Transfer Mode*) networks have assumed major roles. Frame relay provides higher data rates, lowar costs, efficient handling of bursty data transmission in less expenditure. ATM offers more bandwidth to end users at less cost.

The ***Internet*** is the best known example of a WAN. Some segments of the Internet are also WANs in themselves. The Internet

is a system of linked networks that are worldwide in scope and facilitate data communication services such as *remote login*, *file transfer*, *e-mail*, the *World Wide Web* etc. With the rise in demand for connectivity, the Internet has become a communications highway for millions of users. The Internet was initially restricted to military and academic institutions, but now it is a full-fledged conduit for any and all forms of information and commerce. Internet websites now provide personal, educational, political and economic resources to every corner of the planet.

CHECK YOUR PROGRESS

Q.2. Fill in the blanks:

i) _____ defines the physical or logical arrangement of links in a net work.

ii) In _____ topology, every devices has a dedicated point-to-point link to every other device.

iii) _____ topology is the combination of different types of topologies.

iv) In _____ topology, each device has a dedicated point-to-point link only to a central controller.

v) _____ topology provides alternative paths between devices in the network.

vi) Ring topology requires _____ cables than bus topology.

vii) The topology used in Ethernet is _____ topology.

viii) _____ topology uses central controller or hub.

Q.3. What topology is used by 10Base-5 and 10Base-2 Ethernet?

.....

Q.4. What topology is used by FDDI ?

.....

Q.5. State True or False :

i) For larger LANs, the client-server LAN architecture is less cost effective as compared to peer-to-peer LANs.

ii) The world's most popular WAN is the Internet.

iii) Cable television network is an example of MAN.

iv) Ethernet is an example of LAN.

1.9 TRANSMISSION TYPES

Digital transmission is the sending of information over a physical communications media in the form of digital signals. Analog signals must therefore be digitised first before being transmitted. However, as digital information cannot be sent directly in the form of 0s and 1s, it must be encoded in the form of a signal with two states, for example:

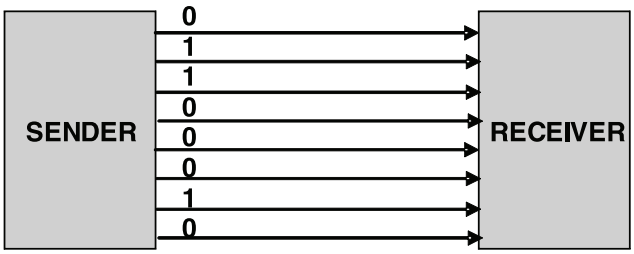
- two voltage levels with respect to earth
- the difference in voltage between two wires
- the presence/absence of current in a wire
- the presence/absence of light

Digital data transmission can occur in two basic modes:***parallel*** and ***serial.*** Data within a computer system is transmitted via parallel mode on buses with the width of the parallel bus matched to the word size of the computer system. Data between computer systems is usually transmitted in bit serial mode. Consequently, it is necessary to make a parallel-to-serial conversion at a computer interface when sending data from a computer system into a network and a serial-to-parallel conversion at a computer interface when receiving information from a network. The type of transmission mode used may also depend upon the distance and the required data rate.

1.9.1 Parallel Transmission

Parallel transmission communicates bits simultaneously over multiple lines(wires, frequency channels); typically, the total consists of one or more bytes at a time. Parallel devices have a wider data

bus than serial devices and can therefore transfer data in words of one or more bytes at a time. As a result, there is a speedup in parallel transmission bit rate over serial transmission bit rate. The timing for parallel transmission is provided by a constant clocking signal sent over a separate wire within the parallel cable; thus parallel transmission is considered synchronous. Computers are typically connected to printers and external disk drives via parallel interfaces, ports, and buses.

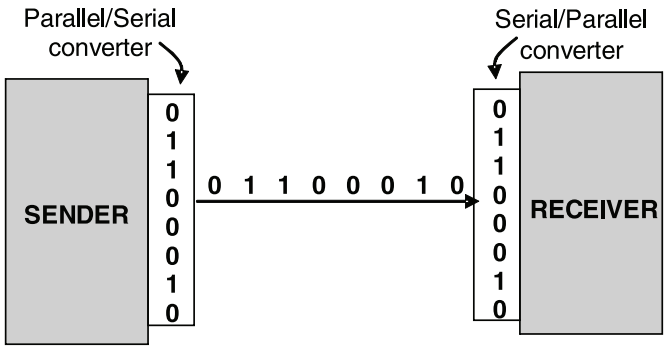


(a) Parallel Transmission;
The eight bits are sent through eight wires at a time

Fig. 1.17

1.9.2 Serial Transmission

Serial transmission sends one bit at a time over a single transmission line. The cost of communication hardware is considerably reduced since only a single wire or channel is required for the serial bit transmission which also slows the speed of transmission. Telephone lines use serial transmission for digital data. Thus, modems are connected to the computer via a serial port. A ***serial port*** is a socket on a computer used for connecting the serial interface to a serial line or bus. A ***serial interface*** is a data channel that transfers digital data serially; it is typically implemented as a cord that plugs into an expansion slot on a computer motherboard. Serial interfaces have multiple lines, but only one is used for data. An external ***serial bus*** carries serial data to any device connected to it, e.g., Ethernet. Serial transmission can be either *synchronous* or *asynchronous*.



(b) Serial Transmission;
The eight bits are sent one after another through a single wire

Fig. 1.18

Serial transmission technology is increasingly used for the transmission of digital data. A large number of up-to-date communications networks apply serial transmission. The numerous applications include computer networks for office communications, building and manufacturing automation, and finally, Internet. The transmission of a stream of bits from one device to another accross a transmission media involves a great deal of cooperation and agreement between the two sides (sender and receiver). One of the most fundamental requirements is ***synchronization***. The receiver must know the rate at which bits are being received so that it can sample the medium at appropriate intervals to determine the value of each received bit. For achieving the desired synchronization, there are two approaches. ***Synchronous*** and ***asynchronous transmissions*** are two different methods of transmission synchronization.

1.9.2.1 Asynchronous Transmission

Communication is called *asynchronous* if the transmitter and the receiver do not need to synchronise before each transmission. A sender can wait arbitrarily long between transmissions and the receiver must be ready to receive data when it arrives. Most PC serial devices such as mouse, keyboards and modems are asynchronous.

As the name implies, asynchronous communication is performed between two or more devices which operate on independent clocks. Thus, there is no guarantee that when Point A begins transmitting, Point B will begin receiving, or that Point B will continue to sample at the rate Point A transmits. In asynchronous transmission, data are transmitted one character at a time, where each character is five to eight bits in length. Timing or synchronization must only be maintained within each character; the receiver has the opportunity to resynchronize at the beginning of each new character. The following figure (Fig.1.19) depicts what happens when transmission clocks differ significantly. In fig.1.19 (a), we see that, the receiver samples at mid point of each bit of the incoming data. In fig.1.19 (b), the receiver clock is too slow; causing bit 4 to be skipped and as a result, the data is corrupted.To combat this type of timing problem, asynchronous communication requires additional bits to be added around actual data in order to maintain signal integrity. The bits of the character are transmitted beginning with the least significant bit.

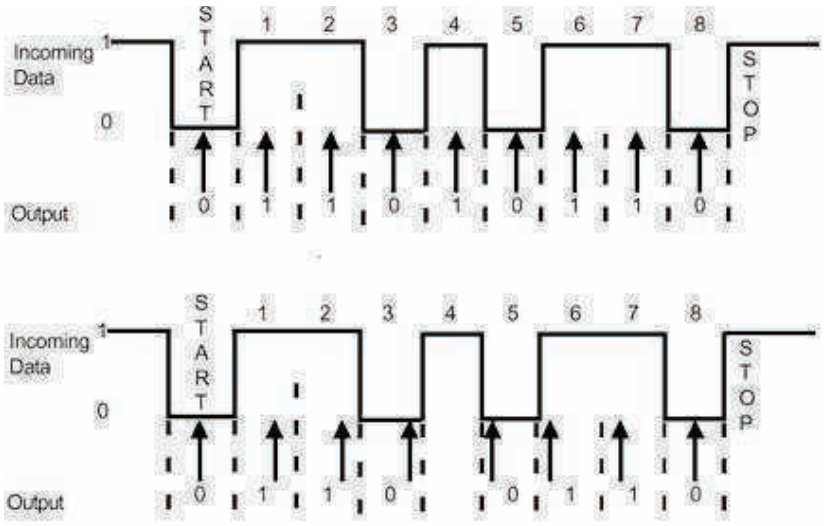


Fig. 1.19 : Asynchronous Data Sampling

Asynchronously transmitted data is preceded with a ***start bit*** which indicates to the receiver that a character is about to begin. The end of a character is followed by a ***stop bit***, which tells the

receiver that the character has come to an end, that it should begin looking for the next start bit, and that any bits it receives before getting the start bit should be ignored. To avoid confusion with other bits, the start bit is twice the size of any other bit in the transmission. To ensure data integrity, a ***parity bit*** is often added between the last bit of data and the stop bit. The parity bit is set by the transmitter so that the total number of ones in the character, including the parity bit, is even (even parity) or odd (odd parity), depending on the convention being used. The receiver uses this bit for error detection. The parity bit makes sure that the data to be received is composed of the same number of bits in the same order in which they were sent.

1.9.2.2 Synchronous Transmission

The term synchronous is used to describe a data transfer method in which a continuous stream of data signals is accompanied by timing signals (generated by an electronic clock) to ensure that the transmitter and the receiver are synchronized with one another. These types of connections are used when large amounts of data must be transferred very quickly from one location to the other. The speed of the synchronous connection is attained by transferring data in large blocks instead of individual characters. A block of bits is transmitted in a steady stream without start and stop bits. Data or information is moved from one place to another at instants in time that are measured against the clock signal being used. This signal usually comprises of one or more high frequency rectangular shaped waveforms, generated by special purpose clock circuitry. These pulsed waveforms are connected to all the devices that operate synchronously, allowing them to start and stop operations with respect to the clock waveform.

Typical examples of synchronous signals include the transfer and retrieval of address information within a computer via the use of an *address bus*. For example, when a processor places an

address on the address bus, it will hold it there for a specific period of time. Within this interval, a particular device inside the computer will identify itself as the one being addressed and will acknowledge the commencement of an operation related to that address.

In synchronous transmission, each block begins with a preamble bit pattern and generally ends with a postamble bit pattern. In addition, there are some other bits that convey control information. The data with the preamble, postamble, and control information are termed as a ***frame***. A general frame format for synchronous transmission is shown in Fig.1.20. Typically, the frame starts with a preamble called a flag, which is 8 bits long.

8-bit flag	Control fields	Data fields	Control fields	8-bit flag

The same flag is used as a postamble. The receiver looks for the occurence of the flag pattern to signal the start of a frame. This is followed by some number of control fields, then a data field, more control fields, and finally the flag is repeated.

1.10 MODES OF COMMUNICATION

Transmission modes mean the way in which a communication is achieved between two linked devices. The device which sends data or information is called the sender and the one which receives the information is called the receiver. A channel can support either one way communication or two way communication at a time. Based on the way of communication link, transmission modes can be classified as : *simplex*, *half duplex* and *full duplex*.

- ***Simplex :*** A *simplex* connection is a connection in which the data flows in only one direction, from the transmitter to the receiver. This type of connection is useful if the data do not need to flow in both directions, for example, from our computer to the printer or from the mouse to our computer. It allows one-way

communication of data through the network, with the full bandwidth of the cable being used for the transmitting signal.

- ***Half-duplex :*** A *half-duplex* system provides for communication in both directions, but only one direction at a time (not simultaneously). Typically, once a party begins receiving a signal, it must wait for the transmitter to stop transmitting, before replying. This type of connection makes it possible to have bidirectional communications using the full capacity of the line. A good analogy for a half-duplex system would be a one-lane road with traffic controllers at each end. Traffic can flow in both directions, but only one direction at a time, regulated by the traffic controllers. Many networks are configured for half-duplex communication. One suitable example of a half-duplex system is a two-"walkie-talkie".

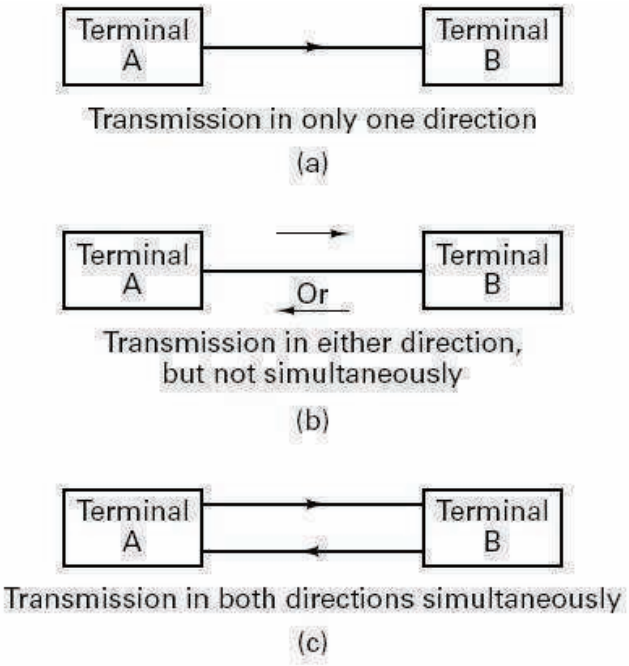


Fig. 1.21 (a)Simplex mode, (b) Half-duplex mode and (c) Full-duplex mode

- ***Full- duplex :*** The preferred transmission mode for network communication is the *full-duplex* mode. A *full-duplex* allows communication in both directions simultaneously. Each end of the line can thus transmit and receive at the same time, which

means that the bandwidth is divided in two for each direction of data transmission if the same transmission medium is used for both directions of transmission. A good analogy for a *full-duplex* system would be a two-lane road with one lane for each direction. For example, telephone networks are full-duplex, since they allow both callers to speak and be heard at the same time.

1.11 SWITCHING TECHNIQUES

When we have multiple work stations, a problem of connecting them for one to one communication arises. One solution for this problem is to establish point to point connections between each individual pair of stations. To interconnect ***n*** stations, ***n(n-1)/2*** individual connections are needed. For instance, to connect 10 components, a total of individual 45 connections are required; for 100 components, 4950 connections are required. The requirement increases drastically as the number of stations to be interconnected increase, and for a large number of stations, it is almost impossible to maintain individual connections. A well known solution for such type of problems is, ***switching***. Let us think, how things would be if we could only use our telephone to talk to just one other person! So there are requirements for switching systems to route our calls around the world. The switches can be placed on the transmission path so that the stations do not need to be interconnected directly. In this section, we will briefly discuss the various switching techniques which are in use currently.

In general, there are three methods of switching have been used: ***circuit switching***, ***message switching*** and ***packet switching***.

1.11.1 Circuit Switching

Circuit switching is the transmission technology that has been used since the first communication networks in the nineteenth century. The basic idea of circuit switching is to set up a dedicated logical path between two users or machines, prior to the commencement of data communication. In circuit switching, a caller

must first establish a connection to a callee before any communication. During the connection establishment, resources are allocated between the caller and the callee. The most common application of circuit switching is *telephone* network. Circuit switching mechanism is divided into three phases: *circuit establishment*, *data transfer* and *circuit disconnect.*

Characteristics of Circuit Switching :

- An end to end dedicated path is needed.
- Connection path must be established before the beginning of data transmission.
- Channel capacity must be reserved between each pair of nodes whether that capacity is utilized or not.
- The technology is developed to handle voice data because of its key requirement that there should be no delay in the transmission and a constant signal transmission rate must be maintained.

Advantages of Circuit Switching :

- It is well suited for real time communication purposes.
- The service provided by circuit switching is guaranteed since the channel remains dedicated to users throughout the communication session.

Disadvantages of Circuit Switching :

- Any unused ***bandwidth*** over the allocated circuit is wasted.
- Line may be idle most of the time.
- Both sender and the receiver must function with the same speed. This limits the utility of the network in interconnecting a variety of host computers and terminals.

Bandwidth : A communication channel utilizes a specific frequency to transmit the electromagnetic energy which represents the data. Transmitting information requires more than a single frequency. And, for this purpose a band of spectrum around the nomical frequency is required, which is known as bandwidth of the signal.

1.11.2 Message Switching

Message switching refers to a switching technique involving transmission of messages from node to node through a network. In this technique, the source computer sends data or the message to

the switching office first, which stores the data in its buffer. It then looks for a free link to another switching office and then sends the data to this office. This process is continued until the data are delivered to the destination computers. Owing to its working principle, it is also known as *store and forward*. That is, store first (in switching office), forward later, one jump at a time.

Advantages of Message Switching :

- No waiting of the setup of path- As soon as a user has data to send, he/she may transmit it over the channel.
- The channel can be fully utilized.
- Priority of messages can be implemented.
- Broadcasting can be done very easily to all the nodes in a network.

Disadvantages of Message Switching :

- Not suitable for real time transmission
- In message switching, message size is not fixed. For very large message, the nodes are required to have large buffers, which may not be practically implemented due to economical and technical constraints.
- Since there is no size limitation of the message, long messages can keep the channel blocked for a long period of time.

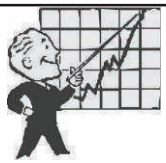
1.11.3 Packet Switching

Packet switching is very similar to message switching. The main difference is that the length of the units of data that may be presented to the network is limited in a packet-switches network.

With message switching, there is no limit on block size.In contrast, packet switching places a tight upper limit on block size. A fixed size of packet which can be transmitted across the network is specified. Another point of its difference from message switching is that data packets are stored on the disk in message switching whereas in packet switching, all the packets of fixed size are stored

in main memory. This improves the performance as the access time (time taken to access a data packet) is reduced and thus the throughput (measure of performance) of the network is improved.

There are two approaches to implement packet switching. These are : the datagram approach and the virtual circuit approach.



CHECK YOUR PROGRESS

Q.6. Choose the correct answer:

i) In simplex mode of transmission
   a) Data transmission is one way
   b) Data can be transmitted to small distances only
   c) Data format is simple
   d) None of the above

ii) In half-duplex data transmission
   a) Data can be transmitted in one direction only
   b) Data can be transmitted in both directions
   c) Data can be transmitted in both directions simultaneously
   d) None of the above

iii) In _____ transmission, a start bit and a stop bit form a character byte.
   a) asynchronous b) synchronous
   c) parallel d) none of these

iv) _____ communicates bits simultaneously over multiple lines
   a) serial transmission
   b) synchronous communication
   c) asynchronous communication
   d) parallel transmission

1.12 LET US SUM UP

This unit provides the basic concept of computer networking. **Networking** is the linking of computers (not necessarily over large distances) so they can communicate, sharing hardware and software, thus uniting processing power. Various concepts such as connection-oriented and connection-less services, broadcast and point-point networks etc. are also presented in this unit. We are also acquainted with the different types of computer networks with their relative advantages and disadvantages. It also provides the concept of network topologies and various internetworking devices. Apart from this, types of transmission and communication modes are also covered towards the end. A brief introduction of switching techniques is also included in this unit.

1.13 FURTHER READINGS

- *"Computer Netwotks",* Andrew S. Tanenbaum, Prentice Hall India.
- *"Data and Computer Communications",* William Stallings, Pearson Prentice Hall.

1.14 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1 : i) False, ii) True, iii) False, iv) True

Ans. to Q. No. 2 : i) Topology, ii) mesh, iii) Hybrid, iv) star, v) Mesh, vi) more, vii) bus, viii) star

Ans. to Q. No. 3 : Bus topology

Ans. to Q. No. 4 : Ring topology

Ans. to Q. No. 5 : i) False, ii) True, iii) True, iv) True

Ans. to Q. No. 6 :
i) a) Data transmission in one way
ii) b) Data can be transmitted in both directions
iii) a) asynchronous
iv) d) parallel transmission

1.15 MODEL QUESTIONS

Q.1. Define computer network. What are the goals of computer networks?

Q.2. What is the difference between circuit switching and packet switching?

Q.3. What are the different types of networking devices?

Q.4. What are the advantages and disadvantages of circuit switching?

Q.5. What do you mean by network topology? Discuss briefly each type of network topology.

Q.6. List the relative advantages and disadvantages of bus, ring and star topologies.

Q.7. Differentiate between connection-less and connection-oriented networks.

Q.8. What are the different modes of communication? Distinguish simplex, half-duplex, and full-duplex mode of transmission.

Q.9. Distinguish between peer-to-peer LAN and client-server LAN.

Q.10. Describe briefly the various features of serial and parallel transmission.

Q.11. Explain the concept of message switching.

Q.12. What are the basic differences of the function of bridges and gateways in a computer network?

UNIT 2 : NETWORK MODELS

UNIT STRUCTURE

2.1 LEARNING OBJECTIVES

After going through this unit, you will be able to :

- describe design issues of network architecture
- describe functions of various network layers
- define various network terminologies
- distinguish between connection-oriented and connection-less service
- compare between OSI and TCP/IP model

2.2 INTRODUCTION

The computer network and its structure can be best understood by studying its underlying communication software and the related hardware. Historically, first computer networks were designed to work on hardware which proved to be fatal afterwards. It leads to inflexibility to the computer

networks. The later development of computer networks were based primarily on highly structured software implemented on ever changing hardware. The communication software in a computer network is a much thought out software which is organized as layered software. The internal structure of the layered software is discussed in this unit.

2.3 DESIGN ISSUES OF LAYER

Before proceeding to learn the layered structure of network software and the various aspects of computer network, we should be acquainted with different design issues of ***layer***.

- To interchange data between two processes running on two computers there must be some addressing technique for the communication correctly.
- The communication may be unidirectional (simplex communication) or in both directions alternately one after another (half-duplex communication) or bidirectional (full-duplex communication).
- Error control is also an important issue because physical communication channels are not perfect, rather, they are error prone. Now both communicating parties must agree on which error detecting and correcting code is to be used. The receiver should also let the sender know which message is received correctly and which is not.
- During transfer, messages are often divided into pieces and all the pieces may not be transferred in proper order. This loss of sequencing has to be taken care of by the protocol concerned.
- There must be provision to refrain a fast sender from swamping a slow receiver.
- The layer concern may decide to use the same connection for several unrelated conversations by the multiplexing and de-multiplexing techniques.
- When there are many paths between the sender and the receiver,

a decision must be taken as to which route is to be taken. The decision may be static or dynamic.

2.4 PROTOCOL HIERARCHY

From the design issues discussed above it is apparent that the computer network design is a complex job. To reduce the complexity of design, most of the computer networks are organized as a stack of layers, one above another, taking the service offered by the layer below. In this structure, a lower layer gives certain services to the layer just above it; at the same time it shields the details of the implementation of those services from the upper layer.

In the layered organization, a particular layer on one machine talks with a peer layer on another machine. During the conversation, they follow some rules and conventions. These rules and conventions are collectively known as **protocol**. Here we have used the term **peer** which means entities comprising the corresponding layer on different machines. So, it is the peers that talk using their own protocol.

In Fig 2.1 a five layer network is shown. Here we can see dotted arrow between peers and solid arrow between any two adjacent layers. Dotted arrow indicates that layer *n* on one machine communicates with

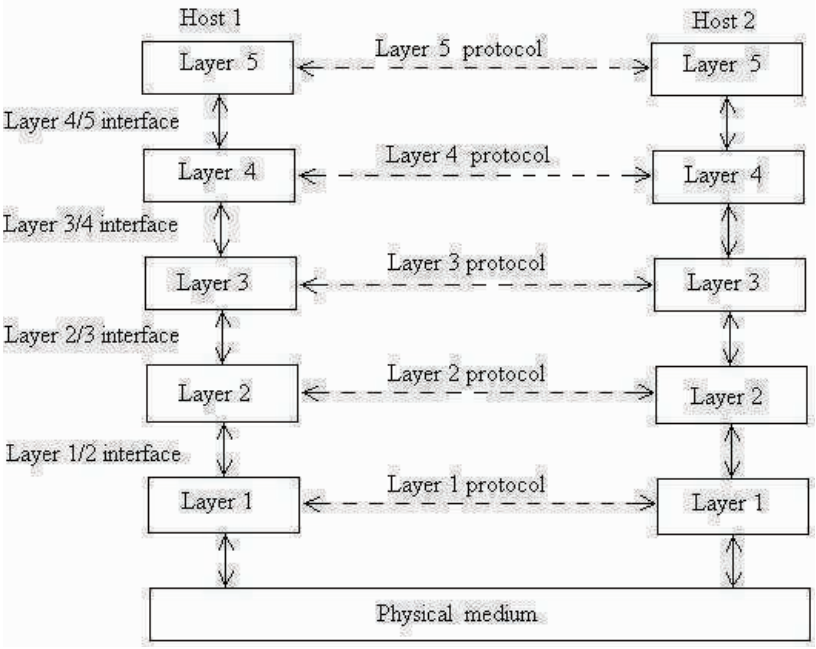


Fig. 2.1 Layers, protocols and interfaces

layer *n* on the other machine. During communication they follow their protocol.

Every layer communicates with the peer layer on the other machine. But all these communications are virtual since no data really moves through these dotted lines; rather data moves through solid arrow lines. In the process of communication, each layer hands over their data to the layer immediately below it. In this way, data moves downward until the lowest layer, below which lies the physical medium through which the the actual communication takes place. This is the picture in the sending machine. The picture is just opposite in the receiving machine where data moves upward after it enters the computer from the physical medium.

In the Fig 2.1 each layer gets **service** from the layer just below it. A layer performs some primitive operations to give the service required by the immediate upper layer. The transaction between two adjacent layers takes place as per a predefined guideline where each layer performs a specific collection of functions. So, there exists an **interface** between each pair of adjacent layer through which they exchange data and information and in the process, the upper layer gets service from the lower layer. As long as the interface is unchanged, one can change the underlying hardware at any time without affecting the network operations. As for example, underground copper cables are gradually replaced by fiber optic cables but it is not hampering the operations of the existing network because the interfaces between the layers remain unchanged.

The layers and their protocols are collectively known as network **architecture.** In network architecture each layer has its own protocol. The protocols used by all the layers of a network system is called **protocol stack.** Stack means something arranged one above another, like stack of bricks or something similar. In a layered network architecture, layers are arranged from bottom to top, one upon another, hence their respective protocols also lie one upon another. That's why the name protocol stacks. In the same sense, *protocol hierarchy* indicates that the protocol of any layer is hierarchically above the protocol of the layer immediately below it.

2.5 ISO-OSI REFERENCE MODEL

The OSI reference model is shown in Fig 2.2. The International Standard Organization (ISO) developed a proposal for a network model and the resulting model is known as ISO – OSI reference model. This model has seven layers and the layers are :

i) Physical layer
ii) Data link layer
iii) Network layer
iv) Transport layer
v) Session layer
vi) Presentation layer
vii) Application layer

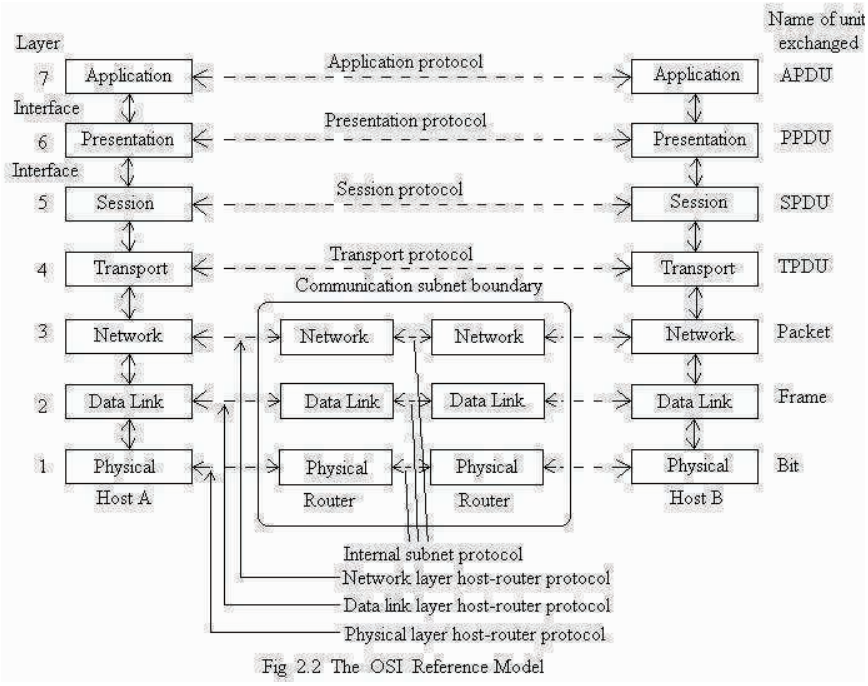


Fig. 2.2 : Layers, protocols and interfaces

(i) The Physical Layer : The physical layer is responsible for transmitting raw bits over the communication channel. This layer is to ensure how to send a 1 bit from the sending computer as 1 bit to the receiving computer; not as 0 bit. The physical layer also deals with the issues of how many bits per second will be transmitted, what level of voltage will be used to represent 1 and

0, whether transmission will be unidirectional or bidirectional, how the initial connection be established and terminated at the end, how many pins of network the connector has and which pin is for what etc etc. Hence, the design issues of the physical layer is mostly mechanical, electrical and procedure oriented.

(ii) **The Data Link Layer :** The data link layer use the raw transmission facility and transforms it to an apparently error-free facility to be used by the network layer. This layer breaks the input data into frames by inserting appropriate frame boundary, transmits the frames sequentially and processes the acknowledgment sent back by the receiving computer. If a frame is completely destroyed by noise burst, it is the duty of data link layer to retransmit it from the source machine. Data link layer also ensures that a fast sender is not allowed to swamp a slow receiver by sending data at a higher rate than it can be handled by the receiver. This is called ***flow control***. In a broadcast network it is the duty of MAC (Medium Access Control) sub-layer of data link layer to decide who will access the transmission medium at a particular time.

(iii) **The Network Layer :** The network layer controls the operation of the subnet. The layer is to determine how packets are routed from source to destination. The routing may be static or dynamic depending on traffic load and availability of channel.

Too many packets may cause congestion (traffic-jam) and control of such congestion is also a duty of the network layer.

The subnet operation requires cost; hence, some accounting function is also there being built into the network layer. When a packet crosses national boundary some other aspects of accounting has to be dealt with by network layer.

Packets have to travel in between heterogeneous network running on different platforms using different network protocol and the network layer is also responsible to resolve all the problems arising out of such situations.

(iv) **The Transport Layer :** The transport layer is to accept the data from the session layer, breaks it into smaller units if necessary, hands over these to the network layer and ensures that the pieces all delivered correctly to the receiver. The above duties must be done efficiently and in such a way that it will not affect the upper layer in case there is any change in the hardware.

Normally, the transport layer creates individual connection for each session. If high throughput is required, the transport layer may establish multiple network connections, dividing the data among individual connections, thereby improving the throughput. To reduce cost the transport layer may also multiplex several transport connections onto the network connection. However, multiple connections or multiplexing must not be seen by the session layer.

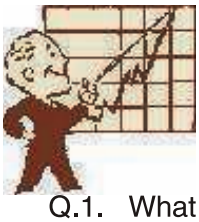
The transport layer also determines the type of service given to the user of the network. Error free point-to-point connection is the most popular transport layer service where messages or bytes are delivered in order in which they were sent. The transport layer also performs flow control.

(v) **The Session Layer :** This layer offers facility to different users on different computers to establish session between them. A session allows an user to remotely log into a distant machine and transfer file between the two machines. Session layer perform token management to provide unidirectional communication. It also provides a service called synchronization.

(vi) **The Presentation Layer :** This layer performs data presentation job by following syntax and semantics rules. Before presenting data to the user, it transforms data into their acceptable form.

(vii) **The Application Layer :** This layer is the nearest layer to all the network users. It offers variety of protocols that are commonly needed. It helps to transfer file. Different file systems have different meanings in different machines with different data formats etc. When files are transferred from one machine to

another with different file systems, the application layer takes the necessary steps to resolve the abnormalities.



CHECK YOUR PROGRESS

Q.1. What are *service* and interface?

.....

.....

Q.2. What do you mean by network architecture?

.....

.....

Q.3. How many layers are there in ISO-OSI model?

.....

Q.4. What are the prime duties of Data Link Layer?

.....

2.6 IMPORTANT TERMINOLOGIES

When we study the subject of computer network, we encounter many terminologies associated with the subject. Already we have come across a few terminologies such as **peer, interface, protocol, service** etc. Some others are briefly described below:

- **Entity :** The active components in each layer is called an entities. Entity can be a software process or hardware like an intelligent input/output device etc.
- **Peer Entity:** Entities in the same layer running on different machines are called peer entities.
- **Service provider and Service user:** In layered architecture, layer *n* provides a service which is used by layer *n+1*. Here layer *n* is service provider and layer *n+1* is service user.
- **SAP (Service Access Points):** A layer *n* offers services to layer *n+1* at a place which is called service access point. Each SAP has a unique address for identification.

2.7 CONNECTION-ORIENTED AND CONNECTIONLESS SERVICE

A layer can offer two different types of services to the layer immediately above it – connection-oriented and connectionless service.

In ***connection-oriented*** service, the service user atfirst establishes a connection atfirst, communicates over the connection and at last release the connection. It is similar to a telephone system.

In ***connectionless*** service, no connection is established beforehand. Instead, like in a postal system, every massage carries its full destination address and each is routed independently to its destination. If a big message is broken into pieces and sent to the same destination, then in connectionless service sometimes it may happen that the first piece may arrive at the destination after the later pieces. That means at the receiving end the order of delivery may not be same as the order of transmission. In connection-oriented service this never happens.

2.8 TCP/IP REFERENCE MODEL

TCP/IP reference model was developed much earlier than the OSI reference model. It was evolved from the US Department of Defense's (DoD) research network- The ARPANET. Eventually the ARPANET connected many universities and other government organizations. During the process of interconnecting all these through the existing telephone lines, satellite link and radio, the protocol used for the ARPANET had trouble and therefore, a new architecture was needed to overcome that. The model has four layers, namely :

1. The Host-to-Network Layer.
2. The Internet Layer.
3. The transport Layer.
4. The Application Layer.

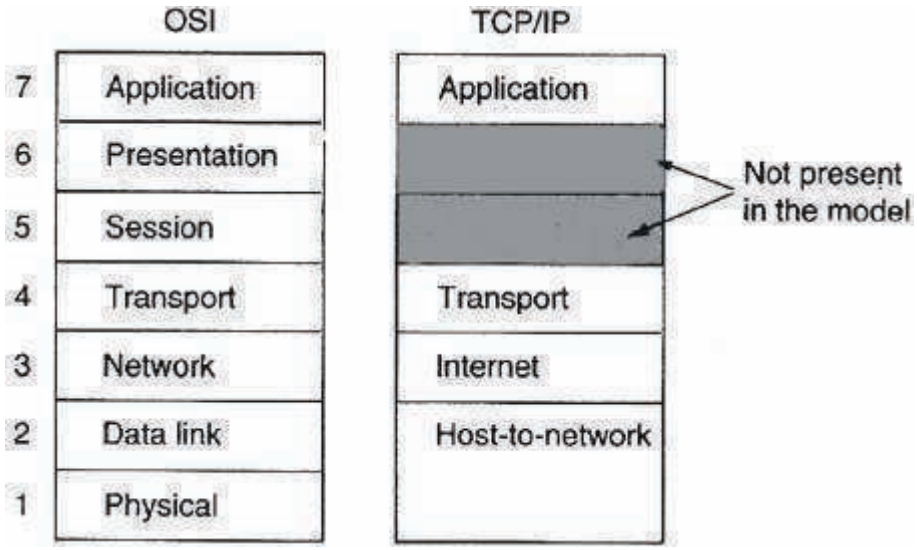


Fig. 2.3 : The TCP/IP reference model

1. **The Host-to-Network Layer :** In TCP/IP reference model the bottom layer is not defined clearly. Yet we can consider that whatever is there below the internet layer is the bottom layer in the TCP/IP model. In the model, the host has to be connected to the network using some protocol so that it can send IP packets over it.
2. **The Internet Layer :** The DoD planned to set up their inter-network in such a way that it had to survive even if a particular link failed in a probable war. So, this requirement led to connectionless packet-switching network instead of a connection-oriented circuit-switching network. The internet layer is designed to fulfil the goal of the architecture in such a way that it becomes the linchpin of the whole architecture. The job of this layer is to pump the packets from the host machine into any network and to help the packets to go to the destination independently. In this style of communication, packets may arrive in a different order than they were sent. This layer has its own protocol called **IP (Internet Protocol)** and a specified packet format. Packets routing as well as congestion avoidance are the major issues in this layer. This layer is similar to the network layer in OSI reference model.

3. **The Transport Layer :** The layer immediately above the internet layer is called the transport layer. This layer communicates with the peer layer on the other machine. It has two protocols namely **TCP and UDP.**

   (i)TCP: TCP is a reliable connection-oriented protocol that ensures delivery of byte stream from source machine to destination machine. This layer breaks the byte stream received from the upper layer into messages and passes them to the internet layer. At the receiving machine, these messages are reassembled by the TCP which passes them to the upper layer. Flow control is also another job of this layer to restrict a fast sender from swamping a slow receiver.

   (ii) UDP: UDP is another protocol used by this layer which offers an unreliable, connectionless service. Here, unlike TCP, sequencing and flow control is not done. When prompt delivery is more important than accurate delivery, UDP is used. It is also widely used in one time client-server type communication. Email, video or sound transmissions are some of these applications.

4. **The Application Layer :** In OSI model, there are session and presentation layers above the transport layer. In TCP/IP model these two layers are absent. So, on top of the transport layer, the application layer is present in TCP/IP reference model. All the high level protocols are present here. TELNET, FTP, SMTP are some of the early inclusions. Later, other protocols such as DNS, NNTP, HTTP are added to this layer.

2.9 COMPARISON OF ISO-OSI & TCP /IP REFERENCE MODEL

There is not much difference between the OSI and TCP/IP reference model. In both, the concept of independent stack of protocols is used. The functions of the layers are also more or less same. In both models, starting from bottom up to the transport layer, the function of the layers is to provide

end-to-end network independent transport service for communicating processes. The layers above the transport layer are application oriented.

On the other hand, there are some differences between the two models. In OSI reference model, three concepts are distinct. These are -

1. Services,
2. Interfaces,
3. Protocols.

The *Service* tells what a particular layer serves the layer just above it, not how these services are accessed by the above layer or how these are provided by the layer. The *Interface* tells how the above layer accesses the services provided by the layer just below it. It also does not say how these are provided. The *Protocols* used between peer layers are the set of rules agreed upon by both the layers to get the job done. Protocols can be changed without affecting the software in the higher layers.

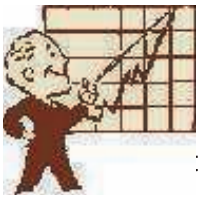
In TCP/IP model, there is no such distinction between *Services, Interface and Protocol*. Therefore, in TCP/IP reference model the protocols are not so hidden as in the OSI reference model. As the technology advances, protocol between a peer layer can be replaced easily in OSI model than in TCP/IP model.

In OSI model, the layered structure was thought out before the protocols were invented. The designers were new in the network technology and hence in some layer a sub-layer has to be provided later to accommodate some new mode of communication. For example, in data link layer, the MAC sub-layer was introduced later when broadcast communication came to deal with channel allocation issues. On the other hand, in TCP/IP model, the protocols came first and then the model. So there was no problem of fitting the protocols into the model.

The two models also differ in their number of layers; In OSI model there are seven layers whethas TCP/IP model has four layers. Both have (inter)network, transport and application layers in common but the other layers are not the same.

In OSI model, network layer supports both *connection-oriented* and

connectionless communication and the transport layer supports only *connection-oriented* communication. On the contrary, in TCP/IP model the network layer supports only *connectionless* communication but the transport layer supports both the modes i.e. *connectionless* and *connection-oriented* communication.



CHECK YOUR PROGRESS

: are the two services that can be offered by a layer to the layer above it?

.....

Q.6. How many layers are there in TCP/IP reference model?

.....

Q.7. Which model of network architecture was developed earlier – OSI or TCP/IP?

.....

Q.8. Which two layers of OSI model are absent in TCP/IP model?

.....

2.10 LET US SUM UP

- There must be some addressing technique for smooth communication between two computers.
- Simplex communication means one directional communication.
- In half-duplex communication, communication is bidirectional alternatively; not at the same time.
- Full-duplex communication means bidirectional communication at all time.
- Most of the computer networks are organized as a stack of layers, one above another, taking the service offered by the layer below.
- Protocol means a set of rules followed by two peers during communication.
- Entity: The active components in each layer are called entities. Entity can be a software process or hardware like an intelligent input/output

device etc.

- Peer Entity: Entities in the same layer running on different machines are called peer entities.
- Service provider and Service user: In layered architecture, layer *n* provides a service which is used by layer *n+1*. Here layer *n* is service provider and layer *n+1* is service user.
- SAP (Service Access Points): A layer *n* offers services to layer *n+1* at a place which is called service access points. Each SAP has a unique address for identification.
- The layers and their protocols are collectively known as network architecture.
- OSI model is a seven layer network architecture.
- A layer can offer two different types of services to the layer immediately above it – connection-oriented and connectionless service.
- In TCP/IP model of network architecture, there are four layers.
- Most of the computer networks are based on TCP/IP model.

2.11 FURTHER READINGS

- Tanenbaum, Andrew, *Computer Networks*, PHI.
- Forouzan Behrouz A., *Tata Mcgraw Hill*.
- Norton Peter, *Complete Guide to Networking*.
- Comer, E. Douglas, Narayanan, M. S., *Computer Networks and Internets with Internet Applications*, Pearson Education.

2.12 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1 : A layer performs some primitive operations to fulfill the requirement of the layer immediately above it. This responsibility of the lower layer is called service.

On the other hand interface is the junction between

two adjacent layers across which the lower layer provides the services to the layer above it.

Ans. to Q. No. 2 : The layers and their protocols are collectively known as network **architecture.**

Ans. to Q. No. 3 : Seven layers.

Ans. to Q. No. 4 : Framing, flow control , error control, and access control.

Ans. to Q. No. 5 : Connection-oriented service and connection-less service.

Ans. to Q. No. 6 : Four layers.

Ans. to Q. No. 7 : TCP/IP reference model was developed earlier than OSI model.

Ans. to Q. No. 8 : Session layer and presentation layer.

2.13 MODEL QUESTIONS

Q.1. What are the design issues of layered architecture of a computer network?

Q.2. What is the principal difference between connection-less and connection-oriented communication ?

Q.3. Describe ISO-OSI reference model of computer network.

Q.4. Define : peer entity, protocol, protocol stack, SAP.

Q.5. Which of the OSI layers handles each of the following:

a) Breaking the transmitted bit stream into frames.

b) Determining the route through which subnet is to be used.

Q.6. Describe the functions of various layers of the TCP/IP model.

Q.7. What are the responsibilities of the network layer in the TCP/IP model?

Q.8. What are the responsibilities of the transport layer in the TCP/IP model ?

Q.9. How do the layers of the TCP/IP model correlate to the layers of the

OSI model ?

Q.10. Match the following to one or more layers of the OSI model:

a. Flow control

b. Route determination

c. Provides access for the end user

d. Interface to the transmission media.

UNIT 3 : TRANSMISSION MEDIA

UNIT STRUCTURE

3.1 LEARNING OBJECTIVES

After going through this unit, you will be able to

- know the different classes of transmission media
- describe the twisted pair, coaxial and fiber optics cables
- elaborate the radio waves, infrared, microwaves
- know the Wireless LANs

3.2 INTRODUCTION

So far, you must have been acquainted with the basic terminology of computer networks, concept of layers as well as ISO-OSI and TCP/IP

model. In this unit, we will concentrate on the transmission media and its various types.

3.3 TRANSMISSION MEDIUM

Transmission medium is the physical path that carries data from transmitter to receiver. The signals are transmitted from one device to another device in the form of electromagnetic energy with the help of transmission medium. The transmission medium can be divided into two classes : **Guided** (wired) media and **unguided** (wireless) media. Guided media includes twisted pair cables, coaxial cables and fiber optics cables. For guided media, the electromagnetic waves travel along a solid medium, such as different types of cables. For unguided media, the medium is wireless and occurs through air, space or water.

3.4 GUIDED MEDIA

Guided transmission media uses a cabling system that guides the data signals along a specific path. The data signals are bounded by the cabling system. Guided media is also known as bound media. “Cabling” is meant in a generic sense and is not meant to be interpreted as copper wire cabling only. The followings are the basic guided media used in networking :

- Coaxial Cable
- Twisted-pair cable
- Fiber optic cable

3.4.1 Coaxial Cable

The first version of Ethernet was based on coaxial cable. The original form of Ethernet 10Base-5 used a thick coaxial cable (called thick coax) that was not directly connected to the computer’s NIC (Network Interface Card). An attachment unit Interface (AUI) ran from a DB15 connector on the back side of the NIC to the thick coax. A “vampire tap” was inserted into the thick coax to which the AUI is connected.

Another version of coaxial cables are there which are thinner in size and hence its name is thin coaxial cable (called thin coax). 10Base-2 Ethernet cards are connected to this type of cable by a BNC (Bayonet-Neill-Concilman) –T connector on the rear side.

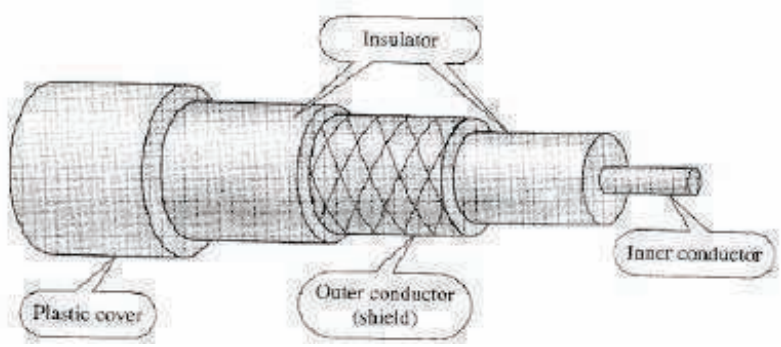


Fig. 3.1 : Construction of a coaxial cable

The physical construction of a coaxial cable can be seen in the Fig 3.2. We can see that the cable has a central core made of solid or stranded copper which carries the signals. Upon the central conductor there is an insulating layer upon which a braided wire mesh is provided as a shield to protect the cable from external noise. Upon this shield another insulating sheath is there enclosing which a plastic cover is provided to complete the construction of the cable.

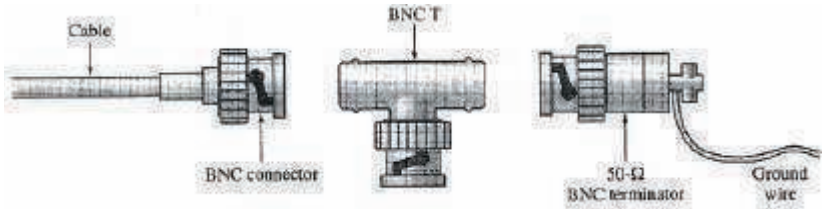


Fig. 3.2 : BNC and BNC-T Connector

Thick and Thin coax differs in size and cable impedance. Coaxial cables are categorized by their Radio Government (**RG**) ratings. Each RG number denotes a set of physical specifications uniquely.

Category	Impedance	Use
RG – 59	75 Ω	Cable TV
RG - 58	75 Ω	Thin Ethernet
RG - 11	50 Ω	Thick Ethernet

Table 3.1 : Categories of Coaxial Cables

Applications :

Coaxial cable was extensively used in analog telephone networks to carry 10,000 voice signals at a time. Later these cables were used in digital telephone networks which could carry digital data up to 600 Mbps. But coaxial cables are almost replaced today by fiber optic cables.

Cable TV networks are still running on coaxial cables in our country. However, in some advanced countries these are replaced by fiber optic cables.

Another most common application of coaxial cable is in traditional Ethernet LAN, which are also gradually replaced by twisted-pair cables.

Advantages :

- **Strong construction :** Constructional features make a coaxial cable strong in structure.
- **Good immunity to noise :** Coaxial cables have good immunity to external noise.
- **Good LAN length :** LAN implemented by using coaxial cables are of moderate length; it is around 500 meter for thick coax and 200 meter for thin coax.

Disadvantages :

- **Heavy weight :** Coaxial cables are heavy in weight. Therefore coaxial cables need strong support.
- **Unreliable tap :** When thick coax is connected by vampire tap, it provides an unreliable connection because with slight shaking the connection becomes loose.
- **High cost of installation :** Due to heavy weight laying of coaxial cables causes high labour cost.

3.4.2 Twisted Pair Cable

Twisted-pair cable is just what its name implies; insulated wires housed within a protective casing with a specified number of twist

per foot of distance. Twisting of wires reduces the effect of electromagnetic interference which may be generated from nearby electric motors, fluorescent tube lights etc. Shielded twisted-pair (STP) cables are provided with shielding and additional insulation over the cluster of wires to protect it from outside noise. Unshielded twisted-pair (UTP) cables are mostly used in small office or home LANs which are less costly. Fig 3.3 shows UTP and STP cable.

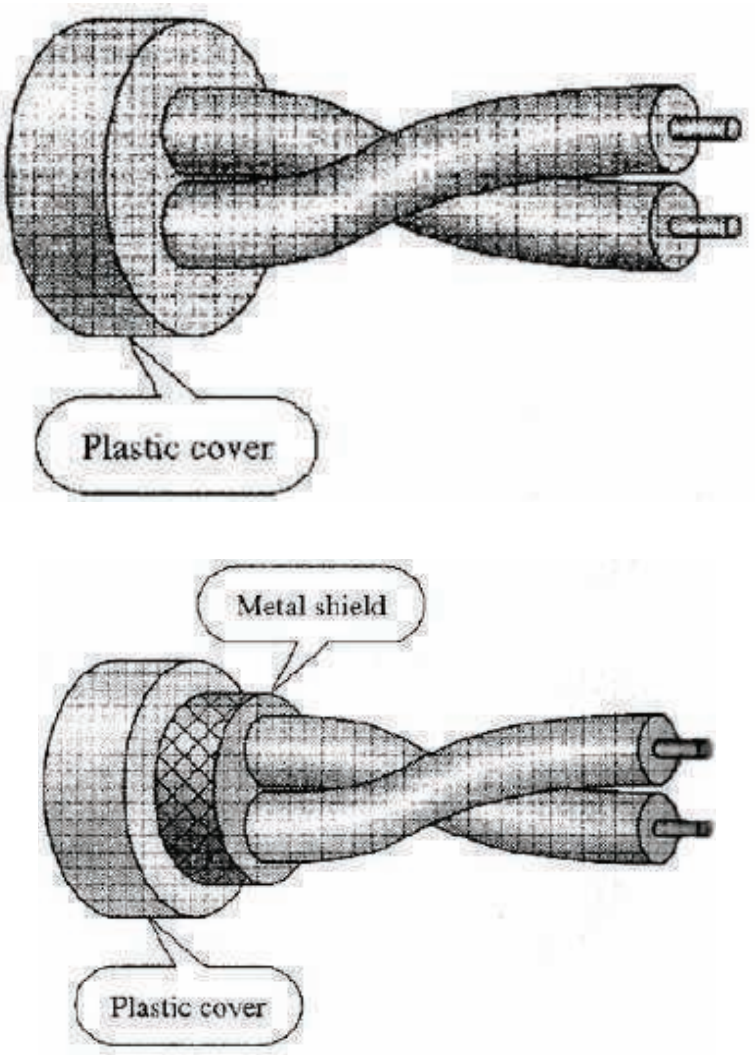


Fig. 3.3 : Twisted pair cable

The unshielded twisted-pairs are classified by The Electronic Industries Association (EIA) into seven categories. The categories are determined by cable quality. 1 is the lowest and 7 is the highest in quality. Table 3.2 shows the different categories of UTP cables.

Cate-gory	Specification	Data Rate (Mbps)	Use
1	Unshielded twisted-pair used in telephone	< 0.1	Telephone
2	Unshielded twisted-pair originally used in T-lines	2	T-1 lines
3	Improved CAT-2 used in LAN	10	LANs
4	Improved CAT-3 used in Token-Ring Networks	20	LANs
5	CAT-5 Cable wire with a jacket and outside sheath	100	LANs
5e	Extension of CAT-5, can minimize cross-talk & interference	125	LANs
6	CAT-6 cable with other matched components	200	LANs
7	Shielded screen twisted-pair (SSTP)	600	LANs

Table 3.2 : Categories of UTP cables

The most common UTP connector is RJ 45 (Registered Jack 45) which can be inserted in one way only.

Applications :

- Twisted-pair cables are extensively used in telephone lines as voice and data channels. The lines connecting subscribers to the telephone exchange are unshielded twisted-pair cables.
- People use twisted-pair cables to connect DSL lines for high speed Internet Connection.
- LAN such as 10Base-T and 100Base-T uses twisted-pair cables.

Advantages :

- **Low cost :** The cost of twisted-pair is not so high.
- **Light weight** : Twisted-pair cables are lighter in weight. Hence it does not require heavy support.
- **Easy installation & maintenance:** The technology of twisted-pair cable laying is a job of almost any person. Connecting the RJ45 connector to the cable is called crimping and it requires a few hours of practice.
- **Cheaper equipment:** Crimping tools and other tools necessary for twisted-pair cable preparation are cheap. Hence these are easy to purchase.

Disadvantages :

- **Susceptible to cross talk:** Twisted-pair cables are not totally immune to cross talk.
- **Distance limitation :** The maximum length of LAN using twisted-pair cable is short, in comparison to optical fiber.

3.4.3 Fiber Optics Cable

Fiber optic cable is a communication medium made of glass or plastic that can transmit signals in the form of light. In optics there is a principle which states that when a beam of light travels from denser medium to rarer medium then it deviates away from the normal drawn at the point of incidence at the junction of the two media. It can be seen from the Fig 3.4.

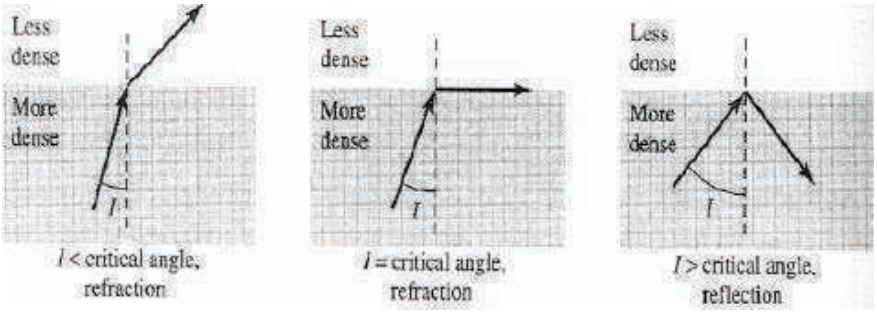


Fig. 3.4 : Bending of Light Ray

If the angle of incidence is such that the angle of refraction is 90^0 then the angle of incidence is called **critical angle.** Now if the angle of incidence is greater than critical angle then the refracted ray would re-enter into the denser medium. This phenomenon is called **total internal reflection.**

In optical fiber light signals travel by following the principle of total internal reflection. In an optical fiber, a glass or plastic **core** is surrounded by a **cladding** of less dense glass or plastic. This difference in density facilitates total internal reflection for a light signal that travels through the cable. Fig 3.5 shows the propagation of light through an optical fiber.

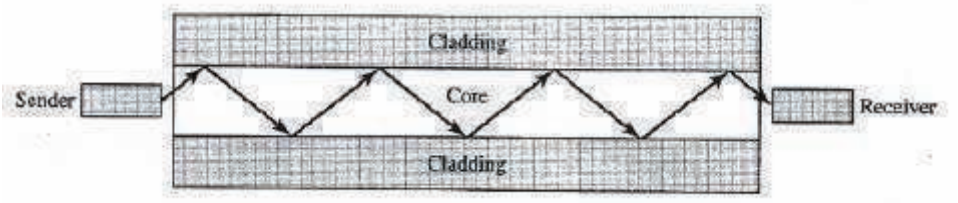


Fig. 3.5 : Light propagation through optical fiber

Current technology provides two modes of light propagation through an optical fiber. These two modes are: **mono mode** and **multi mode.** Further, fiber optic cable has two varieties: **step index** and **graded index.**

In step index fiber, core and cladding has a definite boundary. In graded index fiber, density of the fiber gradually decreases from inner core to the outer boundary.

In ***mono mode***, step index fiber is used. Mono mode fibers are of the order of 8 – 10 microns in diameter. Mono mode fibers are costly and they can transmit light signal to a longer distance than multi mode fiber. A highly focused beam of light is injected into the fiber at an incident angle close to the horizontal line. Its density is also much lower so that the critical angle is almost equal to 90^0. Therefore, the reflected beam also propagates in almost horizontal line. The delay is minimum here.

Multi mode operation can transmit multiple beams of light signal at a time. These fibers are thicker in diameter than the mono mode fiber, of the order of 50 microns. These are cheaper but can transmit signal to a shorter distance. In multi mode both step index and graded index cables are used.

Fiber optic cables are connected to NIC by three types of connectors: **Subscriber channel (SC) connector, Straight-tip (ST) connector** and **MT-RJ connector.**

Applications : Fiber optic cable is now extensively used as a communication medium for backbone networks due to its low cost wide bandwidth. Its data transfer rate now arrived at 1600 Gbps. Some cable TV companies use a combination of optical fiber and coaxial cable. Here optical fiber provides the backbone network and

the coaxial cable gives service connection to the users. 100Base-FX (Fast Ethernet) and 1000Base-X (Gigabit Ethernet) LAN uses optical fiber cable.

Advantages and Disadvantages of Optical Fiber :

Advantages : Fiber optic cables have several advantages over the metallic cables such as coaxial cable and twisted-pair.

- **Higher bandwidth :** Fiber optic cable can provide very high bandwidth and, therefore, high, data rate than the coaxial and twisted-pair cable.
- **Less attenuation :** It offers less attenuation than metallic cables. Hence, signal can travel up to 50 Km without repeater in a fiber optic cable.
- **Immunity to electromagnetic interference :** Electromagnetic noise cannot affect a light signal traveling through a fiber optic cable.
- **Resistance to corrosion :** Fiber optic cables are not affected by corrosive substances.
- **Light weight :** These are much lighter in weight than metallic cables.
- **Greater immunity to tapping :** Light signals are more difficult to tap than an electrical signal. Hence, the signal passing through a fiber optic cable has greater immunity to tapping.

Disadvantages : Despite many advantages, fiber optic cable has some disadvantages also. These are:

- **Difficult to instal and maintain :** Since fiber optic cable is a new technology, so skills personal for installation and maintenance of the fiber optic cable are not easy to find.
- **Unidirectional signal propagation :** Light propagation is unidirectional. So, if we require bidirectional communication, we need two fiber cables.
- **Cost :** The fiber optic cables and the interfaces are more expensive till date in comparison to other types of cables.

CHECK YOUR PROGRESS

Q.1. What are the different types of cables used in LAN?

.....

.....

Q.2. How can a thick coax be connected to the AUI?

.....

Q.3. What is the impedance of a coaxial cable used in cable TV?

.....

Q.4. What is the maximum data rate of SSTP cable?

.....

Q.5. Why is twisting done in twisted-pair cables?

.....

.....

Q.6. On what principle does light travels in fiber optic cable?

.....

3.5 UNGUIDED MEDIA

In wireless transmission, the data signals travel without any guides media. The data signals are not bound to a cabling media and are therefore often called unbound media. The transmission and reception are achieved by means of an antenna. In two way communication, the same antenna can be used for both transmission and reception.

For wireless communication, signals can travel from source to destination in several ways. They are - ***ground propagation, sky propagation*** and ***line-of-sight propogation***.

Radio waves travel through the lowest portion of the atmosphere. These low frequency signal (which is about 2 MHz) emanate in all directions from the transmitting antenna and follow the curvature of the planet. The distance depends on the amount of power in the signal. This type of propagation is called **ground propagation**.

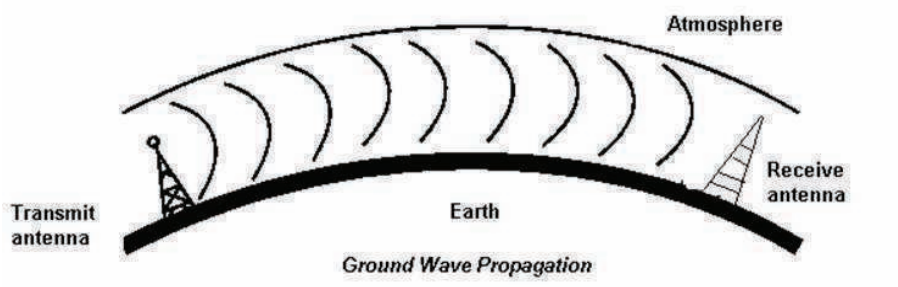


Fig. 3.7 : Ground wave propagation (below 2 MHz)

Higher frequency radio waves (2 to 30 MHz) propagate upward into the layer of the atmosphere where particles exist as ions (ionosphere). This type of transmission allows greater distances with lower power output and is called as **sky propagation**.

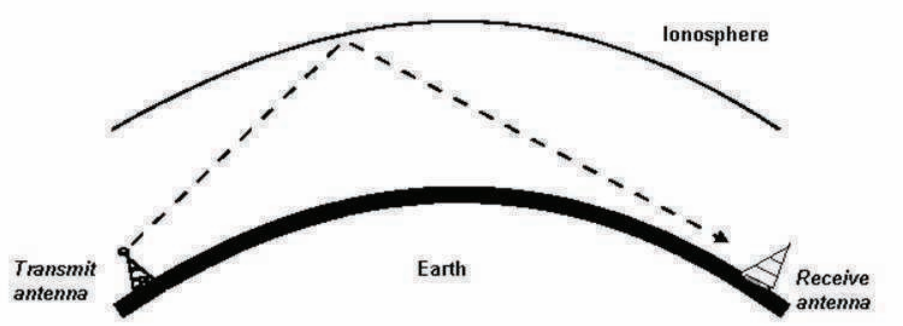


Fig. 3.8 : Sky wave propagation (2 to 30 MHz)

When very high frequency signals are transmitted in straight lines directly from antenna to antenna, it is called **line-of-sight propagation**. Antennas must be directional, facing each other, and either tall enough or close enough together not to be affected by the curvature of the earth.

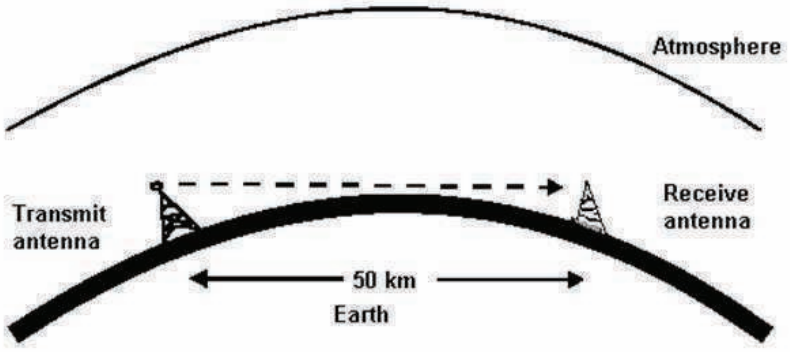


Fig. 3.8 Line-of-sight propagation (above 30 MHz)

3.5.1 Radio Waves

The radio waves are omnidirectional while the microwaves are directional. Radio waves are used for one sender and multiple receivers i.e. for multicasting property. Because of this multicast communication, it is used by radio, television, cordless phones and pagers. Radio wave is a general term to encompass frequencies in the range 3 KHz to 1 GHz. The microwaves range in frequencies between 1 to 300 GHz. Broadcast radio term may be informally used for the FM radio and VHF television and number of data networking applications.

As the radio waves are omnidirectional, they do not require dish-shaped antennas with precise alignment. Radio waves used omnidirectional antennas that send the signals in all directions. We can have different types of antennas based on wavelength and strength. Radio waves can penetrate walls. It can be considered an advantage. For example, AM radio can receive signals inside the building. It has the disadvantage that radio wave band is relatively narrow and if we subdivide it farther, it becomes narrower resulting in lower data rate for digital communications. Another problem with the radio waves is the multipath interference. Reflection from different sources can create multiple paths between antennas which is evident when TV reception displays multiple images. But because of longer wavelength, radio waves suffer less attenuation.

3.5.2 Infrared

Infrared signals are used for short range communication. It has the frequency range from 300 GHz to 400 THz. It has wavelength from 1 mm to 770 mm. Infrared communications is achieved by

using the transmitters / receivers(transceivers) that modulate infrared light. Transceivers must be within the line of sight of each other directly or via reflection.

One disadvantage of infrared is that it does not penetrate walls. We cannot use infrared outside a building because the sun's rays contain infrared waves which can interfere with the communication.

When we use infrared remote control, we do not interfere with the use of the remote by our neighbours. It can be used for digital data transmission with high data rate.

As no licensing is required, there is no freuency distribution issue in case of infrared. The association that has setup standards for communication is called Infrared Data Association (IrDA). IrDA port is used to communicate a wireless keyboard to communicate with PC.

3.5.3 Microwaves

Microwaves use line of sight propogation. Microwaves frequency ranges from 1 to 300 GHz. Microwaves are used in cellular phones, satellite networks and Wireless LANs. Microwaves are unidirectional. It is useful in unicasting i.e. one to one communication. To travel longer distances, the antennas must be taller. There should not be any obstacle in between . Usually mountain tops are the preferred positions for the antennas to avoid obstacles. Microwaves can travel for one direction at a time. For two way communication two frequencies need to be allocated.At both ends a transceiver for operating two different frequencies. Repeaters are used along with antennas to regenerate the signal. Microwave is inexpensive and it allows you to communicate from anywhere.

Microwave is commonly used for both voice and television transmission.

There are two types of antennas used for microwave communications: (1) the parabolic dish and (2) the horn.

The parabolic dish is 3 m in diameter and its shape is like a parabola. It focuses a narrow beam to achieve line of sight transmission. The parabolic dish acts as a funnel, catching wide range of waves and directing to a common point.

In horn antenna, the outgoing transmission is broadcast up a stem and deflected outward in a series of narrow parallel beams by the curved head. The scooped shape of the horn collects the received transmissions and deflected down into the stem.

Fig. 3.9 : Microwave Antenna

Typical Digital Microwave Performance

3.5.4 Satellite

A communication satellite is, in fact, a microwave relay station. It is used to link two or more ground based microwave transmitter/ receivers, known as earth stations, or ground stations. The satellite receives transmissions on one frequency band (uplink), amplifies or repeat the signal, and transmit it on another frequency (downlink). A single orbiting satellite will operate on a number of frequency bands, called **transponder channels,** or simply **transponders**.

Thus, the satellites are transponders (units that receive on one frequency and retransmit on another) that are set in geostationary orbits directly over the equator. These geostationary orbits are 36,000 km from the Earth's surface. At this point, the gravitational pull of the Earth and the centrifugal force of Earth's rotation are balanced and thus cancel out each other. Centrifugal force is the rotational force placed on the satellite that wants to fling it out into space. The following figure shows a general way of communication through the satellite.

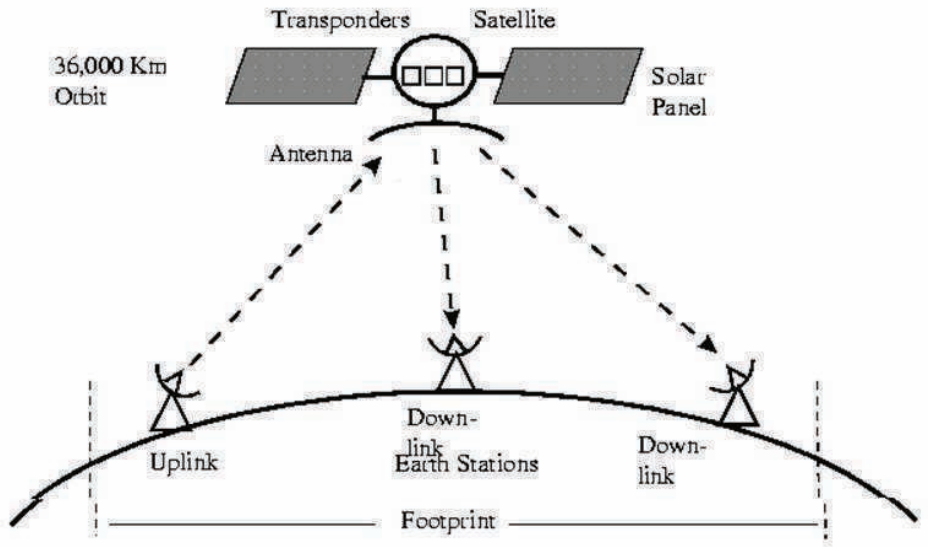


Fig. 3.10 : Satellite Communication

3.4 WIRELESS LANS (IEEE 802.11)

Now-a-days Wireless LAN becomes one of the fastest growing technologies and everyone likes to connect without using cables. One can find wireless LAN in office building, colleges and public areas. At home, a wireless LAN can be used by connecting roaming devices to Internet.

Wireless LANs are generally catogorized according to the transmission techniques. There are two types of categories:

Infrared (IR) LANs : As the infrared technology can not penetrate walls, an individual cell of an IR LAN is limited to a single room.

Spread spectrum LANs : The technology that uses this type LANs is spread spectrum transmission technologies. They operate in the ISM(industrial,scientific and medical) microwave bands in most of the cases. They operate in these bands so that there will be no licensing issue from Federal Communications Commission (FCC).

IEEE 802.11 : IEEE formed a new specification IEEE 802.11, specially for the development of wireless LANs, MAC protocol and physical medium specification. The following lines define the terminologies used in the IEEE 802.11 standard.

IEEE 802.11 terminology :

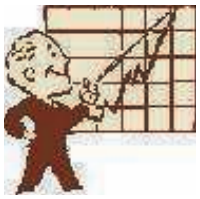
Access Point(AP) : Any entity that has station functionality and provides access to the distribution system via wireless medium for associated stations.

Basic service set (BSS) : A set of stations controlled by a single coordination function.

Coordination function : The logical function that determines when a station operating within a BSS is permitted to transmit and may be able to receive PDUs

Distribution System DS : A system used to interconnect a set of BSSs and integrated LANs to create an ESS.

Extended service set : A set of one or more interconnected BSSs and integrated LANs that appear as a single BSS to the LLC layer at any station associated with one of these BSSs.



CHECK YOUR PROGRESS

Q.7. What is transmission media?

.....

.....

Q.8. What are the three types of guided media?

.....

.....

Q.9. Write two advantages and disadvantages of fiber optics cable.

.....

.....

Q.10. Name the three ways for wireless data to be propagated.

.....

.....

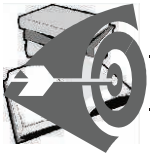
3.7 LET US SUM UP

- Transmission media can be classified two main categories: guided media and unguided media.
- Guided media uses physical cable for data transmission, whereas in case of unguided media, air is the main transmission medium.
- The three main types of guided media are twisted pair cable, coaxial cable and fiber optics cable.
- Fiber optics cable is the latest, best and most expensive.
- Unguided media can be classified as radio waves, microwaves and infrared waves.
- Wireless data are transmitted through ground propagation, sky propagation and line-of-sight propogation.
- Radio waves are omnidirectional.
- Microwaves are unidirectional; propagation is line-of-sight.

- Infrared waves are used for short-range communication such as between a PC and a peripheral device.
- IEEE 802.11 standard defines for Wireless LANs.

3.8 FURTHER READINGS

- Data and Computer Communications by William Stallings, Pearson Education.
- Data Communications and networking by Behrouz A. Forouzan, Tata McGrawHill.



3.9 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1 : The different types of cables used in LANs are : Coaxial cables, shielded and unshielded twisted-pair cables and fiber optic cables.

Ans. to Q. No. 2 : A “vampire tap” is inserted into the thick coax to which the AUI is connected.

Ans. to Q. No. 3 : 75 Ω

Ans. to Q. No. 4 : 600 Mbps

Ans. to Q. No. 5 : Twisting of wires reduces the effect of electromagnetic interference which may be generated from nearby electric motors, fluorescent tube lights etc.

Ans. to Q. No. 6 : In optical fiber light signals travel by following the principle of total internal reflection.

Ans. to Q. No. 7 : Transmission media are the physical infrastructure components that carry data from one computer to another computer. They are the basis of data communication.

Ans. to Q. No. 8 : Guided media can be subdivided into three main categories.

1)Twisted Pair, (2) Coaxial cable and (3) Fiber Optics.

Ans. to Q. No. 9 : The two advantages of fiber optics cable are :
(i) Huge bandwidth, (ii) Resistance to noise.
The two disadvantages of fiber optics cable are :
(i) Cost, (ii) Maintenance overhead

Ans. to Q. No. 10 : Wireless data are transmitted through ground propagation, sky propagation and line-of-sight propagation.

3.9 MODEL QUESTIONS

Q.1. How does guided media differ from unguided media.

Q.2. Write about a use of each class of guided media.

Q.3. What are the three major classes of guided media.

Q.4. Name the advantages of optical fiber over twisted pair and coaxial cable.

Q.5. Name the three ways for wireless data to be propagated.

Q.6. Write what you know about radio waves and microwaves.

UNIT 4 : INTERNET AND WWW

UNIT STRUCTURE

4.1 LEARNING OBJECTIVES

After going through this unit, you will be able to :

- define Internet and elaborate on its growth
- describe the organization of Internet
- illustrate the world wide web
- describe web servers, web browsers and search engines
- know the server and client side technology

4.2 INTRODUCTION

Ever since the advent of computers, researchers have indulged in a continuous quest to bring the world closer through computers. This effort gave rise to the Internet. It is through the Internet that today millions of people communicate and share information, regardless of their location. This unit will focus on the basics of the Internet and World Wide Web and also shed light upon how the Internet works along with its applications.

4.3 INTERNET – A DEFINITION

The Internet can be defined as a network of globally connected computers that is decentralized by design. This definition can be broken down into three parts. Let's understand each part of the definition in isolation.

It is a network. A network is a collection of computers. The Internet can also be referred to as a network because it is a collection of millions of computers.

Globally connected computers. This means that you can be connected to the Internet, regardless of your location. The Internet has brought people in the world closer by connecting computers located in the remotest of locations.

Decentralized design. The Internet has a decentralized design. That is, there is no centralized body that controls the way in which the Internet functions. The Internet does provide online services that are centrally administered, but as a whole, it would not be incorrect to say that the Internet

has a decentralized design. Each computer connected to the Internet is called a *host*. The operator/ user of a particular host can choose from the millions of available Internet services and can also make services available through the Internet.

You can consider Internet to have the following characteristics :

- *A complex network* - with simplified definition as a 'network of network'
- *Disorganized* - Internet can be cumbersome and confusing, even for experienced users
- *A decentralized system* - millions of individual networks and over 200 million individual computers connected through the world
- *Composed of many billions of files*(web pages).
- *Dynamic* - changing every minute of every day. On an average, a new network is connected to the Internet every 30 minutes.
- *Expanding exponentially* - the Internet is growing at the rate not less than 15% per month.

4.4 INTERNET ARCHITECTURE

It is important to understand what the term "architecture" means. The notion of network architecture was introduced during the Internet research phase by the research community that had developed the ARPAnet protocols. Network architecture is a set of high-level design principles that guides the technical design of the network, especially the engineering of its protocols and algorithms. There are two most commonly used architecture in Internet technology : *peer-to-peer* and *client server architecture*.

4.4.1 Peer-to-Peer

Peer-to-peer is a communication model in which each and every node is capable of sharing information and can initiate a communication session. On the Internet, peer-to-peer (referred to as P2P) is a type of transient Internet network that allows a group of computer users with the same networking program to connect with

each other and directly access files from one another's hard drives. **Napster** and **Gnutella** are examples of this kind of peer-to-peer software.

4.4.2 Client-Server

The Client-Server Architecture is based on the principle where the client computer requests for some data and the data are sent by the server computer through the network. The concept of *client/server* computing has particular importance on the Internet because most of the programmes are built using this design. Servers are powerful computers or processes dedicated to managing disk drives (file servers), printers (print servers), or network traffic (network servers). Clients are PCs or workstations on which users run applications. Clients rely on servers for resources, such as files, devices, and even processing power.

The following figure shows the two architectures :

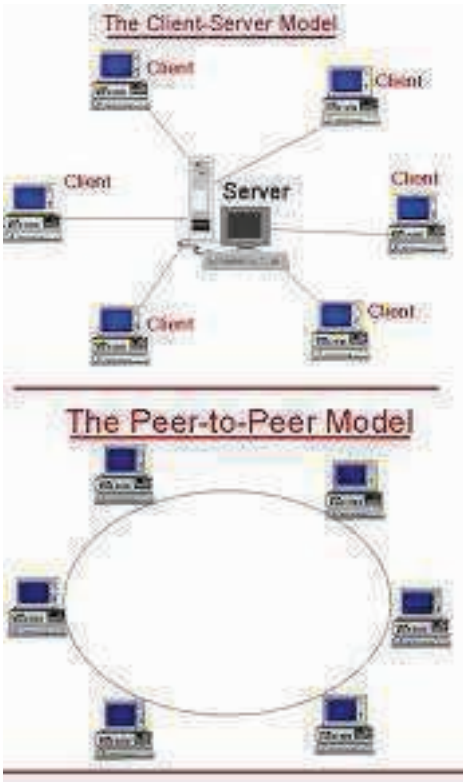


Fig. 4.1 : Client Server and peer-to-peer architecture

4.5 ACCESSING INTERNET

In order to access the Internet, one requires the following:

- A client computer with necessary hardware and client software
- The connectivity through Internet Service Provider (ISP) for flow of data
- Host computer(s) which is also called Web server hosting the desired data.

The necessary hardware devices that must be had on the client computer are :

- Processor of Pentium (Intel based) or AMD or Macintosh
- Network Interface Card (NIC)
- Modem, it can be an external or internal (fitted inside the computer)

The necessary softwares that must be found on the client computer are :

- Operaring system like WIndows, UNIX, LINUX or OS/2 etc.
- Web browser like Netscape, Internet explorer, FireFox etc. (it must be compitable with the operating system)

Common methods of Internet access in homes include **dial-up, landline broadband(ADSL)** (over coaxial cable, fibre optic or copper wires), **Wi-Fi, satellite and 3G technology cell phones**. We will concentrate basically on the following methods

- dial-up connections
- ADSL connections and
- Cable Connections

4.5.1 Dial-Up Connections

Dial-up connections is a type of Internet connectivity that operates through a standard telephone line. Before a person can subscribe to a dial-up service, he or she must have a computer and dial-up modem. A telephone line feeds into the modem. The modem is controlled by software in the computer; for example, the Network

Connections utility that comes with Microsoft Windows operating systems. Here you can setup a profile for the ISP (Internet Service Provider, like BSNL), which will tell the modem what phone number to call and how to communicate with the dial-up service. The ISP itself provides this information.

Upon joining a dial-up service, the subscriber chooses a username and password. Once the modem calls the phone number and makes a connection, a "*handshake*" takes place in which information is exchanged between the computer modem and the remote server. The username and password are supplied by the modem. This grants the user an access through the dial-up gateway to the Internet. Dial-up connections can be very economic and are widely available, the cost per minute is comparable to that of a local phone call, or priced as a monthly plan which will include a certain amount of time. As these connections use a standard modem the hardware costs are minimal. Dial-up connections are very slow compared to other connection types. When connected to the internet the same phone line cannot be used for phone calls, so if anyone calls you when you are connected, they will get the busy signal.

Dial-up connections transfer data over an analogue line, so before the data is sent it has to be converted from digital to analogue, Likewise, when data is received it has to be converted from analogue to digital (this is what the modem does), This adds a performance overhead which affects the speed of the connection.

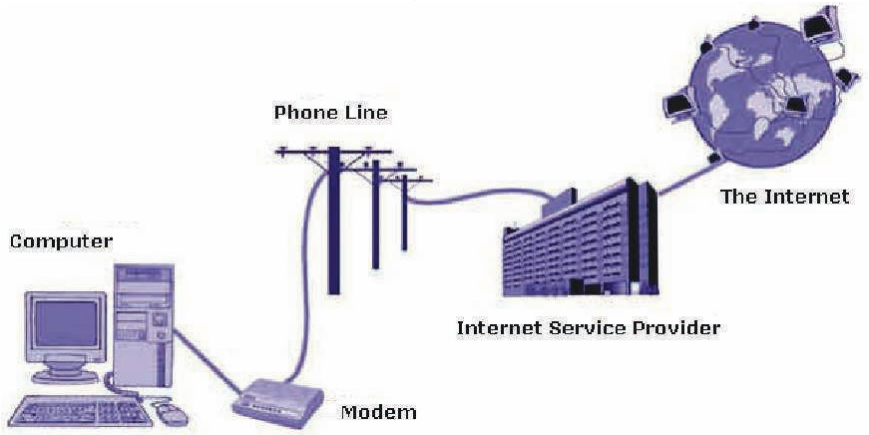


Fig. 4.2 : Dial-up Connection

4.5.2 ADSL Connections

ADSL (Asymmetric Digital Subscribers Line) connections are becoming more and more widely available and can provide an excellent Internet connection. The connections work by splitting your phone line into two separate channels, one for data (Internet) and other voice (phone calls), which means you can talk on the phone and be connected to the Internet at the same time.

You will often see ADSL connection services advertised as having different speed specifications. Given below are some common configurations:

256Kbps/128Kbps or 512Kbps/128Kbps
1Mbps/256Kbps or 2Mbps/512Kbps
8Mbps/1024Kbps

Notice that there are two values to each configuration. The first figure states the download speed and the second figure is the maximum upload speed. As an example let us take the second configuration 512Kbps/128Kbps. This means that you can potentially download data at a speed of 512Kbps and upload data at 128Kbps.

Advantage of ADSL connection : ADSL technology eliminates the need for a second phone line by allowing voice and data transfer at the same time (you can use the phone as normal while connected to the Internet). Because ADSL transfers data digitally, it eliminates the usual performance overhead associated with standard dial-up connections. In other words, ADSL doesn't need to convert the data from digital to analogue and back again.

Disadvantage of ADSL connections : ADSL connections are not available to everyone. You should always ensure that you have ADSL coverage in your area. The hardware costs can be quite significant as you will need a special ADSL modem and ADSL filters to use the service. Most ISPs allow you to hire these items which can reduce the initial cost. Because ADSL connections are always on you will need a firewall to protect your PC.

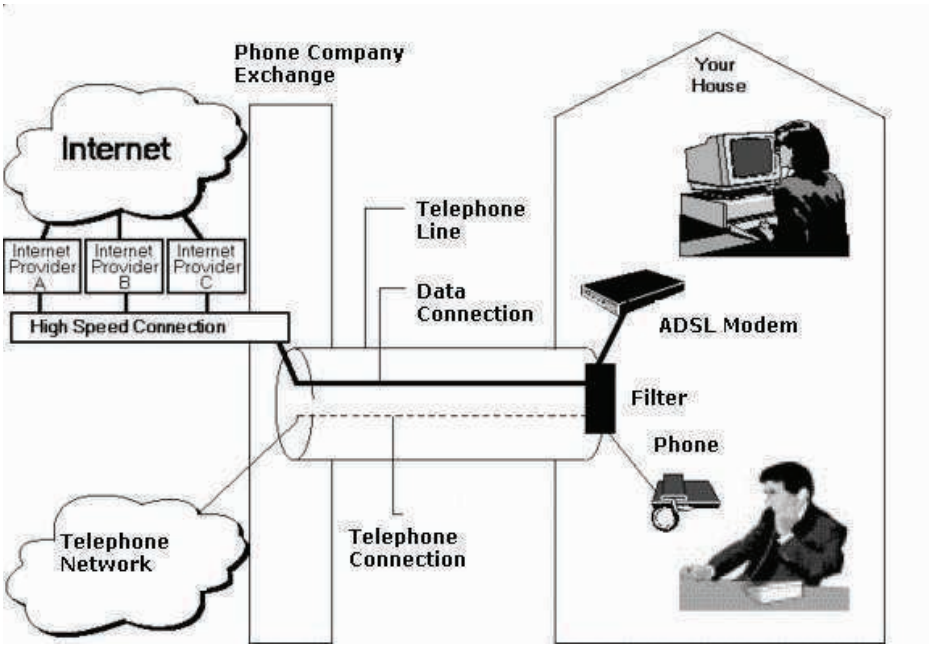


Fig. 4.3 : ADSL Connection

4.5.3 Cable Connections

Cable connections are considered one of the best types of Internet connection available to the home user because they offer very fast and reliable connections with a fixed monthly fee. Cable companies usually offer different packages to suit different Internet subscribers.

The different packages will offer different speed specifications and bandwidth limits. Because a cable connection uses a totally separate medium to transfer data it doesn't affect your ability to make/receive phone calls.

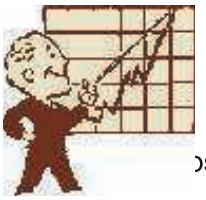
Advantage of Cable connection : Speed is a major reason for having a cable connection. Like ADSL connections, cable connections transfer data digitally, eliminating any digital/analogue conversion overhead. Cable connections are always on, eliminating long waits to make a connection.

Disadvantage of Cable connection : Cable connections are not available in every area. You will need to contact the cable company

of your choice to ensure that you have coverage.

4.6 INTERNET SERVICE PROVIDER (ISP)

Internet service providers (ISPs) are companies that help the users to connect to the Internet for a monthly fee. In return, they provide a username, a password, and telephone number. The username and the password are used to authenticate the user on the Internet. The telephone number is used to establish connection with the dial-up server of the ISP. However, ISPs also support other forms of Internet access like DSL and cable connections and other dedicated technologies. In addition to providing Internet services to individual users, ISPs also provide Internet services to large companies in return for an annual fee. When such a company subscribes to an ISP, the company provides Internet access to all the computers on the corporate network. Examples of ISP in india are Bharti Airtel Ltd, Reliance Communication, BSNL etc.



CHECK YOUR PROGRESS

ose the correct answer

a) In a peer-to-peer communication model a group of computers use
   i) different network program
   ii) same network program
   iii) none of the above

b) Internet is
   i) complex system ii) decentralized system
   iii) dynamic system iv) all of the above

c) Dial-up connections are
   i) very fast ii) fast
   iii) very slow iv) none of these

d) Dial-up connections transfer data over

i) analogue line ii) digital line
iii) both analoogue and digital
iv) none of these

e) In ADSL connection data and voice
i) can be sent at the same time
ii) can the send one at a time
iii) cannot be sent iv) all the above

4.7 ORGANIZATION OF INTERNET

The Internet system consists of a number of interconnected packet networks supporting communication among host computers using the ***Internet protocols (IP)***. A computer linked on the Internet is known as the host computer. The data to be moved from one host to another host is broken into small pieces called ***packets***. Each packet has a header with the address of destination host. The packets of different sizes move on in various networks before reaching the destination. Various packets of one file may take different routes to reach a destination. The different networks on the Internet are connected with special purpose devices called **routers,** a term which is already familiar to us. These routers look for destination address given on each packet and direct the packet to take the best route to the destination. Routers take their decisions based on information that is constantly reaching them from all over the Internet. They also hear from other routers about the links that are down or congested/slow, or about routers that are no longer accepting packets for certain destinations. Each packet's destination and proposed route are evaluated individually, in the blink of an eye, and sent off along the best route for that particular packet at

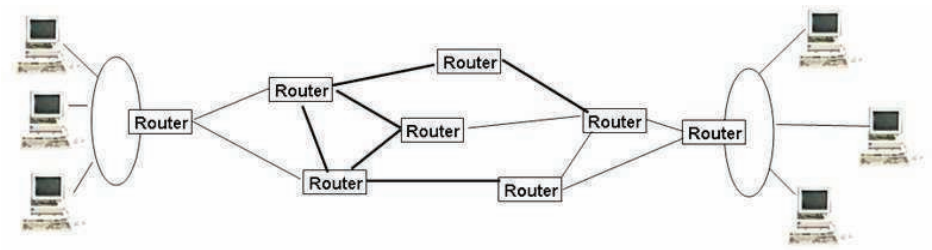


Fig. 4.4 : Routers connected on the Internet

that particular moment. The following diagram(4.4) shows the function of routers.

4.7.1 Internet Protocol Suite

The Internet protocol suite is the set of communications protocols that implement the *protocol stack* on which the Internet runs. A protocol stack is a complete set of protocol layers that work together to provide networking capabilities.

A protocol is a mutually agreed-upon format for doing something. With regard to computers, it most commonly refers to a set of rules (i.e., a standard) that enables computers to connect and transmit data to one another; this is also called a ***communications protocol***. The Internet protocol suite is sometimes called the ***TCP/IP protocol suite***, which refers to the two most important protocols in it : the *Transmission Control Protocol (TCP)* and the *Internet Protocol (IP)*. A protocol can be implemented by hardware, software, or a combination of the two. It is called a protocol stack because it is typically designed as a hierarchy of layers as shown in the figure below, each supporting the one above it and using those below it. Each layer solves a specific set of problems involving the transmission of data and provides well-defined services to the layers

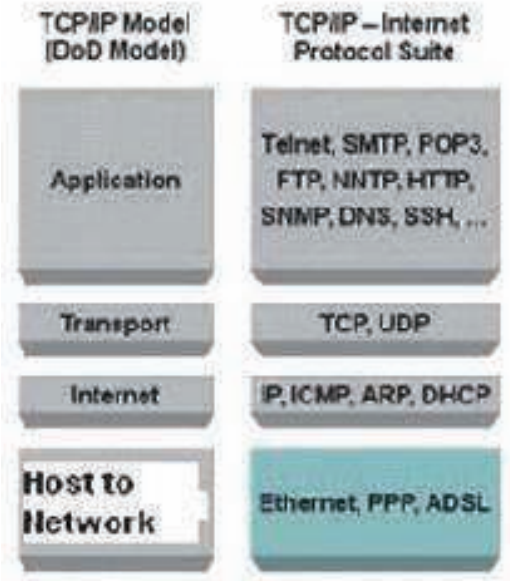


Fig. 4.5 : TCP/IP protocol suite

above it. The application layer is logically closer to the the application programs and deal with more abstract data, and it relies on lower layers to convert their data into forms that can be physically manipulated for transmission.

Let us see the functions of a few protocols of application layer :

Telnet : Telnet is a popular client-server application program used for terminal services. Telnet is an acronym for Terminal Network. Telnet protocol is used to establish an on-line connection to a remote machine, so that the client can access the utility or application program from the remote machine.

FTP : The FTP (File Transfer Protocol) is a standard network protocol used to copy a file from one host to another over a TCP/IP-based network, such as the Internet. Using FTP, you can also update (delete, rename, move, and copy) files at a server. You need to **log on** to an FTP server.

SMTP : The SMTP (Simple Mail Transfer Protocol) protocol is used by the Mail Transfer Agent (MTA) to deliver your eMail to the recipient's mail server in the Internet. The SMTP protocol can only be used to send emails, not to receive them.

POP 3 : The POP (Post Office Protocol 3) protocol provides a simple, standardized way for users to access mailboxes and download messages to their computers. When using the POP protocol all your eMail messages will be downloaded from the mail server to your local computer.

IMAP : The IMAP (Internet Message Access Protocol) is one of the most prevalent Internet standard protocols for e-mail retrieval.

HTTP : The HTTP (Hypertext Transfer Protocol) is the set of rules for exchanging files (text, graphic images, sound, video, and other multimedia files) on the **World Wide Web.** Relative to the **TCP/IP** suite of protocols (which are the basis for information exchange on the Internet), HTTP is an application **protocol.**

DNS : The DNS (Domain Name System or Service or Server),

is an Internet service that translates domain names like www.google.com or www.kkhsou.org etc. into IP addresses.

4.7.2 IP Address

So far we have discussed the fundamental concepts of Internet. Our discussion will be incomplete if we donot mention about the Internet address system. Let us see what is Internet address briefly.

The number of nodes on the Internet are increasing day-by-day. Always remember that each host computer or node on the Internet has its own unique address through which communication is possible with every one. To identify a host on the Internet, three addressing systems have been evolved : (a) A numerical system called I*P addressing*, (b) a hierarchical naming system called the *Domain Name System*, and (c) an addressing system called URLs, which are used for identifying sites on the web.

An ***Internet Protocol address (IP address)*** is a numerical label that is assigned to any device connecting to the Internet and that uses the Internet Protocol for communication between its nodes. Each IP address has specific components and follows a basic format. Each IP address is 32-bit logical address that is divided into two main parts: the *network number* and the *host number*. The network number identifies a network and must be assigned by the Internet Network Information Center (InterNIC) if the network is to be part of the Internet. The host number identifies a host on a network and is assigned by the local network administrator.

The 32-bit IP address is grouped eight bits at a time, separated by dots, and represented in decimal format (known as *dotted decimal notation*). Each bit in the octet has a binary weight (128, 64, 32, 16, 8, 4, 2, 1). The minimum value for an octet is 0, and the maximum value for an octet is 255. The following figure illustrates the basic format of an IP address 198.168.1.133 (written in decimal).

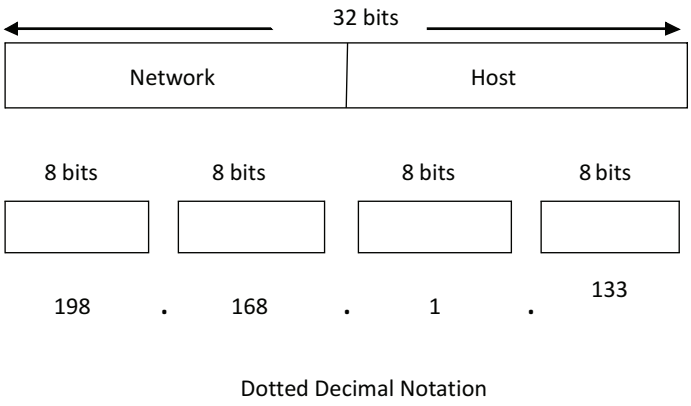


Fig. 4.6 : Format o f an 32-bit IP address

We will not discuss IP addressing in more details now but you should know that IP addressing is again divided into five different classes which are A, B,C, D, and E. The classes A, B, and C are available for commercial use only. In the following classes A, B and C are shown :

	1st octet	2nd octet	3rd octet	4th octet
Class A	Network	Host	Host	Host
Class B	Network	Network	Host	Host
Class C	Network	Network	Network	Host

Fig. 4.7 : IP Address Class

You have seen that IP addresses are numeric and it may be quite difficult to remember such long numeric data. So there is a system to translate it into simple English names. The Domain Name System (DNS) serves as a directory programme for IP addresses and it takes care of translating IP addresses to simple English names.

4.7.3 Domain Name System

DNS refers to Domain Name System and represents a powerful Internet technology for converting domain names to IP addresses. Behind every site, there is an IP address. But, while it is easy to remember the name of a website, it is quite hard to remember the exact IP address. For example, everybody knows about Google.com,

but if you had to remember "74.125.45.100", things would have been much harder.

How does a DNS program works? - Every time a domain name is typed in a browser it is automatically passed on to a DNS server, which translates the name into its corresponding IP address.

This system offers :

- an **hierarchical namespace** where each name is unique
- a system of **distribution servers** enabling namespace to be made available.
- a **client system** which helps to find out the IP address corresponding to a name.

DNS Hierarchy : The structure of the DNS system relies on a tree structure. The top-most node of the tree is the DNS root domain (.), under which there are subdomains, such as .com, .edu, .gov, and .mil, which are called ***top level domains (TLDs)***. Each node of

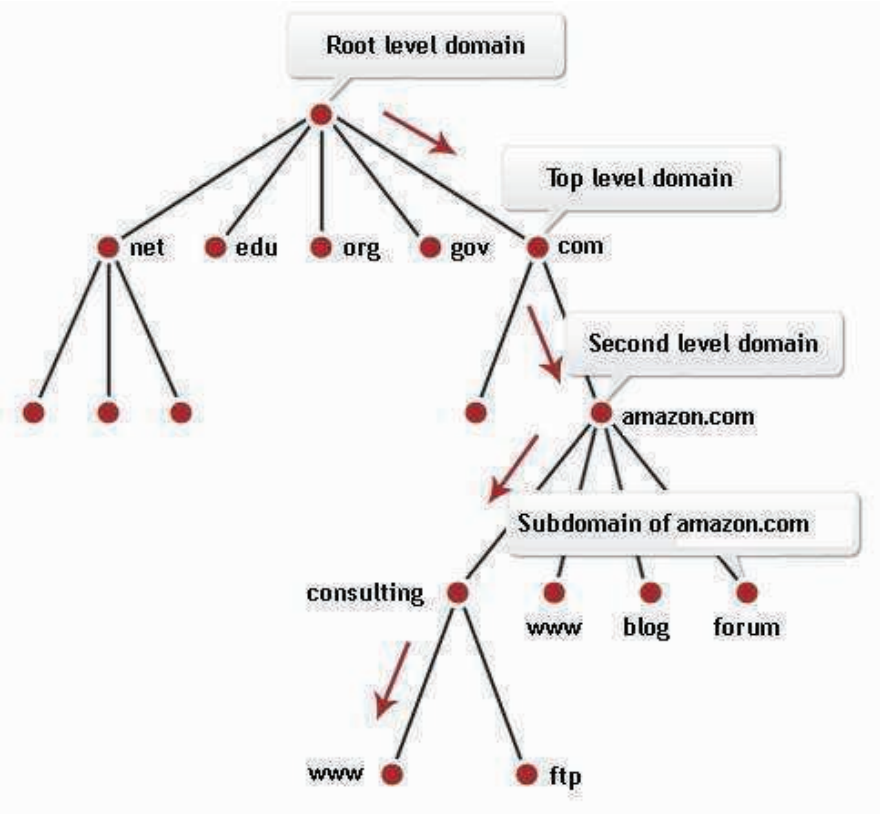


Fig. 4.8 : DNS Hierarchy

the tree is called a **domain name.** The end of a branch is called the **host**, and corresponds to a machine or entity on the network. The host name given to it must be unique in the respective domain. In the following figure DNS hierarchy is shown.

The root DNS servers (root name servers) keep track of all the Top Level Domain (TLD) name servers. The client queries the root name servers to resolve a request for the given domain name. In response the root name server provides the address of the TLD name server for the given query in which the domain name ends with. For example, if a client requests for google.com, the root name server will address the client to the com DNS server so as to solve his query.

The top level name server holds the list of authoritative name server in their respective domain. For example, the ***com*** domain holds the address of yahoo.com, google.com etc. Every TLD includes many second-level domains; for example, amazon.com as shown. Every second level TLD may include number of third level domains. In the figure you have noticed that TLD divides the Internet domain name space into several domains. Most commonly used domains are :

com – Usually used by commercial organization. Eg. Yahoo (yahoo.com)

edu – Usually used by educational institutes. Eg. San Jose State University (sjsu.edu)

org – Used by non profit organizations. Eg. IEEE (ieee.org)

mil – used by military organizations. Eg. US army (army.mil)

net – In earlier days it was used to represent the network infrastructure. Now a days it is open public for any commercial organization.

gov – used to represents government organization. Eg. assam.gov.in

The top level domain names also use two-letter country designations which is known as *geographic domain*. For example,

.us is used for the United States,

.ca for Canada (not California),

.uk or .gb for the United Kingdom or Great Britain,

.il for Israel and

.in for India etc.

4.7.4 Uniform Resource Locators (URL)

A URL (Uniform Resource Locator) is the the global address of documents and other resources on the World Wide Web. The type of resource depends on the Internet application protocol. Using the World Wide Web's protocol (HTTP), the resource can be an HTML page, an image file, a Java applet or any other file supported by HTTP. The URL contains the the following parts

- name of the protocol required to access the resource
- a domain name that identifies a specific computer on the Internet where the resource(file that we want to access) is located,
- path name of the file on the host computer.

The protocol identifier and the resource name are separated by a colon and two forward slashes. In the following an example is shown :

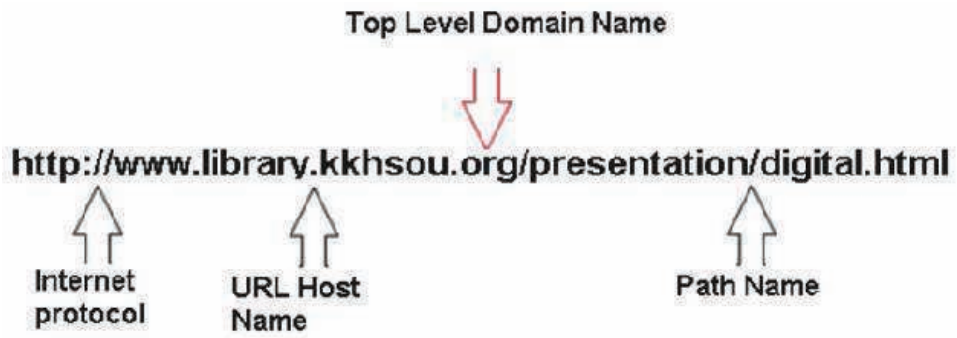
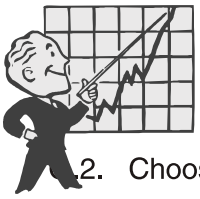


Fig. 4.9



CHECK YOUR PROGRESS

Q.2. Choose the correct answer

a) For connection of the Internet, you will need

i.an IP address ii. a TCP/IP protocol

iii.an ISP iv. All the above

b) A host on the Internet finds another host by its

i. postal address ii. IP address

iii. electronic address iv. none of above

c) User can get files from another computer on the Internet by using

i. FTP ii. HTTP iii. UTP iv. i & ii both

d) IP addresses are translated into simple English names by the following system -

i. HTTP ii. SMTP iii. DNS iv. FTP

e) An IP address contains

i. 64 bits ii.16 bits iii. 8 bits iv. 32 bits

Q.3. Define IP address, Domain name and Host.

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4.8 APPLICATION OF INTERNET

The Internet is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic and optical

networking technologies. Now-a-days the application of Internet touches the every field of modern society. Let us briefly focus some of them.

Email : Email is now an essential communication tool in business. It is also excellent for keeping in touch with family and friends. The advantages to email is that it is free (no charge per use) when compared to telephone, fax and postal services.

Information : There is a huge amount of information available on the Internet for just about every subject known to man, ranging from government law and services, trade fairs and conferences, market information, new ideas and technical support.

Services : Many services are now provided on the Internet such as online banking, job seeking and applications, and hotel reservations. Often these services are not available off-line or cost more.

E-Commerce : The Internet is a very effective way to buy and sell products all over the world. Business houses use the Internet to provide product information, online support service, etc. Companies carry out online trading including advertising, selling, buying, distributing products, and providing after-sales services through the Internet.

Communities : Communities of all types have sprung up on the Internet. Institutions use the Internet for voice and video conferencing and other forms of communication that allow people to telecommute, or work from a distance. It is a great way to meet up with people of similar interest and discuss common issues. Scientists and scholars use the Internet to communicate with colleagues, to perform research, to distribute lecture notes and course materials to students, and to publish papers and articles.

Entertainment : Entertainment is another popular reason why many people prefer to surf the Internet. In fact, media of Internet has become quite successful in trapping multifaceted entertainment factor. Downloading games, visiting chat rooms, online gaming or just surfing the Web are some of the uses people have discovered. There are numerous games that may be downloaded from the Internet for free.

4.9 WORLD WIDE WEB

The World Wide Web- known as WWW or W3 or simply, the Web - is one of several Internet resource discovery tools developed to help people publish, organize and provide access to information on the Internet. The Web was first developed by Berners Lec in 1989 while working at CERN, European Particle Physics Laboratory in Switzerland, and has now become the most powerful, and popular, resource discovery toll on the Internet. The WWW can be defined as a hypertext, multimedia, distributed information system that provides links to hypertext documents, as well as to many other Internet tools and databases.

The most important things required to understand the underlying mechanism of the Web are the client-server architecture, the Hypertext transfer protocol (HTTP), Universal Resource Locators (URLs) which we have already seen very briefly and the another important resource is Hypertext Markup Language (HTML). The most common method of creating a web document is through the use of Markup Languages. Most of these are created by adding a set of formatting code to ASCII text to show fonts, justifi-cations, links, etc. on the web. A markup language is a language that uses tags to indicate a change in presentation style or a change in content type.

By now, you can imagine that the web ***documents*** are referring to each other by ***links***. This simple view is known as the ***hypertext*** paradigm. The reader sees on the screen a document with sensitive parts of text representing the links. A link is followed by mere pointing and clicking.

4.9.1 Web Pages

A web page is nothing but a hypertext document which is suitable for the World Wide Web and can be accessed through a web browser and displayed on a monitor or mobile device. Web pages are usually written in HTML or XHTML and may contain static contents or dynamic contents. Web pages provide navigation to other web pages via ***hypertext links***. Hypertext is a system of organizing, navigating, distributing and publishing information electronically.

Contents of a Web Page :

A web page may contain various types of information, which can be divided into two main groups - *perceived information* (visible to the website visitor) and *hidden information* (hidden from the visitor's eye).

Depending on the purpose and target audience of a website, its perceived information could be textual, non-textual and interactive.

The non-textual information includes static images (e.g. GIF, JPEG, PNG or TIFF), animated images (e.g. animated GIF, Flash, Shockwave, Java Applet), vector formats (e.g. Flash, SVG), audio file formats (MIDI, WAV, MP3, Java Applets), video files (WMV, RM , FLV, MPG, MOV) etc. Interactive content on web pages could be displayed via DHTML, interactive illustrations, DHTML based buttons. *Hyperlink* or *link* is a navigational element in a web page through which navigation between the content on separate pages is possible.

The hidden information on web pages includes comments, metadata, charset details, CSS visual specifications, scripts (e.g. the interactivity focused JavaScript) etc.

Depending on the type of information contained in a web page, web pages can be divided into three categories :

- ***dynamic web page***
- ***static web page***
- ***active web page***

A ***dynamic web page*** is a kind of web page that has been prepared with fresh information (content and/or layout), for each individual viewing. It is not static because it changes with the time (ex. a news content), the user (ex. preferences in a login session), the user interaction (ex. web page game), the context (parametric customization), or any combination of the foregoing.

A web page is **static**, if it does not change its behaviour in response to external actions. A static web page remains the same, i.e. static, for all its life, unless and until someone manually changes its contents. Examples of some static web pages are some home pages, page specifying the contact details, etc., which do not change

that often.

An **active web page** is a web page that executes a program on the client machine, i.e. web browser. It means the web page shown by a web browser is the program currently executed by the client and hence that page is called an active web page.

Creating a Web Page :

A web page can be created in many different ways. There are a lot of web pages created by simply using HTML code which are simple and not very interactive. Advanced web pages can be created by using a programming language which is also known as scripting languages, such as ***JSP, PHP, Python*** or ***Perl***.

How do web pages work?

The information on a web page is displayed online with the help of a web browser, which connects with the server where the website's contents are hosted through the Hypertext Transfer Protocol (HTTP). For instance, if you look at the URL of the web page you are on at the moment, you could notice the prefix 'http://', which tells the browser what protocol to use to execute the particular URL request.

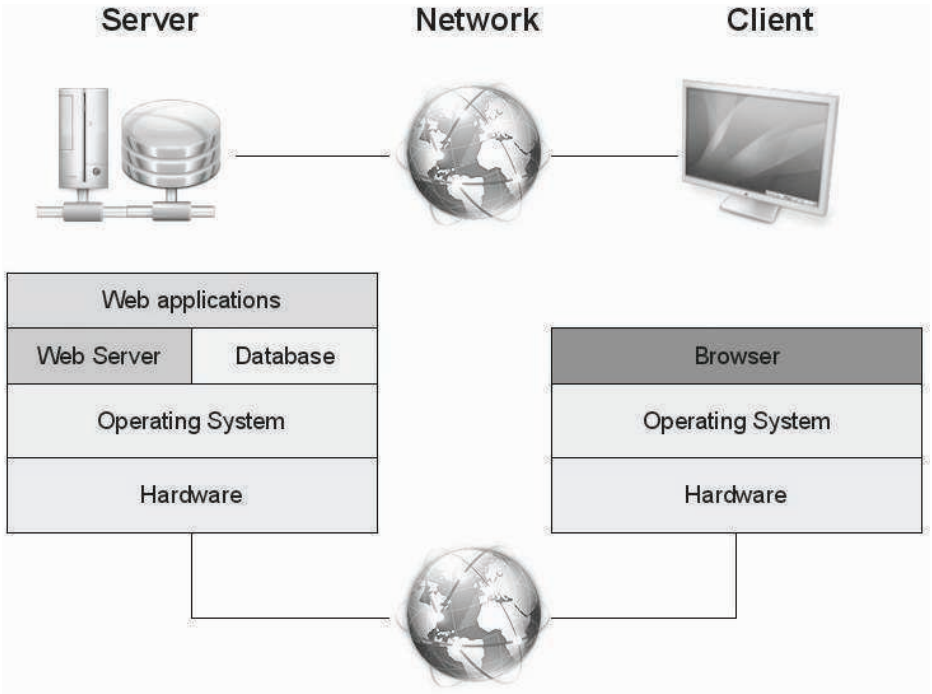
Each web page's contents are usually presented in HTML or XHTML format, which allows for the information to be easily structured and then quickly read by the client's web browser. With the help of CSS (Cascading Style Sheets), designers can precisely control the web page's look and feel as far as the layout typographic elements, color scheme and navigation are concerned. CSS instructions can be either embedded within the HTML web page (valid for that particular page) or can be included in a separate external file (valid for the whole site).

4.9.2 Web Browsers

In a network such as the World Wide Web, all the computers are divided into two categories : *client* and *server*. A ***web client*** is a software that accesses a web server by sending requests and

processing the resulting response.

The Fig. 4.10 shows how a web server and a web client is connected to a network and what components are actually held by them for communicating each other.



The web server is the computer on the Internet that stores the web pages, images and other web resources. When we click a hyperlink or type a URL into the web browser, a request for the web page is made by the web client to the web server. The server then receives the request and responds by sending the HTML page to the browser. The browser then interprets and displays the page.

The client-side processing is carried out by the **Web browser**. The browser consists of an interface and processing software. ***Web browsers*** are programs running on the client. They are called browsers because they allow the users to browse the resources available on the servers. We can search for and view different kinds of information on the Web with browsers. The main purpose of a web browser is to make the information resources in the Web available to the users. A browser allows you to view the documents

written in HTML (Hyper Text Markup Language). These documents are called *web pages* which we have alrady discussed.

4.9.3 Web Servers

Server software runs exclusively on server machines, handling the storage and transmission of documents. In contrast, client software such as Netscape, Internet Explorer, etc. runs on client computer that access, translates and displays documents.

A web server is a software package that processes HTML documents for viewing by Web browsers that runs on client computers. Web servers can be run from any hardware platform. There are servers that are specifically designed for Macintosh computers, PCs, Silicon Graphics, and various other platforms, including the Amiga. It can also run under several operating systems, including MS Windows, Windows NT, Unix, Linux etc.

The web server is responsible for document storage and retrieval. It sends the document requested (or an error message) back to the requesting client. The client interprets and presents the document. The client is responsible for document presentation. The language that web clients and servers use to communicate with each other is called the Hypertext Transfer Protocol (HTTP). All web clients and servers must be able to speak HTTP in order to send and receive hypermedia documents. For this reason, web servers are often called HTTP servers, or HTTP Daemons (HTTPD).

4.9.4 Search Engines

The Web is quickly becoming a vast information space that needs search tools to find information efficiently. The search engines can be defined as the tool created for finding, classifying and storing information about various Websites on the Internet. These can help in locating information of relevance on a particular subject by using various search methods. A search engine is a service that indexes,

organizes, and often rates and reviews Web sites. Search engines are online utilities that quickly search thousands of Web documents for an entered word or phrase. Search engines are usually accessed through Web browser software. Each search engine provides different searching options and has its own look.

Fig. 4.11 : A list of Search Engines

You may wonder as to how the search engines find the answers to a query so quickly. Actually it is a four-step process and the steps are :

- ***Crawling*** the Web, following links to find pages.
- ***Indexing*** the pages to create an index from every word to every place it occurs.
- ***Ranking*** the pages so that the best ones show up first.
- ***Displaying*** the results in a way that is easy for the user to understand.

Given below is a list of important search engines which you can use for searching the web.

Name	**URL :**
Altavista	http://www.altavista.com
Excite	http://www.excite.com
Hotbot	http://www.hotbot.com

Infoseek	http://www.infoseek.com
Lycos	http://www.lycos.com
Northern Light	http://www.northernlight.com
Webcrawler	http://www.webcrawler.com
Yahoo	http://www.yahoo.com
Google	http://www.google.com

4.9.5 Web Cookies

Basically, the cookies stores tracking data about your browsing. Cookies is a message given to a Web browser by a Web server. The browser stores the message in a text file in the client machine and uses each time the browser requests a page from the server. Web cookies were also called "magic cookies" when they were first introduced. When you enter a Web site using cookies, you may be asked to fill out a form providing such information as your name and interest.

If you use Microsoft Internet Explorer, your cookies are kept as individual files in a folder named "Cookies", often found in the "Documents and Settings" folder. If you use Mozilla Firefox, your cookies are stored in a text file named "cookies", often found in the "Firefox/Profiles" folder.

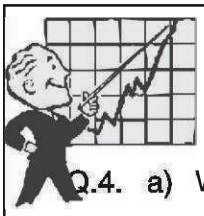
Some of the reasons why web sites use cookies are described below:

Customization : Some sites use cookies to record your surfing patterns, and then optimize the information the site subsequently presents. For example, a search site may present you with advertising that reflects your interests based on the keywords you search for.

Distribution : One of the key reasons for which web sites use cookies is to distribute the information storage. A cookie takes up a small amount of space on an individual computer, but would take up a very large amount of space if they all had to be stored back on a

web site's server.

Security : If a cookie was stored on a web site, then it can be accessed by anyone with access to that web site. However, when the cookie is stored on your computer, then it can't be accessed by hackers that break into the web site.



CHECK YOUR PROGRESS

Q.4. a) Which of the following protocols is used by the Internet mail?

i. HTTP ii. TCP/IP iii. SMTP iv. none of these

b) Find the odd item from the following -

i. Yahoo! ii. HOtBot iii. LycosS iv. Win2000

c) Computers on the Internet owned and operated by education institution form part of the

i. com domain ii. edu domain

iii. mil domaiin iv. gov domain

d) For a small website, one needs to buy space from the

i. Network administrator ii. Telephone exchange

iii. ISP iv. None of these

e) Find the odd item from the following :

i. FTP ii. SMTP iii. JAVA iv. HTTP

Q.5. Distinguish between web server and web browser.

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Q.6. Distinguish between Internet and WWW.

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4.10 TECHNOLOGIES IN WWW

The Web uses the HTTP protocol, which governs the dialog between the client and the server. Now, if we consider the technologies used in WWW then we can divide it into two categories like : *technologies in client side* and *technologies in the server side*. Client-side technologies are the programs that operate in the browser. There is no need to interact with the server. These programs are created by using the languages known as ***client side scripting language*** which are generally very easy to use, and you can try them on your own computer. **HTML** is a basic mark-up language that you will use to create the structure of your web page so HTML is one of the client side language. Remember that HTML is not a scripting language which is a basic building block of static web page.

A ***script*** is a program that is executed by the web server in response to a request. The SCRIPT element includes a script in the HTML document. Scripts allow greater interactivity in a document by responding to the user events. A scripting language is a lightweight programming language. *VBScript, Java Script* are examples of scripting languages.

The client-side scripts are executed by the browser or the client. Their work is confined only to the browser. They donot have to wait for the server to process and return data. This makes the web pages more responsive. The browser should also support the scripts that the web page wants to display.

The following applications are used to form server-side technology.

PHP : PHP is a fast, server-side scripting language that is used to create interactive, dynamic web sites.

JSP : Java Server Pages or JSP for short is Sun's solution for developing dynamic web sites. JSP provides excellent server side scripting support for creating database driven web applications.

CGI/Perl : Perl is a programming language that can handle input and output from a Web Server, usually through the Common Gateway Interface.

XML/XSL : XML is a software and hardware independent markup

language designed for describing and transmitting information. XSL is a language for defining, transforming and formatting XML documents.

MySQL : MySQL is a fast, open-source Relational Database Management System that uses the popular Structured Query Language (SQL).

PostgreSQL : PostgreSQL is a more sophisticated open-source Relational Database Management System. It is well-suited to sites that require robust database functionality, such as e-commerce sites.

Linux/Apache : Linux is a popular open-source operating system, and Apache is the most widely-used web server on the Internet. Together they provide a fast, extremely reliable, secure platform for web sites.

CHECK YOUR PROGRESS

Q.7. Fill in the blanks :

i. A _____ is a program that is executed by the web server in response to a request.

ii. The client-side scripts are executed by the _____.

iii. Web _____ allow a Web site to store information about you as well as to track your visits to it over a prolonged period of time.

Q.8. Choose the appropriate option:

i) Which of the following protocols is responsible for Internet mail?

a) TCP/IP b) HTTP c) FTP

d) None of these

ii) A user can get files from another computer on the Internet by using

a) FTP b) HTTP c) UTP

d) None of these

iii) Take the odd item out

a) Internet Explorer b) Mozilla Firefox

c) Google d) Netscape navigator

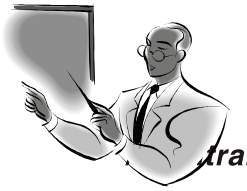
iv) Take the odd item out

a) PHP b) JSP c) HTML d) XML

v) FTP is used for

a) Uploading files only b) Downloading files only

c) Both (a) and (b) d) None of these



LET US KNOW

Intranet is a Web-based architecture used for managing internal information of an office, company, university or college or even a large library that runs on IP protocols. It means that an intranet is a private network that is contained within an enterprise.. It uses Internet protocols such as **TCP/IP** (Transmission Control Protocol/Internet Protocol), **HTTP** (Hypertext Transfer Protocol), **HTML** (Hyper Text Markup Language) **SMTP** (Small Message Transfer Protocol), **FTP** (File Transfer Protocol), and **AAA** (Access, Authorization, and Authentication). It may consist of many interlinked Local Area Networks and also use leased lines in the Wide Area Network. The main purpose of an intranet is to share information within the organization and computing resources among employees. An intranet can also be used to facilitate working in groups and for teleconferences.

An ***Extranet***, or extended Intranet, can be defined as a private network of linking branch offices or several cooperating organizations located outside the walls of any organisation. An Extranet service uses existing Intranet interactive infrastructure, including standard servers, e-mail clients and Web browsers. This makes Extranet far more

economical than the creation and maintenance of a proprietary network. It enables trading partners, suppliers and customers with common interests to form a tight business relationship and a strong communication bond.

4.11 LET US SUM UP

The Internet is a network of networks. It connects millions of computers and thousands of computer networks throughout the world. The Internet has revolutionised our society, our economy and our technological systems. This unit has discussed specifically the technology associated with the Internet such as Internet architecture, organization of Internet (Internet protocol and Internet addressing). It is important to know the various information resources and services available in Internet or World Wide Web (www). It is equally important to know about search engines, selecting and searching from a particular search engine. Client side technologies includes HTML, DHTML, VB Script, Java Script,ECMAScript, JScript, Java applets and Flash Animations etc. Server side technologies includes PHP, JSP, CGI/ Perl, XML/XSL, MYSQL, PostgreSQL etc.

4.12 FURTHER READINGS

- Data and Computer Communications by William Stallings, Pearson Education.
- Data Communications and networking by Behrouz A. Forouzan, Tata McGrawHill.
- "Web technologies: a computer science perspective", *Jeffrey C. Jack son*, Pearson Prentice Hall.
- "Web Technology : A Developer S Perspective", *Gopalan, Gopalan/ akilandeswari*, Pearson Prentice Hall.

4.13 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1 : a) ii, b) iv, c) iii, d) i, e) i.

Ans. to Q. No. 2 : a) iv, b) ii, c) i, d) iii, e) iv.

Ans. to Q. No. 3 : IP address is the Internet Protocol (IP) address given to every computer connected to the Internet. An IP address is needed to route information much like a street address or PO box is needed to receive regular mail. Example: 177.198.48.157

Domain name is a text name which a computer network registers. The domain name is used to give computers text names rather than using the numeric IP addresses. This is like getting a vanity phone number that spells out a word to make it easy to remember.

Computer (host) names are names given to individual computers. Each host name corresponds to an IP address. Host names and domain names are optional and everything will work fine using just IP addresses.

Ans. to Q. No. 4 : a) iii, b) iv, c) ii, d) iii, e) iii

Ans. to Q. No. 5 : A *Web server is a computer* that delivers (serves up) *Web pages.* Every Web server has an *IP address* and possibly a *domain name.* For example, if you enter the *URL http:/www.pcwebopedia.com/index.html* in your browser, this sends a request to the server whose domain name is *pcwebopedia.com.* The server then fetches the page named index.html and sends it to your browser. *Web browser,* a *software application* used to locate and display Web pages which is found on a client computer. The main function of the Web browser is to make the information resource available to the users. The two most popular browsers are *Netscape Navigator* and Microsoft *Internet Explorer.* Both of these are

graphical browsers, which means that they can display graphics as well as text.

Ans. to Q. No. 6 : The terms Internet and World Wide Web are often used in everyday speech without much distinction. However, the Internet and the World Wide Web are not one and the same. The Internet is a global data communications system. It is a hardware and software infrastructure that provides connectivity between computers. In contrast, the Web is one of the services communicated via the Internet. It is a collection of interconnected documents and other resources, linked by hyperlinks and URLs.

Ans. to Q. No. 7 : i) script, ii) browser, iii) cookies

Ans. to Q. No. 8 : i) a, ii) a, iii) c, iv) c, v) c

4.14 MODEL QUESTIONS

Q.1. What is Internet? Explain why Internet is called a 'network of networks'?

Q.2. What do you mean by the Internet architecture? Describe the most commonly used Internet architecture.

Q.3. Differentiate between the dia-up and ADSL Internet connection.

Q.4. Differentiate between the ADSL Internet connection and cablle Internet connection.

Q.5. What is Internet protocol suite? List out the functions of five Internet protocols.

Q.6. What is an IP address? Discuss the function of domain name system.

Q.7. What is an URL? Using an example identify the components of an URL.

Q.8. What is WWW? How does it function? How is it different from Internet?

Q.9. Define the term WWW ? What are the various features of WWW ?

Q.10. Define the terms Web site, Web page, Web server, URL and home page.

Q.11. Discuss the functioning of a web server and web browser. Also give two examples of a web server and web browser.

Q.12. What is Web server application ? How is it different from a Web browser?

Q.13. Describe how the Web browser communicates with the web server.

Q.14. There are many application areas of Internet. Identify four of them and describe two of them.

Q.15. Write short notes on the following :

a) Dial-up connections
b) ADSL connections
c) Internet Service Providers
d) IP Address
e) Domain name system
f) Uniform resource locator
g) WWW
h) Web servers
i) Web browsers
j) Search Engines

UNIT 5 : STATIC WEB PAGE DESIGN

UNIT STRUCTURE

5.1 LEARNING OBJECTIVES

After going through this unit, you will able to :

- describe the basic concept of HTML
- explain the use of document structure tags
- identify the formatting tags
- deal with different list tags
- illustrate the use of hyperlink tags
- discuss how to add graphics using image tags
- explain the use of the table tags
- design framed output using frame tags
- describe the use the form tags.

5.2 INTRODUCTION

In the previous unit we have learnt about the introduction to Internet and the World Wide Web. This unit deals with the Static web page design. In this unit we will learn about the basic concept of Hyper Text Markup Language. We will also gain knowledge of Document structure tags and formatting tags. Besides, this unit also provides a description of list tags, hyperlink tags and image tags. In addition, the unit also describes the table tags and frame tags. Finally, the form tags are explained in this unit.

5.3 BASICS OF HTML

HTML stands for **H**yper **T**ext **M**arkup **L**anguage. It is the language on which the Internet documents are written. With HTML you can create your own Web site. When you see a web page on the Internet and if you click at 'view source' by right clicking on the page, you will visualize the HTML code behind the page. You will find that it is nothing but a collection of commands written within some angular brackets, which are known as HTML tags. The HTML language is based only on the tags. It is a very simple language. A web browser like Internet Explorer can understand a page written in HTML. Though this language provides its own syntax for giving different tags, it does not give you error if you make mistake in writing codes. The only possibility is that you will not get your desired output. It displays outputs only for the correct parts of what you have written.

5.3.1 HTML Tags

All the HTML tags are written in angular brackets. HTML tags are divided into two types:

- Container tags
- Standalone tags or empty tags

CONTAINER TAGS : Container tags are appearing in pairs i.e., they have a starting tag and a closing tag. They contain stuff between the start and the end tags. Both the starting and closing tags have

the same name but the closing tag has a slash in front of the tag name. e.g. <HTML> tag. It is the most important tag and is written as follows:

<HTML> Body of HTML tag. </HTML>

STANDALONE TAGS : It is also known as empty tag. It appears only once. It does not have any closing counterpart. So it does not contain anything. It affects at the position where it is applied.

e.g.
 tag. It breaks a line in the output at the position where it appeares.

5.3.2 HTML Editor

Dreamweaver: It is a software, which enables us to develop a web page with a very little effort. Here you need to specify what your requirement is. The software will design the HTML page against that page.

The HTML codes can be written in any text editor such as Notepad, WordPad, Edit command of MS-DOS, MS-WORD, and ***Dreamweaver*** etc. We must use .html or .htm as the file extension of the HTML file. Once we create the HTML file in any of the text editors we can view it through any web browser.

5.4 DOCUMENT STRUCTURE TAGS

Document Structure tags are used to construct the web page as a whole. A web page created in HTML consists of three distinct sections:

- Comment section
- Header section
- Body section.

The **comment section** contains the comment or remark lines for better understanding about the document. They are non-executable and ignored by the web browser when they are executed. The comment tag is denoted as follows :

<!— This is a comment line in a web page document —>

Header section consists of tags like: <HEAD>, <TITLE>, <META> etc. Using these tags we can construct the header section of a web page.

Body section contains the major portion of the tags and they are included within the <BODY> tags. This section consists of the entire

information about the web document.

<HTML> tags : It is a container tag. The entire web page is enclosed within this tag.

Syntax :

```
<HTML>
    … Web page documents
</HTML>
```

<HEAD> tags : This tag is used to create the header section of a web page document. In this section we normally put the title of the document and other related information like information about the author and their profile etc. It is also a container tag. It may contain other tags like: <TITLE>, <LINK>, <META> etc.

Syntax :

```
<HEAD>
    Header section documents and tags only
</HEAD>
```

<TITLE> tags : This tag is used to create the title of the web page document. It is a container tag.

Syntax :

```
<TITLE> Title of the web page document. </ TITLE >
```

<BODY> tags : It is used to create the body section of the HTML document. This section contains the actual web page document, which is visible to the user through a web browser. Major portion of the tags are belonging to this section.

Syntax :

```
<BODY Bgcolor="color" Text="text-color" Link ="unvisited-link-color" Alink="active-link-color" Vlink="visited-link-color">
    … Body section documents and tags.
</BODY>
```

Attributes : Bgcolor: Here we can set the background Color, which is either 16 **Standard English Color** or an **RGB hexadecimal triplet** e.g. Color="#FF44AA"

Text : Here we can set the color of the entire document.

Standard English Color: The 16 standard colors are: Black, White, Aqua, Silver, Gray, Maroon, Red, Purple, Fuschia, Green, Lime, Olive, Yellow, Navy, Blue and Teal.

RGB hexadeci-mal triplet : It is a combination of three colors: Red, Green and Blue. It has six digits, every continuous two digit represent one color. Each digit is represented by a hexadecimal number. So, it takes value between "#000000" and "#FFFFFF".

Link : It sets the color of unvisited hyperlinks.

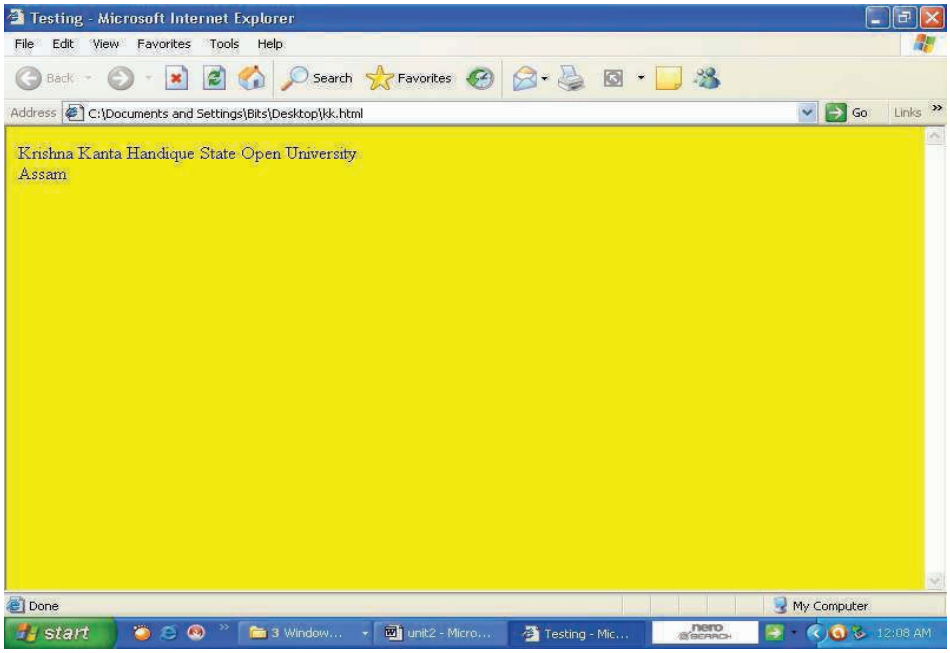
Alink : It sets the color of active hyperlinks.

Vlink : It sets the color of visited hyperlinks.

Example :

```
<HTML>
    <BODY Bgcolor="Yellow" Text="Blue">
    Krishna Kanta Handique State Open University<BR>
    Assam<BR>
</BODY>
</HTML>
```

➔Output :



CHECK YOUR PROGRESS

Q.1. State true or false:

a) Standalone tag contains a body.

b) Any text editor can be used to create a HTML document.

c) Web-browser gives you errors if you make mistakes in

writing a HTML code.

d) Each color code in hexadecimal triplex varies from 00 to FF and it is equivalent to the range 0 to 255 in decimal.

Q.2. Fill in the gaps:

a) Entire _____ can be included within <HTML> tag.

b) Text attribute of <BODY>tag represent the _____ of the entire HTML document.

c) Author's information can be included in the _____ section.

d) <BODY Bgcolor="#00FF00"> will set the _____ with _____ color.

5.5 FORMATING TAGS

Formatting tags can be used to change the typographic formatting of a page. For example, to change font name and size, to change font style like bold, underline, italic, strikeout, superscript, subscript etc.

<BASEFONT> tags : It is a standalone tag. Using this tag we can set the typeface, size and color of the entire body text.

Syntax :

< BASEFONT Face= "list of font names" Size="size" Color="color">

Attributes :

Face : Here we can put several font names separated by comma. Browser will try to apply the first font; if it is not available then the browser will go for the second and so on.

Size : It may vary within the range of 1 to 7.

Color : It may be any one of 16 Standard English color names or an RGB hexadecimal triplet.

<FONT> tag : It is a container tag. This tag can be used to modify font-face or font-size of a particular text portion.

Syntax :

< FONT Face= "font names" Size="size" Color="color">

Text where font properties are applied

</FONT>

Attributes :

Here, explanation of Face, Size and Color are same as BASEFONT.

<Big> tag : It is a container tag. Using it we can display the enclosed text to be bigger than the default font size.

Syntax :

<Big> … Text in bigger size …</Big>

<Small> tag : It is a container tag. Using it we can display the enclosed text to be smaller than the default font size.

Syntax :

<Small> … Text in smaller size … </ Small >

<B> tag: It is a container tag. Using this tag we can change the enclosed text to be bold.

Syntax :

<B> …Boldface text goes here... </B>

<I> tag : It is a container tag. Using this tag we can change the enclosed text to be italics.

Syntax :

<I> …Italic text goes here... </I>

<U> tag : It is a container tag. Using this tag we can change the enclosed text to be underlined.

Syntax :

<U> …Underlined text goes here... </U>

<S> or <Strike>tag : It is a container tag. Using this tag we can put a strikethrough character over the enclosed text.

Syntax :

<S> … Strikethrough text goes here... </S> (or)

< Strike > … Strikethrough text goes here... </ Strike >

<Sub> tag : It is a container tag. Using this tag we can make the enclosed text as subscript one.

Syntax :

_{… subscript text goes here...}

<Sup> tag: It is a container tag. Using this tag we can make the

enclosed text as superscript one.

Syntax :

^{… superscript text goes here...}

<TT> tag : It is a container tag. Using this tag we can obtain a fixed width font, which is equivalent to typewriter font.

Syntax :

<TT> … Text with typewriter font goes here... </TT>

<DFN> tag : It is a container tag. Using this tag we can define the instance of a term. Some browsers display it in italic text.

Syntax :

<DFN> … Term to be defined goes here... </DFN>

<EM> tag : It is a container tag. Using this tag we can obtain emphasized text against the enclosed text. Most of the browsers display it in italic text.

Syntax :

<EM> … Emphasized text goes here... </EM>

<STRONG> tag : It is a container tag. Using this tag we can obtain strongly emphasized text against the enclosed text. Most of the browsers display it in boldface text.

Syntax :

<STRONG> … Strongly emphasized text goes here...
</STRONG>

**
 tag :** It is a standalone tag. It is used to insert a line break in the document. Even if we write the text in different line while designing the documents, browser will not display them in different lines. i.e. Browser do not understand carriage return.

Syntax :

<CENTER> tag : It is a container tag. Using this tag we can align the page contents into centre position.

Syntax :

<CENTER> … Page content with center alignment...
</CENTER>

<DIV> tag : It is a container tag. It contains division of document,

which requires special alignment.

Syntax :

<DIV Align="left| right| center| justify">

… Text to be aligned...

</DIV>

<HR> tag : It is a standalone tag. It is used to insert a horizontal line on the page.

Syntax :

<HR Align="left|right|center" Noshade Size="thickness" Width="percentage of screen or no. of pixels">

Attributes :

Align: default is center.

Noshade: It suppresses the shading effect.

Size: It indicates thickness of the line in pixels.

Width: Here we can set the width of the line in two ways- percentage of the screen or number of pixels.

<H1>- <H6> tag : These are container tags. Using these six tags we can set six different levels of heading. <H1> creates the largest possible heading whereas <H6> creates the smallest possible heading. Each heading will be of boldface text with little extra line spacing.

Syntax :

<Hn Align="left|right|center|justify">

Level n heading

</Hn>

Where n may be any digit between 1 and 6.

<P> tag : It is a container tag. Using this tag we can denote a paragraph. Multiple uses of <P> tags make no difference. i.e. Browser ignores the use of multiple tags.

Syntax :

<P Align="left|right|center|justify">

Paragraph text

</P>

<PRE> tag : It is a container tag. It is used to display pre-formatted

text. i.e. The enclosed text will be displayed as it is.

Syntax :

<PRE Width="Width of the widest line"> Preformatted text </PRE>

<SPAN> tag : It is a container tag. It is used to apply some of the style information.

Syntax :

<SPAN Style="style information" Align="leftlrightl centerl justify">

Text on which style is to be applied.

</SPAN>

CHECK YOUR PROGRESS

Q.2. What is the output of the following two HTML codes:

a) <P><PRE>

Name	City	PO	Pin
Mantu	Ghy	Chand	781003
Nantu	Ghy	Ulu	781007
Badan	Nag	Pani	782410

</PRE></P>

b) <P>

Name	City	PO	Pin
Mantu	Ghy	Chand	781003
Nantu	Ghy	Ulu	781007
Badan	Nag	Pani	782410

</P>

Q.3. Select the correct answer :

a) Using <H1>/<H6> tag smallest heading can be produced.

b) Both <BASEFONT> and <FONT> tags can set font; they have differences/no differences.

c) Multiple
 tag produces multiple/single blank line.

d) Multiple <P> tag produces more gaps/ same gap between paragraphs.

5.6 LIST TAGS

HTML has several different lists such as:

- Ordered List
- Unordered List
- Menu List
- Directory List
- Definition List

Most of the list uses <LI> tag.

<LI> tag : It is a container tag. Using this tag we can denote an item in a list.

Syntax :

<LI Type="List-type" Start="Start-value" > List Item </LI>

Example :

<LI Type="A" Start="2" > Elephant</LI>

➔Output :

A. Elephant

<OL> tag : It is a container tag. Using this tag we can create an ordered list.

Syntax :

<OL Type="1IAIaIII" Start="Start-value" Compact>

<LI> List Item 1 </LI>

<LI> List Item 2 </LI>

…

</OL>

Example :

<OL Type="a" >

<LI> COW</LI>

<LI> CAT</LI>

<LI> DOG</LI>

</OL>

➔Output :

a. COW

b. CAT

c. DOG

<UL> tag : It is a container tag. Using this tag we can create an unordered list. It is normally known as bulleted list.

Syntax :

```
<UL Type="discl squarel circle" Compact>
        <LI> List Item 1 </LI>
        <LI> List Item 2 </LI>
        …
</UL>
```

Example :

```
<UL Type="circle" >
        <LI> COW</LI>
        <LI> CAT</LI>
        <LI> DOG</LI>
</UL>
```

➔Output :

- COW
- CAT
- DOG

<MENU> tag : It is a container tag. Using this tag we can create a menu list. It is a short list and is arranged in a single column.

Syntax :

```
<MENU Compact>
        <LI> List Item 1 </LI>
        <LI> List Item 2 </LI>
        …
</MENU>
```

Example :

```
<MENU Compact >
        <LI> CUT</LI>
        <LI> COPY</LI>
        <LI> PASTE</LI>
</MENU>
```

➔Output :

- CUT
- COPY
- PASTE

<DIR> tag : It is a container tag. Using this tag we can create a directory list. It is also a short list and is arranged in a single column.

Syntax :

```
<DIR Compact>
        <LI> List Item 1 </LI>
        <LI> List Item 2 </LI>
        …
</DIR>
```

Example :

```
<DIR Compact >
        <LI> Ramen, Chandmari</LI>
        <LI> Gakul, Jorhat</LI>
        <LI> Bandita, Nalbari</LI>
</DIR>
```

➔Output :

- Ramen, Chandmari
- Gakul, Jorhat
- Bandita, Nalbari

<DL> tag : It is a container tag. Using this tag we can create a definition list.

Syntax :

```
<DL Compact>
        Term to be defined and definition of the term.
        …
</DL>
```

Example :

```
<DL>
        <DT>Folder</DT>
        <DD>It is a container of files and subfolders. </DD>
```

```
<DT>Icon</DT>
<DD>It is a graphical representation of a program or
file.  </DD>
</DL>
```

➔Output :

Folder :

It is a container of files and subfolders.

Icon :

It is a graphical representation of a program or file.

<DT> tag : It is a container tag. It is used in a definition list to denote the term to be defined.

Syntax :

```
<DT>  term to be defined </DT>
```

Example :

```
<DL>
    <DT>Cow: </DT>
    <DD>A cow is a four footed animal. </DD>
</DL>
```

➔Output:

Cow :

A cow is a four footed animal.

<DD> tag : It is a container tag. It is used in a definition list to denote the definition of the term.

Syntax :

```
<DD> Definition of the term. </DD>
```

Example :

```
<DL>
    <DT>Internet: </DT>
    <DD>Internet is network of computer networks.
    </DD>
</DL>
```

➔Output :

Internet :

Internet is network of computer networks.

CHECK YOUR PROGRESS

Q.4. Fill in the gaps :

a) The _____ tag is used to denote list items.

b) The _____ tag can also be termed as bulleted tag.

c) For defining a scientific formula _____ tag is best suitable.

d) You can use _____ tag for designing a list of files and directories.

Q.5. State true or false :

a) The ordered list is used to denote bulleted list.

b) The menu list is best suitable for a lengthy list of many columns.

c) The <DT> tag is used in a <DIR> list to denote term to be defined.

d) The circle option in <UL> tag produces a solid circle as bullet.

5.7 HYPERLINK AND IMAGE TAGS

<A> tag : Using this tag we can create hyperlink. Hyperlink is created for the text found between <A>and </A> pair. The URL given against the HREF attribute specifies the target document.

Syntax :

<A HREF=”URL” Target=”Frame-Name” Accesskey=”Key-letter”>

Hyperlinked Term.

</A>

Attributes :

HREF=here URL of target document is to be specified.

Target=It is the name of frame to which target document is to be loaded.

Accesskey= It is the shortcut key, using which also target document can be accessed from keyboard by pressing accesskey and ALT key together.

Example :

```
<A HREF="c:\my documents\test.html" Accesskey="T">Test
</A>
```

<IMG> tag : It is a standalone tag. Using this tag we can place an image into a document.

Syntax :

```
<IMG SRC="URL" Width="width in pixel" Height="Height in
pixel" Border="Thickness in pixel" Align="Alignment"
Hspace="Horizontal spacing" Vspace="Vertical spacing"
ISMAP Usemap="Map-name">
```

Attributes :

SRC=here URL of the Image file is to be specified.

Width=Width of the image in pixel

Height=Height of the image in pixel

Border=Thickness of the border in pixel around the image.

Align=It controls how text flows around the image such as: Top, Middle, Bottom, Left or Right.

Hspace=Horizontal spacing in pixel around left and right side of the image.

Vspace=Vertical spacing in pixel around top and bottom side of the image.

ISMAP= Identifies the image to be used as imagemap.

Usemap=Set the name of imagemap.

<MAP> tag : It is a container tag. Using this tag we can create a clickable region, which can be termed as hot region.

Syntax :

```
<MAP Name="Map name">
        Definition of hot region
</MAP>
```

Attributes :

Name=here Map name should be specified and it should be unique within the Web page so that this can be correctly referred by USEMAP attribute of <IMG> tag.

<AREA> tag : It is a standalone tag. Using this tag we can define a hot region in a imagemap.

Syntax :

<AREA Shape="RECTI CIRCLEI POLYI DEFAULT" Coords="co-ordinate lists" HREF="URL" Target="frame name" Accesskey="key letter" NOHREF>

Attributes :

Shape= It specifes the shape of the hot region possible values may be Rect, Circle, Poly Or Default.

Coords=list of co-ordinate which specifies the hot region.

HREF=URL of linked document.

Target=Name of frame to which linked document is to be loaded.

Accesskey=defines the shortcut key

NOHREF=It deactivates the hot regions.

5.8 TABLE TAGS

<TABLE> tag : It is a container tag. Using this tag we can denote a table. All the related tags for creating a table are included within this tag.

Syntax :

<Table Align="alignment" Border="in pixel" Bgcolor="color" Width="pixel or percentage of browser" Cols="no. of columns" Cellspacing="pixel" Cellpadding="pixel" Frame="outer border" Rules="Inner border">

…

</Table>

Attributes :

Align=alignment such as left, right, center

Border=Thickness in pixels

Bgcolor=Background color of the table.

Width=Pixel or percentage of browser width

Cols=Number of columns.

Cellspacing=Number of pixels between cells.

Cellpadding= Number of pixels between cell border and the content.

Frame=It is used for outer border rendering and it can be any one of the following :

ABOVE: Displays border on top of table.

BELOW: Displays border at the bottom of table.

BORDER: Displays border on all the four sides of table.

BOX: Displays border on all the four sides of table.

HSIDES: Displays border on left and right sides of table.

LHS: Displays border on the left side of table.

RHS: Displays border on the right side of table.

VSIDES: Displays border on top and bottom side of table.

VOID: Off the borders.

Rules= It is used for inner border rendering and it can be any one of the following:

ALL: Displays border between all rows and columns.

COLS: Displays border between all columns.

GROUPS: Displays border between all logical groups like:

THEAD, TBODY TFOOT COLGROUP etc.

NONE: Off all inner borders.

ROWS: Displays border between all rows.

<CAPTION> tag : It is a container tag. Using this tag we can denote caption of a table.

Syntax :

```
<CAPTION Align="left|right|top|bottom">
        Caption Text
</CAPTION >
```

<THEAD> tag : It is a container tag. Using this tag we can denote header section of a table.

Syntax :

<THEAD Align=" leftl rightl justifyl center"
Valign="toplmiddlelbottomlbaseline">
Rows of the header.
</THEAD>

Attribute :

Align: Horizontal alignment.

Valign: Vertical alignment.

<TFOOT> tag : It is a container tag. Using this tag we can denote footer section of a table.

Syntax :

<TFOOT Align="leftl rightl justifyl center"
Valign="toplmiddlelbottomlbaseline">
Footnote.
</TFOOT>

Attribute :

Align: Horizontal alignment.

Valign: Vertical alignment.

<TBODY> tag : It is a container tag. Using this tag we can denote the body section of a table.

Syntax :

<TBODY Align="leftl rightl justifyl center"
Valign="toplmiddlelbottomlbaseline">
Footnote.
</TBODY>

Attribute :

Align: Horizontal alignment.

Valign: Vertical alignment.

<COLGROUP> tag : It is a container tag. Using this tag we can denote a grouping of columns, which shares the same properties. i.e. we can set properties to that group of columns as a whole rather than setting properties for each column individually.

Syntax :

```
<COLGROUP Span="no. of columns" Width="width of
column group" Align="left| right| justify| center"
Valign="top|middle|bottom|baseline">
    <COL>
    …
</COLGROUP>
```

Attribute :

Span: It specifies no. of columns in a column group.

Align: Horizontal alignment.

Valign: Vertical alignment.

<COL> tag : It is a standalone tag. Using this tag we can set properties of a column.

Syntax :

```
<COL Span="no. of columns" Width="width of column sub-
group" Align="left| right| justify| center"
Valign="top|middle|bottom|baseline">
```

Attribute :

Span: It specifies no. of columns in a column group.

Align: Horizontal alignment.

Valign: Vertical alignment.

<TR> tag : It is a container tag. Using this tag we can denote a row of a table.

Syntax :

```
<TR Align="left| right| justify| center"
Valign="top|middle|bottom|baseline">
    <TD>…</TD>
    …
</TR>
```

Attribute :

Align: Horizontal alignment.

Valign: Vertical alignment.

<TD>/<TH> tag : It is a container tag. Using these tags we can create cells of a table. <TH> is used to create cells of header section and <TD> is used to create cells of <TBODY> section. The cells created with <TH> become bold with center alignment.

Syntax :

<TH Align="left| right| justify| center"
Valign="top|middle|bottom| baseline" NOWRAP
Colspan="no. of columns" Scope="row|col|
rowgroup|colgroup">
Header item
</TH>
or
<TD Align="left| right| justify| center"
Valign="top|middle|bottom| baseline" NOWRAP
Colspan="no. of columns" Scope="row|col|rowgroup|
colgroup">
Table item
</TD>

Attribute :

Align: Horizontal alignment.

Valign: Vertical alignment.

NOWRAP: Suppress text wrapping within a cell.

Scope: It lets the users to create groups of row, columns, row-groups and column-groups.

5.9 FRAME TAGS

In a framed layout browser window can be divided into smaller regions called **frames**. Framed layout gives a better look to a web page. A few frame tags are used to create a framed layout. When we use the framed layout the <BODY> tag should not be used.

<FRAMESET> tag : It is a container tag. Using this tag we can divide the browser window into frames. It does the job in two ways: divides the window either *horizontally* or *vertically*.

Syntax :

<FRAMESET Rows=”list of row sizes” Cols=”list of column sizes”>

… Frame tags

</FRAMESET>

Attribute :

Though it has two attributes, we can use only one at a time.

Rows: It divides the browser window horizontally. Here we need to specify the size of individual fragments in pixel, in percentage of browser’s window or an asterisk mark (i.e. *). Asterisk mark is used to indicate the remaining horizontal portion.

Column: It divides the browser window vertically. Here also we need to specify the size of individual fragments in pixel, in percentage of browser’s window or an asterisk mark (i.e. *). Asterisk mark is used to indicate the remaining vertical portion.

<FRAME> tag : It is a standalone tag. Using this tag we can place contents into a frame.

Syntax :

<FRAME Src=”URL of document” Name=”frame name” Frameborder=”0l1" Marginwidth=”width in pixel” Marginheight=”height in pixel” NORESIZE Scrolling=”yesInoIauto”>

Attribute :

Src=Here we need to specify the URL of the document to be placed.

Name=Name of frame can be specified here.

Frameborder=It is either 0 to indicate no border or 1 to turn on the frame border.

Marginwidth=It specifies the size of left margin in pixel.

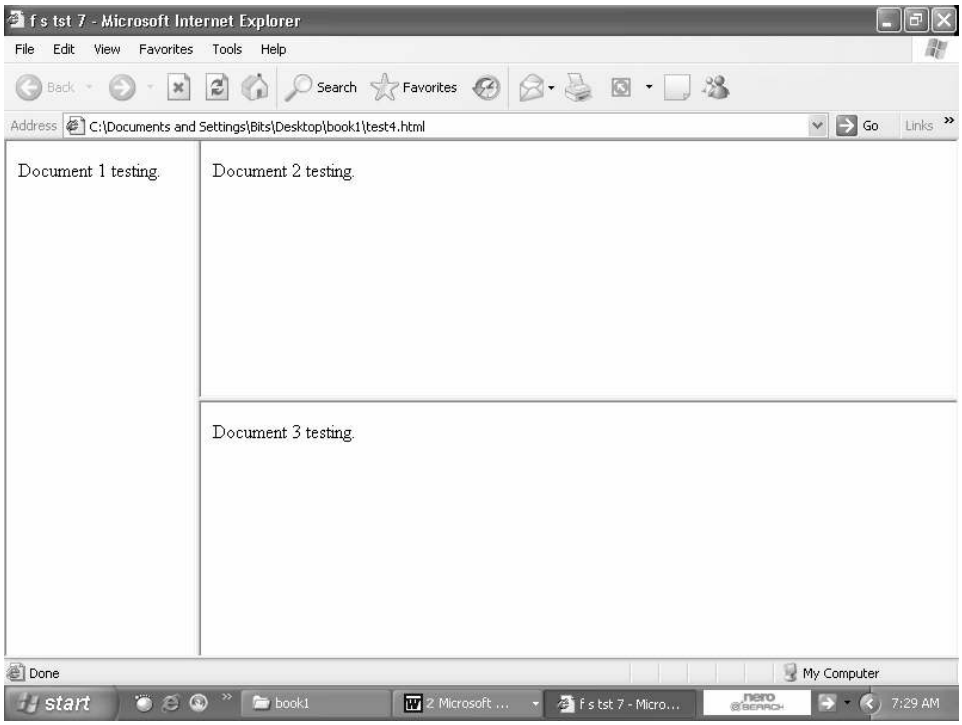
Marginheight= It specifies the size of top margin in pixel.

NORESIZE: If we use this option the user will not be able to drag and drop the frame border.

Scrolling=It can be yes, no or auto

Example :

```
1. <FRAMESET Cols="20%, *">
        <Frame Src="doc1.html">
        <FRAMESET Cols="50%, *">
            <Frame Src="doc2.html">
            <Frame Src="doc3.html">
        </FRAMESET>
   </FRAMESET>
```



<IFRAME> tag : It is a container tag. Using this tag we can place a floating frame into a page. Float frame is one which you can place anywhere else within the page.

Syntax :

```
<IFRAME Src="URL of document" Name="frame name"
Frameborder="0l1" Width="width in pixel or percentage"
Height="height in pixel or percentage" Margin width=" width
in pixel" Marginheight="height in pixel" NORESIZE
Scrolling="yesInolauto" Align="alignment">
    … Alternative text. …
</IFRAME>
```

Attribute :

Src=Here we need to specify the URL of the document to be placed.

Name=Name of frame can be specified here.

Frameborder=It is either 0 to indicate no border or 1 to turn on the frame border.

Width= Width of the frame in pixel or percentage of the browser window.

Height= Height of the frame in pixel or percentage of the browser window.

Marginwidth=It specifies the size of left margin in pixel.

Marginheight= It specifies the size of top margin in pixel.

NORESIZE: If we use this option user will not able to drag and drop frame border.

Scrolling=It can be yes, no or auto

Align= Top, middle, bottom, left or right alignment.

5.10 FORM TAG

HTML Forms are used to select different kinds of user input and to pass data to a server.

A form can contain input elements like text fields, checkboxes, radio-buttons, submit buttons and more. A form can also contain select lists, text area, field set, legend, and label elements.

```
<form>
.
input elements
.
</form>
```

The Input Element : The most important form element is the input element. The input element is used to select user information. An input element can vary in many ways, depending on the type attribute. An input element can be of type text field, checkbox, password, radio button, submit button, and more.

The most used input types are described below.

Text Fields :

<input type="text" /> defines a one-line input field that a user can enter text into:

```
<form>
First name: <input type="text" name="firstname" /><br />
Last name: <input type="text" name="lastname" />
</form>
```

How the HTML code above looks in a browser :

First name:

Last name:

Note : The form itself is not visible. Also note that the default width of a text field is 20 characters.

Password Field :

<input type="password" /> defines a password field:

```
<form>
Password: <input type="password" name="pwd" />
</form>
```

How the HTML code above looks in a browser:

Password :

Note : The characters in a password field are masked (shown as asterisks or circles).

Radio Buttons :

<input type="radio" /> defines a radio button. Radio buttons let a user select ONLY ONE one of a limited number of choices:

```
<form>
<input type="radio" name="sex" value="male" /> Male<br />
<input type="radio" name="sex" value="female" /> Female
</form>
```

How the HTML code above looks in a browser:

- Male
- Female

Checkboxes :

<input type="checkbox" /> defines a checkbox. Checkboxes let a user select ONE or MORE options of a limited number of choices.

```
<form>
<input type="checkbox" name="vehicle" value="Bike" /> I have a bike<br />
<input type="checkbox" name="vehicle" value="Car" /> I have a car
</form>
```

How the HTML code above looks in a browser:

- ☐ I have a bike
- ☐ I have a car

Submit Button :

<input type="submit" /> defines a submit button.

A submit button is used to send form data to a server. The data is sent to the page specified in the form's action attribute. The file defined in the action attribute usually does something with the received input:

```
<form name="input" action="html_form_action.asp" method="get">
Username: <input type="text" name="user" />
<input type="submit" value="Submit" />
</form>
```

How the HTML code above looks in a browser:

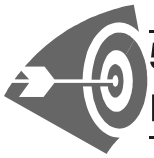
Username : Submit

5.11 LET US SUM UP

- HTML, which stands for Hyper Text Markup Language, is the Universal language on which the web documents(pages) are written (eg. especially pages on the World Wide Web)
- In HTML, a tag tells the browser what to do. When you write an HTML page, you enter tags for many reasons — to change the appearance of text, to show a graphic, or to make a link to another page. HTML tags are divided into two types. Container tags and Standalone tags or empty tags.
- The extension of the HTML file is written as **.html** or **.htm**
- A web page created in HTML consists of three distinct sections- Comment section, Header section, and Body section.
- Formatting tags are used to change the typographic formatting of a page.
- HTML has several different lists such as- Ordered List, Unordered List, Menu List, Directory List and Definition List.
- Hyperlink tags are used to create hyperlink for the text found between <A>and </A> pair.
- Table tag is a container tag which is uses to denote a table.
- Frame tags are used to create a framed layout. When we use the framed layout the <BODY> tag should not be used.
- The form tag is used to create an HTML form.

5.12 FURTHER READINGS

- **Data Communications and Networking –** Behrouza A Forouzan (Tata McGraw-Hill)
- **Computer Networks** *-A. S. Tanenbaum*
- **Web Technologies** *- A.S. Godbole and Atul Kahate.*
- Link for online tutorial : www.w3schools.com
- Using HTML, XML and Java by Eric Ladd and Jim O'Donnell, PHI.



5.13 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1 : a) False, b) True, c) False, d) True

Ans. to Q. No. 2 : a) HTML document, b) Text color, c) Head, d) Background, green

Ans. to Q. No. 3 : Output of a)

Name	City	PO	Pin
Mantu	Ghy	Chand	781003
Nantu	Ghy	Ulu	781007
Badani	Nag	Pani	782410

Output of b)

Name	City	PO	Pin
Mantu	Ghy	Chand	781003
Nantu	Ghy	Ulu	781007
Badani	Nag	Pani	782410

Ans. to Q. No. 4 : a) H6, b) Differences, c) Multiple, d) Same gap

Ans. to Q. No. 5 : a) <LI>, b) <UL>, c) <DL>, d) <DIR>

Ans. to Q. No. 6 : a) False, b) False, c) False, d) False

5.14 MODEL QUESTIONS

Q.1. What are meta tags and why are they is used?

Q.2. What is the difference between width=”100" and width=”100%”.

Q.3. What is DocType?

Q.4. How do you create frames? What is a frameset?

Q.5. What is a Hypertext link?

Q.6. Is it possible in HTML to add more than one submit button having different actions in a single form? Explain.

UNIT 6 : ADVANCED HTML TAGS AND INTRODUCTION TO XML

UNIT STRUCTURE

6.1 LEARNING OBJECTIVES

After going through this unit, you will able to :

- identify the different HTML FORM elements like Text Box, Combo Box, Checkbox, Radio Button etc.
- explain about the additional advanced HTML Tags
- describe about the XML
- discuss the difference between HTML and XML.

6.2 INTRODUCTION

In the previous unit you have learnt about the Static Web page design. This unit will deal with the Advanced HTML tags and Introduction to XML. This unit provides a description of the various HTML Form elements. The unit also describes some additional advanced HTML tags such as Executable Content tags, Cascading Style Sheet (CSS), Class, External

style sheet (ESS) and SPAN tag. Finally this unit will focus on the basic concept of extensible Markup Language (XML).

6.3 HTML FORM

FORM is a powerful tool of HTML for developing interactive web documents. It has several elements for developing different buttons or boxes. <FORM> tag is a container tag.

Syntax :

```
<FORM Name="form name" Method="Get or Post">
        Form elements
</FORM>
```

The method can be GET when small amount data are to be sent to the server. The maximum limit is 1024 byte. The POST method is used for large data and in this case data is sent as a separate bit-stream.

The form elements may be text box, text area, password, radio button, checkbox, combo box hidden field, image, submit button, reset button etc.

TEXT BOX : It is used to capture one line of textual data from user in a web page. The <INPUT> tag is used for the purpose. <INPUT> is a stand alone tag.

Syntax :

```
<INPUT Type="Text" Name="Textbox Name" Size="size of box" Maxlength="maximum length of text to be received" Tabindex="number for controlling tab order"/>
```

TEXT AREA : It is also used to capture text from the user. It is a container tag. Here we can obtain multiple lines of texts instead of a single line of the text as in the case of Text Box.

Syntax :

```
<TEXTAREA Name="Textarea Name" Rows="number of rows" Cols="number of columns">
</TEXTAREA>
```

Password : It is used to capture password from user in a web page. Like Text Box Password also uses <INPUT> tag. Whenever a text typed in this box the letters are hidden.

Syntax :

<INPUT Type="Password" Name="password name" Size="size of box" Maxlength="maximum length of password text to be received"/>

RADIO BUTTON : It is also termed as option button and it is used to capture the user's selection from several option buttons.

Syntax :

<INPUT Type="Radio" Name="radio button name" Value="caption" Checked="true/false" Tabindex="number for controlling tab order"/>

CHECKBOX : It is similar to Radio Button but here we can select multiple options simultaneously.

Syntax :

<INPUT Type="Checkbox" Name="checkbox name" Value= "caption" Checked="true/false" Tabindex="number for controlling tab order"/>

Combo Box : It holds a list of options. It initially displays only one option which is declared by using <OPTION SELECTED>tag. Once the user clicks it a dropped down list will appear and the user can select any one option from that list. It uses a container tag <SELECT> for the purpose. We can use <OPTION> or <OPTION SELECTED> tags within <SELECT> tag, which are again container tags.

Syntax :

<SELECT Name="selectbox name" Size="number; to specify no. of items to display at a time; default 1" Tabindex="number for controlling tab order"/>

<OPTION [SELECTED]> Opt1 </OPTION>
<OPTION [SELECTED]> Opt2 </OPTION>
<OPTION [SELECTED]> Opt3 </OPTION>
…..

</SELECT>

HIDDEN FIELD : Sometimes it is required to isolate some data from other form data. Or sometimes it is needed to hide some data from the user and send directly to the server. In that case we can use hidden field.

Syntax :

<INPUT Type="Hidden" Name="hidden field name" Value="hidden data: may be I or D or U"/>

Where "I" means Input, "D" means Delete and "U" means Update.

IMAGE : It can be used as a clickable element in a form. It gives a graphical look of the clickable area.

Syntax :

<INPUT Type="Image" Name="image name" Src="path to image file" Width ="width in pixel" Height="height in pixel" Border="border size in pixel"/>

Submit and Reset Button : After placing all the other elements in the <FORM> tag next requirement is to send them to web server. The Submit and Reset Buttons are used for that purpose. Submit Button and Reset Button are discussed below:

SUBMIT BUTTON : It is used to submit the data captured by the form using different form elements.

Syntax :

<INPUT Type="Submit" Name="submit button name" Value= "caption"/>

RESET BUTTON : It is used to clear the values of all the buttons set by different form elements. Sometimes it becomes necessary to reset the buttons before capturing data.

Syntax :

<INPUT Type="Reset" Name="reset button name" Value= "caption"/>

CHECK YOUR PROGRESS

Q.1. State true or false :

a) Textbox can receive multiple lines of text as input data.

b) Using checkbox we can select any one option from multiple options.

c) The submit button can send captured data to web server.

d) POST method of FORM tag has a limitation of sending maximum 1024 bytes of data.

6.4 ADDITIONAL ADVANCED HTML TAGS

EXECUTABLE CONTENT TAGS : The executable content tags can add more dynamism to a web page. Dynamic content can be developed by using Java applet and ActiveX control. The executable content tags are: <APPLET> tag, <OBJECT> tag and <PARAM> tag.

<APPLET> tag : It is a container tag using which we can place a Java applet into a web page.

Syntax :

<APPLET Width=”in-pixel” Height=”width_in_pixel” Codbase=“base_URL_for_applet” Code=”applet_class_file” Name=”applet _name” Align=”top/middle/bottom/left/right” Hspace=”horizontal white space” Vspace=”vertical white space” >

….

</APPLET>

<PARAM> tag : It is a stand-alone tag using which we can pass parameter to a Java applet or other executable object.

Syntax :

<PARAM Id=”unique identifier” Name=”parameter_name” Value=”Parameter_value” Valuetype=”type of value: Data/Ref/Object” Type=”executable content type” >

<OBJECT> tag : It is a container tag using which we can place an executable object in a web page.

Syntax :

```
< OBJECT Width=”in-pixel” Height=”width_in_pixel”
Codbase= “URL_of_ object” Codetype=”type of code”
Data=”URL of data” Type=”type of data”
Usemap=”map_name” Name=”object _name” Align=”top/
middle/bottom/left/right” Hspace=”horizontal white space”
Vspace=”vertical white space” Border=”in_pixel”
Tabindex=”tab_position” >
….
</OBJECT>
```

CASCADING STYLE SHEET (CSS) : CSS is a powerful tool for adding style to a web page and to ensure uniformity throughout the page. It also adds dynamism to a web page with the help of its wide range of attributes. **Dynamic HTML** is possible due to CSS and scripting language. Mainly CSS helps in formatting a web page in an efficient way.

Syntax :

```
<STYLE Type=”text/css”>
        Tag {attribute:value; attribute:value …}
        …
</STYLE>
```

Description of different attributes which can be used in a <STYLE> tag.

Attributes	Values
1. Font Attributes	
font-family	font names (Arial, Helvetica etc.)
font-style	normal/italic/oblique
font-weight	normal/bold/bolder/lighter/100/200 /300/400/500/600/700/800/900
font-size	absolute size(xx-small/x-small/small/ medium/large/x-large), relative size (larger /smaller), number of pixel, percentage of parent element’s size

2. Color and Background Attribute

color	a color name or color code
background-color	a color name or color code
background-image	a URL of a image/none
background-repeat	repeat-x (means horizontal)/repeat-y (means vertical)/ repeat (both direction)/no-repeat

3. Text Attribute

text-decoration	none/underline/overline/line-through/ blink
vertical-align	baseline/sub/super/top/text-top/ middle/bottom/text-bottom/% of element's height
text-transform	capitalize/uppercase/lowercase/none
text-align	left/right/center/justify
text-indent	a length / % of element's width

4. Border Attribute

border-style	solid/double/groove/ridge/inset/outset
border-color	a color name or color code
border-width	thin/medium/thick/a length
border -top-width	thin/medium/thick/a length
border-bottom-width	thin/medium/thick/a length
border-left-width	thin/medium/thick/a length
border-right-width	thin/medium/thick/a length
border-top	specify width/color/style
border-bottom	specify width/color/style
border-left	specify width/color/style
border-right	specify width/color/style
border	set all properties

5. Margin Attribute

margin-top	percent/length/auto
margin-bottom	percent/length/auto
margin-left	percent/length/auto

margin-right	percent/length/auto
margin	percent/length/auto

6. List Attribute

list-style	disc/cilcle/square/decimal/lower-roman/upper-roman/lower-alpha/upper-alpha/none

Example :

```
<HTML>
    <HEAD>
        <TITLE> Use of Style Sheets with Font Attributes</TITLE>
        <STYLE Type = “text/css”>
            H1 {font-family:arial; font-size:26pt;text-
            decoration:overline; color:white; background-image:
            url(spb2.jpg);background-repeat:repeat-x;
            text-align = center}
            H2{font-family:helvetica;background-color:yellow}
            P{font-size:14pt; font-style:italic; border-color:blue;
            border-style:groove;border-width:thick;
            margin-left:20%; margin-right:10% ;
            background-image:url(spb2.jpg);
            background-repeat:no-repeat}
            UL {list-style-type:lower-roman}
        </STYLE>
    </HEAD>
    <BODY >
        <H1>HTML Tags</H1>
        <H2>HTML Tags are of two types :</H2>
        <UL><LI>Stand-alone</LI> <LI>Container</LI>
        </UL>
        <P>The Stand-alone tag appears only once. It affects the
        position where it is used. But container tags appear in pairs.
        i.e., this tag has a starting tag and an ending tag</P>
```

```
</BODY>
</HTML>
```

CLASS : CSS is applicable to the whole page. Using class we can control a part of the page such as a paragraph or a few paragraphs. In a style sheet class is defined by a dot followed by the name of the class.

```
<HTML>
    <HEAD>
    <TITLE> example of class </TITLE>
    <STYLE Type = "text/css">
        P{font-size:14pt;   border-color:blue;
        border-width:thick;  margin-left:20%;
        margin-right:10%}
        .term {color:red;  font-style:italic}
        .defn {color:brown}
        </STYLE>
    </HEAD>
    <BODY>
        <P class='term'> Cascading Style Sheet (CSS)</P>
        <P class='defn'> CSS is a powerful tool for adding style to a
        web page and ensure uniformity thorough out the page. It
        also adds dynamism to a web page with the help of its wide
        range of attributes.</P>
    </BODY>
</HTML>
```

EXTERNAL STYLE SHEET (ESS) : The external style sheets are stored in a separate file with extension .css. We can include all the style facilities whatever we have used in case of CSS. This .css file is linked to the web page with the help of <LINK> tag where it is required. The <LINK> is a standalone tag and it is applied in the header section of a page. Its syntax is shown below:

```
<LINK  Rel=stylesheet Href="the .css file name">
```

eg.

Say **test.css** is the external file which contains the following contents:

```
P{font-size:14pt;  border-color:blue;
border-width:thick; margin-left:20%;
margin-right:10%}
.term {color:red; font-style:italic}
.defn {color:brown}
```

This test.css is applied in a HTML file as follows:

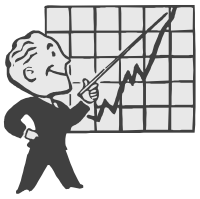
```
<HTML>
    <HEAD>
    <TITLE> example of ESS </TITLE>
        <LINK Rel=stylesheet Href="test.css" >
    </HEAD>
    <BODY>
        <P class='term'> Cascading Style Sheet (CSS)</P>
        <P class='defn'> CSS is a powerful tool for adding
        style to a web page and ensure uniformity thorough
        out the page. It also adds dynamism to a web page
        with the help of its wide range of attributes.</P>
    </BODY>
</HTML>
```

SPAN TAG : We can use this tag to modify part of a style sheet.

e.g.

```
<HTML>
    <HEAD>
    <TITLE> example of class </TITLE>
    <STYLE Type = "text/css">
        P{font-size:14pt;  border-color:blue;
        border-width:thick; margin-left:20%;
        margin-right:10%}
        .term {color:red; font-style:italic}
        .defn {color:brown}
        .hi {font-size:16pt;color:blue}
        </STYLE>
    </HEAD>
```

```
<BODY>
<P class='term'> Cascading Style Sheet <SPAN
class="hi">(CSS)</SPAN></P>
<P class='defn'> <SPAN class="hi"> CSS </SPAN>
is a powerful tool for adding style to a web page and ensure
uniformity thorough out the page. <SPAN class="hi"> CSS
</SPAN> also adds dynamism to a web page with the help
of its wide range of attributes.</P>
</BODY>
</HTML>
```



CHECK YOUR PROGRESS

Q.2. Fill up the gaps:

a) _____ is similar to CSS, but it has an external file with extension _____ to include style.

b) Stylesheet is included in the _____ section using _____ tag.

c) Applet and Param are the executable _____ tag.

d) Class is used to modify _____ of a web-page, but _____ is applicable to the whole page.

6.5 INTRODUCTION OF XML

XML stand for **eXtensible Markup Language.** XML can be used to exchange data between two applications, no matter whether they are compatible or not. The applications may or may not be web applications. As on today XML is the highest demanding data exchange standard in the world. There are many popular DBMS products in the market like Oracle, SQL Server, IMS, IBM, Informix etc. But no one out of them is considered as a data exchange format, because they are not compatible to each other. Prior to the existence of XML also there was the need of exchanging data

amongst the applications. At that time they converted their data to textual format, which was a complicated process. But XML makes this communication easier between two applications, regardless of their platform, format or purpose.

6.5.1 Comparison of HTML and XML

Coding style of XML is almost similar to HTML. i.e. XML also uses tags to structure their documents like HTML. Apart from this there are no similarities between the HTML and XML.

HTML is an information presentation language whereas XML is an information description language. i.e. HTML focu on how to display data to the end user, but XML deals with the representation of data in documents.

HTML is not sufficient for conducting electronic business on the Internet as electronic business requires processing, rearranging, storing, forwarding, exchanging and encrypting of data, which is lacking in HTML. XML solves this problem of HTML.

6.5.2 XML Basics

A XML document may have the following parts:

- XML tag
- Root element
- Start and end element indicator
- Start and end of element declaration
- Element name and value
- Attribute name and value

An example of a XML document is shown below to discuss the different parts of it.

XML tag : The XML tag has been shown in the first line of the example. Every XML document must be started with this line. As shown in the example the text in this line is enclosed with the tag pair <? and ?>.

Root element : It indicates the starting of actual content of the XML document. It is shown by the element <Books> in the line number 2.

Start and end element indicator : The start of an element is indicated by < and end is indicated by >. Every element is following this rule.

```
1.  <?xml version=”1.0" encoding=”iso-8859-1"?>
2.      <Books>
3.          <Book pyear=”2001">
4.              <Title>Learning ANSI C</Title>
5.              <Author>E.Balaguruswami</Author>
6.          </Book>
7.          <Book  pyear=”2002">
8.              <Title>Learning C++</Title>
9.              <Author>E.Balaguruswami</Author>
10.         </Book>
11.         <Book  pyear=”2005">
12.             <Title>Database Systems</Title>
13.             <Author>Korth,Sudarsana</Author>
14.         </Book>
15.         <Book  pyear=”2003">
16.             <Title>Database Systems</Title>
17.             <Author>Elmasri, Navathe</Author>
18.         </Book>
19.     </Books>
```

Start and end element declaration : It is similar to a HTML container tag. i.e. the element declaration is starting with a starting tag enclosed with <> and ends with same tag but with a slash “/” included in front of it. e.g., One example may be: the starting of an element declaration is displayed in line no. 3 and the end of declaration is in line no. 6.

Element name and value : All the items within a tag inside a root element are specified as element. e.g., **Title** or **Author** are the

elements names. The element value is available between the starting and ending tags. If we consider line no 4, then “Title” is the element name and “Learning ANSI C” is the element value.

Attribute name and value : Attributes are available along with the element name within the same starting element declaration. The attribute value is written along with the attribute using “=” operator. For example, in line no. 3, “pyear” is an attribute and “2001” is the attribute value.

6.5.3 Introduction to DTD

We can include a DOCTYPE declaration in a XML document which will refer a DTD file. DTD stands for ***document type declaration***. The DOCTYPE declaration is written in a <!DOCTYPE … > tag. The DTDs are of two types:

- Internal DTD
- External DTD

Internal DTD : In case of Internal DTD, the DTD is declared within the XML document itself in a separate block. It is shown in the following example.

```
<?xml version=”1.0" encoding=”iso-8859-1" standalone=”yes”?>
<?xml-stylesheet type=”TEXT/xsl” href=”abc.xsl”?>
<!Doctype Books[
    <!ELEMENT Books (Book+)>
    <!ELEMENT Book (Title?, Author?)>
    <!ATTLIST Book pub CDATA #REQUIRED>
    <!ELEMENT Title (#PCDATA)>
    <!ELEMENT Author (#PCDATA)>
]>
<Books>
    <Book pub=”2001">
        <Title>Learning ANSI C</Title>
        <Author>E.Balaguruswami</Author>
```

```
        </Book>
        …
        <Book  pub=”2003">
        <Title>Database  Systems</Title>
        <Author>Elmasri,  Navathe</Author>
    </Book>
</Books>
```

Points to be noted **:**

- We should include a clause standalone=”yes” in the <?xml?> tag to indicate internal DTD.
- Elements are declared by using <!ELEMENT...> tag. Here we should use a data type #PCDATA within parenthesis for the DTD element. PCDATA stands for parsed character data.
- The characters **?, +** and ***** following an element name has some special meaning such as:
  - **element ?** indicates element can be repeated 0 or 1 times and it is also called single-valued.
  - **element +** indicates element can be repeated 1 or more times and it is also called multi-valued.
  - **element** * indicates element can be repeated 0 or more times and it is also called multi-valued.
- Attributes of an element are declared by using <!ATTLIST...> tag. It needs a data type CDATA stands for character data and a #REQUIRED keyword.

External DTD : Here the DTD declaration is made in a separate file with extension .dtd, which contains only the <!DOCTYPE name[… …]> parts of the above XML example. The reference to this .dtd file is to be included in the XML file is shown below:

```
<!DOCTYPE BOOKS SYSTEM “book1.dtd”>
```

Provided that the DOCTYPE declaration for the same is available in the file “book1.dtd”. The “book1.dtd” file must contain only the element declaration. It can be as follows for our example:

```
<!ELEMENT BOOKS (BOOK+)>
<!ELEMENT BOOK (TITLE, AUTHOR?)>
<!ELEMENT TITLE (#PCDATA)>
<!ELEMENT AUTHOR (#PCDATA)>
```

CHECK YOUR PROGRESS

Q.3. Select the correct option from the brackets:

a) XML (represents/ displays) data in a better way.

b) In order to include DTD in the same XML file, standalone clause should be ("Yes"/"No") in the <?xml?> tag.

c) When "?" followed an element name, it indicates the special meaning (single-valued/ multi-valued).

d) External DTD file has extension (.dtd/ .doc)

6.6 LET US SUM UP

- FORM is a powerful tool of HTML for developing interactive web documents.
- Text box is used to capture one line of textual data from user in a web page.
- The executable content tags can add more dynamism to a web page. Dynamic content can be developed by using Java applet and ActivX control. The executable content tags are: <APPLET> tag, <OBJECT> tag and <PARAM> tag.
- CSS is a powerful tool for adding style to a web page and ensure uniformity thorough out the page.
- XML stand for extensible markup language. XML can be used to exchange data between two applications
- HTML is an information presentation language whereas XML is a information description language.
- DTD stands for document type declaration.

6.7 FURTHER READINGS

- **Web enabled commercial Application Development using HTML, Javascript, DHTML and PHP** –*Ivan Bayross, BPB*
- **Web Technologies** –*A.S. Godbole and Atul Kahate, Tata McGraw-Hill.*
- Using HTML, XML and Java –*Eric Ladd and Jim O'Donnell, PHI*
- **Fundamental of Database Systems** –*Ramez Elmasri and Shamkant B. Navathe, Pearson.*

6.8 ANSWER TO CHECK YOUR PROGRESS

Ans. to Q. No. 1 : a) False, b) False, c) True, d) False

Ans. to Q. No. 2 : a) ESS, .css, b) Head, STYLE, c) Content
d) Part, CSS

Ans. to Q. No. 3 : a) Represents, b) Yes, c) single-valued, d) .dtd

6.9 MODEL QUESTIONS

Q.1. Give an introduction to forms.

Q.2. What is the difference between radio button and checkbox.

Q.3. Design the following form :

Application for Admission

1. Name :
2. Address :
3. Roll No.

Submit

Q.4. Write an XML document to store the details of Employees. Also design a web page to get the input of employees and to retrieve the full details from the XML document.

UNIT 7 : JAVASCRIPT

UNIT STRUCTURE

7.1 LEARNING OBJECTIVES

After going through this unit, you will be able to :

- describe client side programming
- discuss the basic programming concepts of JavaScript
- identify the different control structures used in JavaScript for branching and looping
- explain the Array
- describe function and its types
- illustrate the form object and its elements, properties, methods, events and event-handlers
- identify built-in Objects in JavaScript like string object, math object and date objects
- discuss the use of user defined objects.

7.2 INTRODUCTION

In the previous unit, you have learnt the advanced HTML tags and basic concept of XML. This unit deals with the concept of JavaScript. In this unit you will learn about the client side programming. This unit also describes the basic programming idea of JavaScript. In addition, you will come across the different control structures used in JavaScript for branching and looping. This unit seeks to provide you a with the concept of array and functions used in JavaScript ansn you will also be able to learn about the working with form object. Besides you will be acquianted with the basic idea of built-in Objects in JavaScript. Finally, the unit will discuss the use of user defined

objects.

7.3 CLIENT SIDE PROGRAMMING

A HTML document is purely static, i.e., it can only present the documents. Interaction is needed to makes it dynamic. To make it interactive, communication is to take place between the client's browser and the web server, where the actual content is stored. In order to fulfil this requirement client side scripting languages are developed. So a client side scripting language is capable of making interaction with the client; it can capture data inserted by the user , and validate data as per the server specification and dispatch corrected data to the web server. The client side programming languages are JavaScript, vbScript etc.

7.3.1 Introduction to JavaScript

JavaScript is a scripting language of the Web. It is the most popular scripting language on the internet and it works in all major browsers, such as Internet Explorer, Firefox, Chrome, Opera, and Safari. JavaScript is used in millions of Web pages to add functionality to validate forms, detect browsers and much more.

Java and JavaScript are two completely different languages in both concept and design. Java (developed by Sun Microsystems) is a powerful and much more complex programming language - in the same category as C and C++.

A scripting language is a lightweight programming language.

- JavaScript was designed to add interactivity to HTML pages
- JavaScript is usually embedded directly into HTML pages
- JavaScript as an interpreted language means that scripts execute without preliminary compilation
- Everyone can use JavaScript without purchasing a license

The HTML <SCRIPT> tag is used to insert a JavaScript into an HTML page. A JavaScript program code is included between the tag pair <SCRIPT> and </SCRIPT>, which is contained either in

the header section or in the body section of the HTML page.

The **<SCRIPT> Tag :** It is a container tag and it is used to include JavaScript code into a HTML document.

Syntax :

```
<SCRIPT Language="JavaScript">
        // JavaScript code
</SCRIPT>
```

7.3.2 Advantages of JavaScript

- JavaScript is an interpreted language, which is interpreted by a JavaScript enabled browser just like a HTML code.
- JavaScript does not require any other special editor for programming. Just simple editor is enough, where any HTML code can be created.
- It has comparatively fewer commands;so the programmer needs to know limited syntax.
- It requires minimum storage spaces which lead to better performance.
- JavaScript can properly execute the event handling like an event driven programming language. Example of events may be: press a button, click mouse button, move mouse over etc.
- Error detection-correction process as well as debugging is easy.

CHECK YOUR PROGRESS

Q.1. Fill in the blanks :

i. A HTML document is a purely _____.

ii. JavaScript is an _____.

iii. _____ Tag is a container tag and it is used to include JavaScript code into a HTML document.

7.4 BASIC JAVASCRIPT CONCEPTS

A few points on JavaScript :

- JavaScript is case sensitive, i.e. it can understand the difference between the capital letter and small letters.
- Every JavaScript statement is ended with a semicolon.
- JavaScript uses a **prompt ()** method to receive data from user in the client browser. Here contents are delimited by using comma.
- JavaScript uses **document.write()** methods to display message or content of variable into client browser. Here also contents are delimited by using comma. Here document is a JavaScript object and write is a method of it.
- In document.write() we can even put any HTML tag, delimited by comma.
- JavaScript uses an **alert()** method, which is used to display message or content of variable. Here contents are delimited by '+' operator.
- JavaScript variables are loosely typed. i.e. type of a variable can be decided by looking at its value. A variable can change its type according to the value stored in it. i.e. the declaration of a variable in JavaScript is not mandatory prior to its use.

7.4.1 Variables

Definition : A variable is a place in memory which can hold a data element. When a variable is defined a memory location is assigned internally to it. Value of a variable can vary during the execution of a program. A variable can be declared by using **var** keyword.

Syntax :

var <variable name>=value;

e.g.

var number=100;

```
var name="Gagan";
```

Rules for giving variable name :

- A variable may start with a uppercase, lowercase, a underscore character (_) or a $ sign.
- Rest of the characters may be letters, underscore (_), doller ($) or digits (0…9).
- If multiple words are used as a variable name then the first character should be lowercase and first character of next words should be capital. e.g. interestRate, discountAmount etc.

7.4.2 Data-Types

Data type means types of data that can hold by a variable. In JavaScript there are four different primitive data types such as: **Number, Boolean, String** and **Null.** JavaScript also supports complex types like: **array** and **object.**

Number : It can take integer, floating point number or NaN (stands for Not a Number) value. Integer can be decimal, hexadecimal or octal. But at the time of display others are converted into decimal.

Boolean : It is represented by **true** and **false.** These are converted to 1 and 0 automatically when used in numerical expression.

String : Strings are represented by putting alphabets or digits within single or double quotation mark.

Null : This type contains a single value i.e. null, which means empty or nonexistent reference.

7.4.3 Operators

Arithmetic Operators : The normal arithmetic operators can be used here also. Such as:

Operator	Name	Meaning
+	plus	for addition
–	minus	for subtraction

/	slash	for division
*	asterisk	for multiplication
%	modulus	for getting remainder of two integer number division
++	increment	increment by 1
—	decrement	decrement by 1

Relational Operators : these are used to compare two quantities. They are used to construct a condition. They produce Boolean values.

Operator	Meaning
==	Equal
>	Greater than
<	Less than
>=	Greater than and Equal
<=	Less than and Equal
!=	Not Equal
===	Strictly Equal
!==	Not Strictly Equal

Logical Operator : These are used to combine two or more condition. They produce Boolean values.

Operator	Meaning
&&	AND
ll	OR
!	NOT

String Operator : It is a "+" symbol used to perform concatenation.

Assignment Operator : It is used to assign a value or expression of right side of an = sign to a single variable to the left hand side. It has several variations as shown below:

Operator	Example	Result
=	a=5;	a is 5
+=	b=7;b+=a;	b is 12
-=	c=4; b-=c;	b is 8
*=	b*=c;	b is 32

/=	b/=8;	b is 4
%=	a%=3;	a is 2

Delete operator : It is used to delete property of an object or an array element.

e.g. delete array1[2];

New operator : It is used to create an instance of an object.

e.g. array1= new array1();

Example Program 1.

```
<HTML>
    <HEAD>
    <SCRIPT Language="JavaScript">
        var num=10;
        var name="TARAJAN";
    </SCRIPT>
    </HEAD>
<BODY >
    <SCRIPT Language="JavaScript">
        // use of document.write().
        document.write("Number is = ",num,"<br/>");
        document.write("Name is = ",name,"<br/>");
        // use of prompt().
        num=prompt("Enter a distance ",num);
        name=prompt("Enter a Destination ",name);
        document.write("Destination is = ",name,"<br/>");
        // use of alert().
        alert("Distance is = "+num+" k.m. ");
        document.write("It is",num, " k.m. apart<br/>");
        // use of conditional expression.
        str1=(num>100)?"More than 100":"Below 100";
        document.write("Num is  ",str1,"<br/>");
    </SCRIPT>
</BODY>
</HTML>
```

CHECK YOUR PROGRESS

Q.2. State True or False :

i. JavaScript is case sensitive, i.e. it can understand the difference between the capital letter and small letters.

ii. In document. write () we can put only limited HTML tag.

iii. Data type means types of data that can be hold by a variable

iv. JavaScript does not support complex types like array and object.

v. '–' symbol is used to perform concatenation.

7.5 CONTROL STRUCTURES IN JAVASCRIPT

Control structures like conditional statements are used in JavaScript to perform different actions based on different conditions.

7.5.1 Branching

If statement : it is similar to C language. Here a condition is tested if it is true then it will execute the true part i.e. statement set 1, if it is false then it will execute the false part i.e. statement set 2,

Syntax :

```
if (<condition>)
        {
            Statement set 1;
        }
[else
        {
            Statement set 2;
        } ]
```

Switch statement : It is more suitable for the situation where we need to select one option from multiple options.

Syntax :

```
switch (choice)
        {
            Case 1 :
                Statement set 1;
                break;
            Case 2 :
                Statement set 1;
                break;
            Case 3 :
                Statement set 1;
                break;
            default :
                Statement set 1;
        }
```

Immediate if (conditional expression) : JavaScript has a conditional expression operator ? and : , using which immediate if is constructed as stated below.

Syntax :

condition ? value if true : value if false

e.g. b=100;

str1=a>b ? “More than 100” : “Below 100”;

7.5.2 Looping

Looping means to execute the same set of statement repeatedly for several times (zero or more times).

for loop : It is same as C language. It is more suitable when the number of iteration is known earlier.

Syntax :

```
for(initialization; termination; incrementation/decrementation)
        {
            Body;
```

```
        }
```

e.g.

```
    for(i=0;i<100;i++)
        {
            document.write(I,"<br/>");
        }
```

while loop : It is also same as C language. It is executed until a condition is satisfied. Once the condition becomes false, the loop is terminated.

Syntax :

```
    while(condition)
        {
            Body;
        }
```

e.g.

```
        i=0;
        while(i<100)
            {
                document.write(I,"<br/>");
                i++;
            }
```

do ... while loop : It is also same as while loop. The only difference is that here the condition is tested at the end of the loop, whereas in case of while the condition is tested at the beginning of the loop.

Syntax :

```
    do
        {
            Body;
        }
            while(condition);
```

e.g.

```
        i=0;
```

```
do
    {
        document.write(I,"<br/>");
        i++;
    }
while(i<100);
```

break and continue statement : These two statements are used in loops.

- **break** statement is used to come out of a loop canceling the rest of the iterations.
- **continue** statement is used to jump to the end of the loop ignoring the statements from its occurrence up to the end of the loop for that iteration only. The next iterations will be executed.

Example program 2 :

```
<html>
    <Head>
    <script language="JavaScript">
        var num1=0,num2=0,i=0;
    </script>
    </head>
    <body >
    <script language="JavaScript">
        num1=prompt("Enter a small number ",num1);
        num2=prompt("Enter a large number ",num2);
        alert("yoU have inserted ! "+num1+" and "+num2);
        for(i=num1; i<=num2;i++)
            document.write(i,"<br/>");
        alert("Over! ");
        document.write("Over! ");
    </script>
    </body>
</html>
```

7.6 ARRAY

An **array** is a common name given to set of variables. It has an index number to be written within square brackets and started with the value 0. Elements of an array are not necessarily of same type, they can be of any type. The array must be declared before using it. Array is a JavaScript object. Array has several methods for the manipulation of its elements. Array is declared as follows:

Syntax :

arrayname = new Array(size);

Or arrayname = new Array();

Example of array declaration :

name = new Array(12);

Use of array :

name[0]=”Kamal”;

name[1]=”Amal”;

…

name[11]=”Ratul”;

7.6.1 Dense Array

It is a JavaScript array where initialization is done at the time of declaration. i.e. Both declaration and initialization are taking place at the same place.

Syntax :

arrayname = new Array(value0, value1, value2, … valuen-1);

e.g.

address= new Array(“Sankar”,”Ulubari”,”Guwahati”, 781007);

7.6.2 Array Within Array

An array can be an element of another array, thereby forming array within array. It can also be considered as multidimensional array. The inner array can be accessed by using double dimension.

e.g.

address= new Array("Sankar","Guwahati", new array(9861288771,9435165455),"Mridul","Jorhat", new array(9976512123, 9707013422,9854329975));

i.e. the array elements for the above array are as follows:

address[0]="Snkar"

address[1]="Guwahati"

address[2][0]="9861288771"

address[2][1]=" 9435165455"

address[3]="Mridul"

address[4]=" Jorhat"

address[5][0]=" 9976512123"

address[5][1]=" 9707013422"

address[5][2]=" 9854329975"

7.6.3 Methods of Array

There are a few methods which are working on array. Such as: join(), reverse().

Join() : This method is used to join all the elements of the array like a single string and return the joint string. We can use the delimiter as argument of join(), that we want between the elements in the joint string. If we do not put any delimiter the default is comma and followed by a space.

e.g.

```
jname = address.join();
document.write(jname,"<br/>");
```

Reverse() : Using this method the elements of an array can be reversed.

e.g.

```
1. address.reverse();                 // it will reverse the array
2. rname1=address.reverse();          // it will reverse the array
                                      //address and stored them
```

```
                                        //into another array rname1
    document.write(rname,"<br/>");   // display array
3.  rname2=address.reverse().join();// it will reverse  as well as
                                        // join the array and store
                                        //them to a string rname2
    document.write(rname,"<br/>");
```

In the above example 1 the original array 'address' is reversed. In example 2, array is again reversed and store the reverse array into a new array rarray1. In example 3, only a reverse string is produced i.e. rname2.

Length property : In an array we can use the length property to find the size of the array.

e.g. n=address.length;

CHECK YOUR PROGRESS

Q3. i. What is an array?

.....

ii. Write down the syntax for dense array.

.....

7.7 FUNCTIONS

Functions are considered to be a subprogram or blocks of code, which performs a subtask. A function can return a value. Function is used to eliminate repetition of coding. It turns the program into a structured one which increases readability.

Functions are of two types :

- User-defined function.
- Built-in function

7.7.1 User-Defined Function

User defined functions are those function which are developed by the programmer itself in the coding. The user defined functions are to be declared first before using it. Once we declare the function we can call it by giving its name. A function is declared by using the keyword function.

Syntax :

```
function fun_name(parameter list delimited by comma)
        {
            Body
        }
```

Though a function can be declared anywhere within the HTML document yet it is better to place it in the header section. It is because, the header section is executed before the body section.

e.g.

```
<html><head><title>Example of Function:: Display Addition chart
                    </title>
<script language="JavaScript">
var a=0;
function addchart(num)
        {
        var n=0,i=0;
        for(i=1;i<=10;i++)
            document.write(num," + ",i," = ",num+i," <br/>");
        }
        </script>
        </head>
        <body>
            <script language="JavaScript">
            a=prompt("Enter a number :",a);
            a=parseIns(a);
            addchart(a);
```

```
        </script>
        </body>
</html>
```

7.7.2 Built-in Function

Built-in functions are those functions which are already developed by the language developer. They are the standard functions, which can be accessed at any time within the <script> tag. In JavaScript there are several such built-in functions. Such as:

eval() : It is used to convert a string value to a numeric value.

parseInt() : It is also used to convert a string value to a numeric value.

parseFloat() : It is also used to convert a string value to a float value.

7.7.3 Dialog Box

In JavaScript there are a few dialog boxes for displaying messages and content of variables. These dialog boxes are very effective as well as attractive for interacting with the user at run time. They appear as a separate window. e.g. the dialog boxes are: prompt, alert and confirmed.

prompt() : It is used to receive data from user at run time. It also displays a message.

Syntax :

```
prompt("message", "Default value");
```

alert() : It is used to display a small message in a separate window.

Syntax :

```
alart("message");
```

Confirm Dialog Box : It is used for the confirmation of the user. A confirmed dialog box may contain **ok** and **cancel** button.

Syntax :

```
confirm("message");
```

CHECK YOUR PROGRESS

Q.4. Fill in the blanks :

i. A function can return a _____.

ii. The user defined functions are to be _____ before using it.

iii. A function is declared by using the _____ function.

7.8 WORKING WITH FORM

We have already learnt about HTML *Form* and all its elements. HTML form provides the facility for data gathering in a web page. It has several GUI controls for that purpose. Also HTML is capable of sending gathered data to the web server and the server side scripting languages in the web server processes those data. Here, **role of JavaScript is to validate the gathered data** in the client's machine itself. This will reduce some unnecessary traffic. Otherwise, lots of traffic is to be involved between the server and the client machine in order to send correct data, as the server side program will not allow invalid data.

7.8.1 JavaScript Form Object

When the <FORM> tag is encountered the JavaScript enabled browsers creates the form object and stores them as a **form array** in memory. Each form object is described between <FORM> and </FORM> tags. i.e. there can be multiple occurrence of <FORM>.. </FORM> tag pair.

7.8.2 Elements of Form Object

The elements of a form object are: Text, Password, TextArea, Button, Radio, CheckBox, Select, Submit, Reset, Hidden and Fileupload. This property is used to refer to the respective form object

element. The basic concepts of these elements are already given in the UNIT 3.

7.8.3 Properties of Form Object

The form object has several properties such as: Name, Value, DefaultValue, Checked, DefaultChecked, Length, Index, Text, SelectIndex, DefaultSelect and Selected.

Name and **value** properties are used by all the form elements.

DefaultValue property is used by Text, TextArea and Password elements of a form.

Checked property is used by Radio button and CheckBox elements of a form.

DefaultChecked property is used by Radio Button and CheckBox elements of a form.

Length property is used by Radio Button element of a form.

Index property is used by Radio Button and Select elements of a form.

Text property is used by Radio Button and Select elements of a form.

SelectIndex property is used by Radio Button and Select elements of a form.

DefaultSelect property is used by Radio Button and Select elements of a form.

Selected property is used by Radio Button and Select elements of a form.

7.8.4 Events of Form Elements

JavaScript uses several events for many of its form elements. Events are the activities of an user in the web page as a result of which a piece of program or a function will be executed. The events are such as: Focus(), Blur(), Select(), Change(), Click(), Clicked() etc.

Focus() event is used by the form elements Text, Password, TextArea and Select. The event handler for Focus() is **onFocus**().

Blur() event is used by the form element Text, Password, TextArea and Select. The event handler for Blur() is **onBlur**().

Select() event is used by the form element Text, Password, TextArea and Select. The event handler for Select() is **onSelect**().

Change() event is used by the form element Text, Password and Select. The event handler for Change() is **onChange**()

Click() event is used by the form element Button, Submit, Reset, CheckBox, and Select. Here the event handler is used is **onClick**().

Clicked() event is used by the form element Radio Button. The event handler used for Clicked() is **onClicked().**

7.8.5 Methods of Form and Form Elements

Methods of Form : The methods of form are used to send data captured by the form elements. These are either GET or POST.

The **GET** method appends the captured data with the URL and send to the web server. It is suitable for sending small amount of data. The maximum limit of data here is 1024 bytes. It is the default method.

The **POST** method is used to send data as a separate bit-stream to the web server. It is used when a large amount data is to be sent.

Methods of Form Elements : These methods are used to handle the events that occurred in different form elements. Such as: onFocus(), onBlur(), onSelect(), onChange(), onClick(), onClicked() etc.

onFocus() method is used by the form elements Text, Password, TextArea and Select.

onBlur() method is used by the form element Text, Password, TextArea and Select.

onSelect() method is used by the form element Text, Password, TextArea and Select.

onChange() method is used by the form element Text, Password and Select.

onClick() method is used by the form element Button, Submit, Reset, CheckBox, and Select.

onClicked() method is used by the form element Radio Button.

CHECK YOUR PROGRESS

Q.5. State true or false of the following

i. 'Password' is an element of a form object.

ii. Checked properly is used by submit button.

iii. Click () event is used by the form element Text.

iv. The GET method is used to append the captured data with the URL and send to the Web server.

v. The POST mothod is used to send data together in bit-stream.

7.9 BUILT-IN OBJECTS IN JAVASCRIPT

In JavaScript some of the built-in Objects are used for data processing related to string, math and date objects.

7.9.1 String Objects

A string in JavaScript is an object and it has properties and methods for the manipulations.

String **property** is the **length,** using which we can find out the number of characters in a string.

String **methods** are: big(), blink(), bold(), charat(), italics(), tolowercase(), touppercase(), substring(). The functions performed by the methods are easily understood by its name. Only a few methods are discussed below.

charat() method: It takes an index as argument and it return the respective character at that index in the string. e.g. str1="WELCOME", then str1.chatat(0) will return "W" and str1.chatat(5) will return "M".

substring() method: Using it we can extract a substring from a string. It takes two arguments: first argument indicates starting index of the substring to be extracted. The second argument indicates the last index of the substring to be extracted +1. i.e. next to the last index of the substring to be extracted. e.g. if str1="WELCOME" then str1.substring(0,3) will return "WEL" and str1.substring(3,6) will return "COM".

7.9.2 Math Object

The math object provides several useful properties and method which helps JavaScript a lot to carry out any mathematical operation smoothly.

Math object has the **properties** like **E, LN10, LN2** and **PI** for Eular's constant, natural logarithm of 10, natural logarithm of 2 and Pi value respectively.

Math objects also has **methods** like: **abs(), ceil(), cos(), floor(), pow(), random(), sin(), sqrt()** and **ten().**

7.9.3 Date Objects

The date object of JavaScript has the methods like: getDate(), setDate(), getHours(), setHours(), getTime() and setTime() for the manipulation of date and time.

7.10 USER DEFINED OBJECTS IN JAVASCRIPT

JavaScript provides facilities for creating user defined object also which can satisfy a particular need.

7.10.1 Creating User Defined Objects

The user defined object can be created with the help of a method. e.g. **address** is a user defined object. Then its **properties** may be described by the name, po, city and contact and they can be referred as:

address.name

address.po

address.city

address.contact

Say one methods may be display(), then it can be referred as:

address.display()

e.g. function address(name, po, city, contact)

```
{
    this.name=name;
    this.po=po;
    this.city=city;
    this.contact=contact;
}
```

7.10.2 Creating Objects within Objects

An object can be used as property of another object, such as: in the previous example, suppose we want to create contact as an object with the properties like: landPhone, mobilePhone, emailAddress. In this case the properties will be specified as:

address.name

address.po

address.city

address.contact.landPhone

address.contact.mobilePhone

address.contact.emailAddress

e.g.

```
function contact(landPhone, mobilePhone, emailAddress)
    {
        this.contact.landPhone= landPhone;
        this.contact.mobilePhone= mobilePhone;
        this.contact.emailAddress= emailAddress;
    }
function address(name, po, city, contact)
    {
        this.name=name;
        this.po=po;
        this.city=city;
        this.contact=contact;
    }
```

Use of user defined onjects :

```
Kamal = new contact("2556778", "9856645453",
"kamalnath@yahoo.co.in");
Champak = new contact("2556557", "9707045683",
"champak@yahoo.com");
add1=new address("Kamal", "Chandmari", "Guwahati",
kamal);
add2=new address("Champak", "Noonmati", "Guwahati",
champak);
```

7.11 LET US SUM UP

- A HTML document is purely static. i.e. It can only present the documents.
- JavaScript is a high level object oriented language.
- JavaScript is case sensitive, i.e. it can understand the difference between the capital letter and small letters.
- When a variable is defined a memory location is assigned internally to it.

- Data type means types of data that can be held by a variable. In JavaScript there are four different primitive data types such as: Number, Boolean, String and Null.
- Looping means to execute the same set of statement repeatedly for several times (zero or more times).
- An array is a common name given to set of variables. It has an index number to be written within square brackets and started with the value 0.
- Functions are considered to be a subprogram or blocks of code, which performs a subtask. A function can return a value.
- Built-in functions are those which are already developed by the language developer. They are the standard functions, which can be accessed at any time within the <script> tag.

7.12 FURTHER READINGS

- **Web enabled commercial Application Development using HTML, Javascript, DHTML and PHP** - *Ivan Bayross*

7.13 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1 : i. static, ii. interpreted language, iii. <SCRIPT>

Ans. to Q. No. 2 : i. True, ii. False, iii. True, iv. False, v. False

Ans. to Q. No. 3 : i. An array is a common name given to set of variables

ii. arrayname = new Array(value0, value1, value2, … valuen-1)

Ans. to Q. No. 4 : i. Value, ii. declared first, iii. keyword

Ans. to Q. No. 5 : i. True, ii. False, iii. False, iv. True, v. False

7.14 MODEL QUESTIONS

Q.1. What is JavaScript? Describe in brief.

Q.2. Write short note on :

a. Variable

b. Data type

c. Operators

Q.3. Write in short about the control structure in Java Script.

Q.4. What is an array? What is its use?

Q.5. Write in short about Function.

Q.6. What is the basic difference between Built in Object and User Defined Object in Java Script? Write in brief about them.