UNIT 1

Data Communication

Structure

1.1 Introduction
1.2 Modes of Data Transmission (Analog and Digital)
1.3 Types of Communications
1.4 Bandwidth
1.5 Communication Channels (Wire cables, Microwave and Fiber optic)
1.6 Types of data transmission (Asynchronous, Synchronous and Isochronous)
1.7 Parallel and Serial Interface
1.8 Transmission Modes (Simplex, Half-duplex and Full-duplex)
1.9 Multiplexing

Learning Objectives

After studying this unit, the student will be able to

• Know about data communication.
• Know about modes & types of data transmission.
• Know about different types of communication channels.
• Know about parallel and serial interfaces
• Understand about different transmission modes.
• Uses of Multiplexing.

1.1 Introduction

The distance over which data moves within a computer may vary from a few thousandths of an inch, as is the case within a single IC chip, to as much as several feet along the backplane of the main circuit board. Over such small distances, digital data may be transmitted as direct, two-level electrical signals over simple copper conductors. Except for the fastest computers, circuit designers are not very concerned about the shape of the conductor or the analog characteristics of signal transmission.

Frequently, however, data must be sent beyond the local circuitry that constitutes a computer. In many cases, the distances involved may be enormous. Unfortunately, as the distance between the source of a message and its destination increases, accurate transmission becomes increasingly difficult. This results from the electrical distortion of signals traveling through long conductors, and from noise added to the signal as it propagates through a transmission medium.

Although some precautions must be taken for data exchange within a computer, the biggest problems occur when data is transferred to devices outside the computer’s circuitry. In this case, distortion and noise can become so severe that information is lost.

Data Communications concerns the transmission of digital messages to devices external to the message source. “External” devices are generally thought of as being independently powered circuitry that exists beyond the chassis of a computer or other digital message source. As a rule, the maximum permissible transmission rate of a message is directly proportional to signal power, and inversely proportional to channel noise. It is the aim of any communications system to provide the highest possible transmission rate at the lowest possible power and with the least possible noise.

Data communication is the transmission of electronic data over some media. The media may be cables, microwaves.

1.1.1 Elements of Data Communication

Four basic elements are needed for any communication system.

1. Sender: The computer or device that is used for sending data is called sender, source or transmitter. In modern digital communication system, the source is usually a computer.
2. **Medium**: The means through which data is sent from one location to another is called transmission medium. If the receiver and transmitter are within a building, a wire connects them. If they are located at different locations, they may be connected by telephone lines, fiber optics or microwaves.

3. **Receiver**: The device or computer that receives the data is called receiver. The receiver can be a computer, printer or a fax machine.

4. **Protocols**: There are rules under which data transmission takes place between sender and receiver. The data communication software are used to transfer data from one computer to another. The software follows same communication protocols can communicate and exchange data.

## 1.2 Data Transmission

Data may be transfer from one device to another by means of some communication media. The electromagnetic or light waves that transfer data from one device to another device in encoded form are called signals. Data transmissions across the network can occur in two forms i.e.:

(i) **Analog signal**.

(ii) **Digital signal**.

### 1.2.1 Analog Signal

The transfer of data in the form of electrical signals or continuous waves is called analog signal or analog data transmission. An analog signal is measured in volts and its frequency is in hertz (Hz).

![Analog Signal](image)

**Fig 1.1 Analog Signal**

**Advantages of Analog Signaling**

- Allows multiple transmissions across the cable.
- Suffers less from attenuation.

**Disadvantages of Analog Signaling**

- Suffers from EMI.
• Can only be transmitted in one direction without sophisticated equipment.

1.2.2 Digital Signal

The transfer of data in the form of digit is called digital signal or digital data transmission. Digital signals consist of binary digits 0 & 1. Electrical pulses are used to represent binary digits. Data transmission between computers is in the form of digital signals.

![Digital Signal](image)

**Fig 1.2 Digital Signal**

**Advantages of Digital Signaling**

- Equipment is cheaper and simpler than analog equipment.
- Signals can be transmitted on a cable bidirectional.
- Digital signals suffer less from EMI.

**Disadvantages Digital Signaling**

- Only one signal can be sent at a time.
- Digital signals suffer from attenuation.

1.3 Types of Communication

A communication network is a set of devices (often referred to as nodes) connected by communication links. It provides a service, the transfer of information between users located at various geographical points.

1.3.1 Point-to-Point Communication

A point-to-point connection is a dedicated communication link between two systems or processes. Think of a wire that directly connects two systems. The systems use that wire exclusively to communicate. The opposite of point-to-point communications is broadcasting, where one system transmits too many.

A telephone call is a circuit-oriented, point-to-point link between two phones. However, calls are usually multiplexed across telephone company trunks; so, while the circuit itself may be virtual, the users are engaging in a point-to-point communication session.
An end-to-end connection refers to a connection between two systems across a switched network. For example, the Internet is made up of a mesh of routers. Packets follow a hop-by-hop path from one router to the next to reach their destinations. Each hop consists of a physical point-to-point link between routers. Therefore, a routed path consists of multiple point-to-point links.

In the ATM and frame relay environment, the end-to-end path is called a virtual circuit that crosses a predefined set of point-to-point links.

1.3.2 Point-to-Multipoint Communication

Point-to-multipoint (PMP) communication refers to communication that is accomplished through a distinct and specific form of one-to-many connections, offering several paths from one single location to various locations. Point-to-multipoint is generally abbreviated as PTMP, P2MP or PMP. PMP communication is commonly used in telecommunications.
PMP is usually used for establishing private enterprise connectivity to offices in remote locations, long-range wireless backhaul solutions for various sites, and last-mile broadband access. As such, it is widely used in IP telephony and wireless Internet by means of gigahertz radio frequencies. These PMP networks are employed in distribution amenities, huge corporate campuses, school districts, public safety applications, etc.

The point-to-multipoint communication consists of a central base station that supports several subscriber stations. These offer network access from a single location to multiple locations, permitting them to use the same network resources between them. The bridge located at the central location is known as the base station bridge or Root Bridge. All data that passes between the wireless bridge clients should initially go via the root bridge.

A point-to-multipoint network can be easily deployed when compared to the deployment of a point-to-point network because the equipment has to be deployed only at the new subscriber’s site. The only condition is that all the remote sites must come within the visibility and range of the base station. Hills, trees and other kinds of obstructions make point-to-multipoint nods unsuitable for office and residential coverage.

PMP systems are categorized into single system and bi-directional systems. A point-to-multipoint network is suitable for either customers or backhaul operations that are in need of a high-speed, reliable connection, but worried about paying for unused dedicated capacity. The drawback of point-to-multipoint node topology is its inability to interconnect with other nodes because of the directional antenna.

1.3.3 Simplex Communication

Simplex communication is permanent unidirectional communication. Some of the very first serial connections between computers were simplex connections. For example, mainframes sent data to a printer and never checked to see if the printer was available or if the document printed properly since that was a human job. Simplex links are built so that the transmitter (the one talking) sends a signal and it’s up to the receiving device (the listener) to figure out what was sent and to correctly do what it was told. No traffic is possible in the other direction across the same connection.

You must use connectionless protocols with simplex circuits as no acknowledgement or return traffic is possible over a simplex circuit. Satellite communication is also simplex communication. A radio signal is transmitted and it is up to the receiver to correctly determine what message has been sent and whether it arrived intact.
Since televisions don’t talk back to the satellites (yet), simplex communication works great in broadcast media such as radio, television and public announcement systems.

1.3.4 Half Duplex Communication

A half-duplex link can communicate in only one direction, at a time. Two way communications is possible, but not simultaneously. Walkie-talkies and CB radios sort of mimic this behavior in that you cannot hear the other person if you are talking. Half-duplex connections are more common over electrical links. Since electricity won’t flow unless you have a complete loop of wire, you need two pieces of wire between the two systems to form the loop. The first wire is used to transmit; the second wire is referred to as a common ground. Thus, the flow of electricity can be reversed over the transmitting wire, thereby reversing the path of communication. Electricity cannot flow in both directions simultaneously, so the link is half-duplex.

1.3.5 Full Duplex Communication

Full duplex communication is two-way communication achieved over a physical link that has the ability to communicate in both directions simultaneously. With most electrical, fiber optic, two-way radio and satellite links, this is usually achieved with more than one physical connection.
Your telephone line contains two wires, one for transmit, the other for receive. This means you and your friend can both talk and listen at the same time.

![Full Duplex Communication](image)

**Fig 1.7 Full Duplex Communication**

### 1.4 Bandwidth

Bandwidth in computer networking refers to the data rate supported by a network connection or interface. One most commonly expresses bandwidth in terms of bits per second (bps).

The term comes from the field of electrical engineering, where bandwidth represents the total distance or range between the highest and lowest signals on the communication channel (band).

Bandwidth represents the capacity of the connection. The greater the capacity, the more likely that greater performance will follow, though overall performance also depends on other factors, such as latency.

#### 1.4.1. Importance of Bandwidth

- Bandwidth is finite. Regardless of the media used to build a network, there are limits on the network capacity to carry information. Bandwidth is limited by the laws of physics and by the technologies used to place information on the media. For example, the bandwidth of a conventional modem is limited to about 56 kbps by both the physical properties of twisted-pair phone wires and by modem technology.

- Bandwidth is not free. It is possible to buy equipment for a LAN that will provide nearly unlimited bandwidth over a long period of time. For WAN connections, it is usually necessary to buy bandwidth from a service provider. In either case, individual users and businesses can save a lot of money if they understand bandwidth and how the demand will change over time. A network manager needs to make the right decisions about the kinds of equipment and services to buy.
• Bandwidth is an important factor that is used to analyze network performance, design new networks, and understand the Internet. A networking professional must understand the tremendous impact of bandwidth and throughput on network performance and design. Information flows as a string of bits from computer to computer throughout the world. These bits represent massive amounts of information flowing back and forth across the globe in seconds or less.

• The demand for bandwidth continues to grow. As soon as new network technologies and infrastructures are built to provide greater bandwidth, new applications are created to take advantage of the greater capacity. The delivery of rich media content such as streaming video and audio over a network requires tremendous amounts of bandwidth. IP telephony systems are now commonly installed in place of traditional voice systems, which further adds to the need for bandwidth. The successful networking professional must anticipate the need for increased bandwidth and act accordingly.

1.4.2 Measurement

In digital systems, the basic unit of bandwidth is bits per second (bps). Bandwidth is the measure of how many bits of information can flow from one place to another in a given amount of time. Although bandwidth can be described in bps, a larger unit of measurement is generally used. Network bandwidth is typically described as thousands of bits per second (kbps), millions of bits per second (Mbps), billions of bits per second (Gbps), and trillions of bits per second (Tbps).

1.5 Communication Channels (Wire cables, Microwave and Fiber optic)

1.5.1 Coaxial Cable

First invented in the 1880s, “coax” was best known as the kind of cable that connected television sets to home antennas. Coaxial cable is also a standard for 10 Mbps Ethernet cables. When 10 Mbps Ethernet was most popular, during the 1980s and early 1990s, networks typically utilized one of two kinds of coaxial cable - thin net (10BASE2 standard) or thick net (10BASE5). These cables consist of an inner copper wire of varying thickness surrounded by insulation and other shielding. Their stiffness caused network administrators difficulty in installing and maintaining thin net and thick net.

A type of wire that consists of a center wire surrounded by insulation and then a grounded shield of braided wire. The shield minimizes electrical and radio frequency interference.
Coaxial cabling is the primary type of cabling used by the cable television industry and is also widely used for computer networks, such as Ethernet. Although more expensive than standard telephone wire, it is much less susceptible to interference and can carry much more data.

1.5.2. Twisted Pair

A twisted pair consists of two insulated copper wires typically about 1 mm thick. The wires are twisted together in a helical form. The purpose of twisting the wires is to reduce electrical interference from similar pairs close by. The following figure illustrates the twisted pair (two parallel wires constitute a simple antenna; a twisted pair does not).

Twisted pair is the ordinary copper wire that connects home and many business computers to the telephone company. To reduce crosstalk or electromagnetic induction between pairs of wires, two insulated copper wires are twisted around each other. Each connection on twisted pair requires both wires. Since some telephone sets or desktop locations require multiple connections, twisted pair is sometimes installed in two or more pairs, all within a single cable. For some business locations, twisted pair is enclosed in a shield that functions as a ground. This is known as shielded twisted pair (STP). Ordinary wire to the home is unshielded twisted pair (UTP).
Twisted pair is now frequently installed with two pairs to the home, with the extra pair making it possible for you to add another line (perhaps for modem use) when you need it.

Twisted pair comes with each pair uniquely color coded when it is packaged in multiple pairs. Different uses such as analog, digital, and Ethernet require different pair multiples.

Although twisted pair is often associated with home use, a higher grade of twisted pair is often used for horizontal wiring in LAN installations because it is less expensive than coaxial cable.

The wire you buy at a local hardware store for extensions from your phone or computer modem to a wall jack is not twisted pair. It is a side-by-side wire known as silver satin. The wall jack can have as many five kinds of hole arrangements or pin outs, depending on the kinds of wire the installation expects will be plugged in (for example, digital, analog, or LAN).

1.5.3. Microwaves

Microwave communication is a method of transmitting information or energy by the use of radio waves whose wavelengths are conveniently measured in small numbers of centimeter; these are called microwaves. This part of the radio spectrum ranges across frequencies of roughly 1.0 gigahertz (GHz) to 30 GHz. These correspond to wavelengths from 30 centimeters down to 1.0 cm.

Microwaves are widely used for point-to-point communications because their small wavelength allows conveniently-sized antennas to direct them in narrow beams, which can be pointed directly at the receiving antenna.
This allows nearby microwave equipment to use the same frequencies without interfering with each other, as lower frequency radio waves do. Another advantage is that the high frequency of microwaves gives the microwave band a very large information-carrying capacity; the microwave band has a bandwidth 30 times that of all the rest of the radio spectrum below it. A disadvantage is that microwaves are limited to line of sight propagation; they cannot pass around hills or mountains as lower frequency radio waves can.

Microwave radio transmission is commonly used in point-to-point communication systems on the surface of the Earth, in satellite communications, and in deep space radio communications. Other parts of the microwave radio band are used for radars, radio navigation systems, sensor systems, and radio astronomy.

### 1.5.4 Fiber-Optics

Optical fiber (or “fiber optic”) refers to the medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand or fiber. Optical fiber carries much more information than conventional copper wire and is in general not subject to electromagnetic interference and the need to retransmit signals. Most telephone company long-distance lines are now made of optical fiber.

An Optical fiber cable has a cylindrical shape and consists of three concentric sections; the core, the cladding and the jacket. The core is the innermost section and consists of fiber made of glass or plastic. The core has diameter in the range 8-100 micrometers. Each fiber is surrounded by its own cladding, which is a glass or plastic coating that has optical properties different from those of core. The interface between the core and the cladding acts as a reflector to
confine light that would otherwise escape the core. The jacket is composed of plastic and other material layered to protect against moisture, abrasion, crushing and other environmental damage.

Transmission over an optical fiber cable requires repeaters at distance intervals. The glass fiber requires more protection within an outer cable than copper. For these reasons and because the installation of any new cabling is labor-intensive, few communities have installed optical fiber cables from the phone company’s branch office to local customers (known as local loops). A type of fiber known as single mode fiber is used for longer distances; multimode fiber is used for shorter distances.

1.6 Types of data Transmission (Asynchronous, Synchronous and Isochronous)

1.6.1 Synchronous Data Transmission

Synchronous data transmission is 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 in step (synchronized) with one another. The data is sent in blocks (called frames or packets) spaced by fixed time intervals.

Synchronous transmission modes 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.

Synchronous transmission synchronizes transmission speeds at both the receiving and sending end of the transmission using clock signals built into each component. A continual stream of data is then sent between the two nodes.

The data blocks are grouped and spaced in regular intervals and are preceded by special characters called syn or synchronous idle characters. See the following illustration.

| Data flow | Syn | Syn | data | data | data | data |

After the syn characters are received by the remote device, they are decoded and used to synchronize the connection. After the connection is correctly synchronized, data transmission may begin.

An analogy of synchronous transmission would be the transmission of a large text document. Before the document is transferred across the synchronous
line, it is first broken into blocks of sentences or paragraphs. The blocks are then sent over the communication link to the remote site.

The timing needed for synchronous connections is obtained from the devices located on the communication link. All devices on the synchronous link must be set to the same clocking.

**The following is a list of characteristics specific to synchronous communication**

- There are no gaps between characters being transmitted.
- Timing is supplied by modems or other devices at each end of the connection.
- Special syn characters precede the data being transmitted.
- The syn characters are used between blocks of data for timing purposes.

Due to there being no start and stop bits the data transfer rate is quicker although more errors will occur, as the clocks will eventually get out of sync, and the receiving device would have the wrong time that had been agreed in the protocol for sending/receiving data, so some bytes could become corrupted (by losing bits).

Most network protocols (such as Ethernet, SONET, Token Ring) use synchronous transmission.

### 1.6.2 Asynchronous Data Transmission

In contrast, asynchronous transmission works in spurts and must insert a start bit before each data character and a stop bit at its termination to inform the receiver where it begins and ends.

The term asynchronous is used to describe the process where transmitted data is encoded with start and stop bits, specifying the beginning and end of each character.

These additional bits provide the timing or synchronization for the connection by indicating when a complete character has been sent or received; thus, timing for each character begins with the start bit and ends with the stop bit.

When gaps appear between character transmissions, the asynchronous line is said to be in a mark state. A mark is a binary 1 (or negative voltage) that is sent during periods of inactivity on the line as shown in the following figure.
When the mark state is interrupted by a positive voltage (a binary 0), the receiving system knows that data characters are going to follow. It is for this reason that the start bit, which precedes the data character, is always a space bit (binary 0) and that the stop bit, which signals the end of a character, is always a mark bit (binary 1).

The following is a list of characteristics specific to asynchronous communication

- Each character is preceded by a start bit and followed by one or more stop bits.
- Gaps or spaces between characters may exist.

With asynchronous transmission, a large text document is organized into long strings of letters (or characters) that make up the words within the sentences and paragraphs. These characters are sent over the communication link one at a time and reassembled at the remote location.

In asynchronous transmission, ASCII character would actually be transmitted using 10 bits. For example, “0100 0001” would become “1 0100 0001 0”. The extra one (or zero, depending on parity bit) at the start and end of the transmission tells the receiver first that a character is coming and secondly that the character has ended. This method of transmission is used when data are sent intermittently as opposed to in a solid stream. In the previous example the start and stop bits are in bold.

The start and stop bits must be of opposite polarity. This allows the receiver to recognize when the second packet of information is being sent.
Asynchronous transmission is used commonly for communications over telephone lines.

1.6.3 **Isynchronous Data Transmission**

The Isynchronous format for data transmission is a procedure or protocol in which each information character or byte is individually synchronized or framed by the use of Start and Stop Elements, also referred to as start bits and stop bits.

The Isynchronous Transmission Format is also known as START-STOP mode or CHARACTER mode. Each character or byte is framed as a separate and independent unit of DATA that may be transmitted and received at irregular and independent time intervals. The characters or bytes may also be transmitted as a continuous stream or series of characters.

The character or byte may contain the number of bits required to allow translation of the BIT PATTERN into a group of symbols used to represent

- Letters (alpha characters)
- Numbers (numerical values)
- Punctuation Marks
- Control Elements

1.6.3.1 **Elements of an Isochronous Data Communication Network**

```
TERMINAL   MODEM       MODEM       TERMINAL
____       _____   COMMUNICATIONS   _____       _____
| | | |   LINK   | | | |
| DTE |<->| DCE | | | | DCE |<->| DTE |
| | | |   ^   |   V V V |   | | | |
|____| |____| DATA |____| |____|
^ | ‘— CLOCKING —’ | ^
| | | |
| ‘—————— INTERFACE ———————’ |
| | |
‘——————— EXTERNAL CLOCK ——————’
```
• The Terminals or DTE devices normally communicate with other terminals or DTE devices across a communications Network via some form of Modems (Modulator-Demodulators) that are connected through a communications Link.

• The terminals are connected to the modems through an Interface. There are many different types of interfaces in use due to the differences in the characteristics of the DTE terminals and the communications links being used, and the performance requirements.

• The Isochronous interface normally will include some form of timing, data Strobe, or Clock that will be used to ensure a steady and continuous flow of data.

• The terminals or DTE devices operating in the Isochronous Mode will normally require External Timing or Clocks to strobe the data out of and into the modems or DCE Devices.

• The modems or DCE devices operating Async normally provide any data timing or clocks to the DTE devices.

• The normal IDLE condition of the communications link is referred to as Mark, which indicates that there is continuity through the link and that energy is present. The transition from Mark to the Space condition indicates that an event is occurring, either a character is being received or the communications link has been interrupted.

• The transition to a Space condition for a defined time period (Bit Time) will normally indicate the “start” of a character and is referred to as the Start Bit. After the last bit of the data character, the communications link should “stop” the data and be returned to the Mark condition for one or more bit times or Stop Bits.

### 1.7 Parallel and Serial Interface

#### 1.7.1 Parallel Interface

A parallel interface refers to a multiline channel, each line capable of transmitting several bits of data simultaneously. Most commonly, personal computers (PCs) have at least one parallel interface for connecting a printer using a parallel port.

The first parallel interface was the Centronics parallel interface developed and used in the Centronics 101 model printer in 1970. This became the standard; but a variety of cables were required. Data products and other manufacturers created up to 50-pin connectors. By 1981 IBM introduced their personal
computers with printer connections using a cable with a DB25F 25-pin connector on the PC end and a 36-pin Centronics connector on the printer end. In 1987 IBM introduced a bidirectional parallel interface; and by 1992 Hewlett-Packard introduced their version, called “Bitronics,” with its LaserJet 4. These were both superseded by the IEEE 1284 parallel interface standard in 1994.

The IEEE 1284 standard specified five modes of operations, each specifying a direction of data flow, i.e. toward or away from the computer or bidirectional. These are:

- **Compatibility Mode**: This is the original Centronics parallel interface.
- **Nibble Mode**: This allowed data transfer back to the computer.
- **Byte Mode**: This allows data to be sent back to the computer at the same speed that data is sent from the computer to the printer or other device.
- **ECP Mode**: This stands for “enhanced capability port” and allows bidirectional data flow for printers and scanners.
- **EPP Mode**: This uses data cycles to quickly transfer data in both directions at speeds of 500 kilobytes to 2 megabytes per second.

One of the latest parallel interface technologies is known as “high-performance parallel interface” or HIPPI. It is used for transferring billions of bits of data per second over short distances on local area networks (LANs). By interconnecting computers and network storage devices, this technology has been described as functioning as a supercomputer; one company used the term “SuperLAN.” The fastest data transfer rates are 6.4 Gbps (gigabytes per second) for distances up to 1 kilometer.

### 1.7.2 Serial Interface

A serial interface uses a serial port, a single line capable of only transmitting one bit of data at a time; a computer mouse connection is a good example. A serial port is an interface that allows a PC to transmit or receive data one bit at a time. It is one of the oldest types of interfaces and at one time was commonly used to connect printers and external modems to a PC. Modern serial ports are used in scientific instruments, shop till systems such as cash registers and applications like industrial machinery systems. Compared to a parallel port, the data transfer rate of a serial port is slower.
1.8 Types of Transmission Modes

There are three ways for transmitting data from one point to another:

1. **Simplex**: In simplex mode the communication can take place only in one direction. The receiver receives the signal from the transmitting device. This mode of flow of information is Unidirectional. Example: Radio, T.V., Pager transmission.

   ![Simplex Diagram]

   Simplex A to B only

2. **Half-duplex**: In half-duplex mode the communication channel is used in both directions, but only in one direction at a time. Thus a half-duplex line can alternately send and receive data. Example is the wireless communication.

   ![Half-Duplex Diagram]

   Half-Duplex A to B or B to A

3. **Full-duplex**: In full duplex the communication channel is used in both directions at the same time. Use of full-duplex line improves the efficiency as the line turn-around time required in half-duplex arrangement is eliminated. Example of this mode of transmission is the telephone line.

   ![Full-Duplex Diagram]

   Full-Duplex A to B and B to A

1.9 Multiplexing

Multiplexing is a technique of simultaneous transmission of multiple signals over a single data link. It allows the various users to share the channel simultaneously. Data multiplexers are used to share the transmission media. It reduces the cost of transmission media and modem by increasing bandwidth utilization and efficiency of the system.

Multiplexing technologies may be divided into several types, all of which have significant variations. They are:

- Space-Division multiplexing (SDM)
- Frequency-Division multiplexing (FDM)
• Time-Division multiplexing (TDM)
• Code Division multiplexing (CDM).

1.9.1 Space-division multiplexing

In wired communication, space-division multiplexing simply implies different point-to-point wires for different channels. Examples include an analogue stereo audio cable, with one pair of wires for the left channel and another for the right channel, and a multipair telephone cable. Another example is a switched star network such as the analog telephone access network (although inside the telephone exchange or between the exchanges, other multiplexing techniques are typically employed) or a switched Ethernet network. A third example is a mesh network. Wired space-division multiplexing is typically not considered as multiplexing.

In wireless communication, space-division multiplexing is achieved by multiple antenna elements forming a phased array antenna. Examples are multiple-input and multiple-output (MIMO), single-input and multiple-output (SIMO) and multiple-input and single-output (MISO) multiplexing.

[Diagram of Space Division Multiplexing]

1.9.2 Frequency-division multiplexing

The spectrum of each input signal is shifted to a distinct frequency range. Frequency-division multiplexing (FDM) is inherently an analog technology. FDM achieves the combining of several digital signals into one medium by sending signals in several distinct frequency ranges over a single medium.

One of FDM’s most common applications is cable television. Only one cable reaches a customer’s home but the service provider can send multiple television channels or signals simultaneously over that cable to all subscribers without interference. Receivers must tune to the appropriate frequency (channel) to access the desired signal. A variant technology, called wavelength-division multiplexing (WDM) is used in optical communications.
1.9.3 Time-division multiplexing

Time-division multiplexing (TDM) is a digital (or in rare cases, analog) technology. TDM involves sequencing groups of a few bits or bytes from each individual input stream, one after the other, and in such a way that they can be associated with the appropriate receiver. If done sufficiently quickly, the receiving devices will not detect that some of the circuit time was used to serve another logical communication path.

Consider an application requiring four terminals at an airport to reach a central computer. Each terminal communicated at 2400 bit/s, so rather than acquire four individual circuits to carry such a low-speed transmission, the airline has installed a pair of multiplexers. A pair of 9600 bit/s modems and one dedicated analog communications circuit from the airport ticket desk back to the airline data center are also installed.
1.9.4 Code-division multiplexing

Code division multiplexing (CDM) or spread spectrum is a class of techniques where several channels simultaneously share the same frequency spectrum, and this spectral bandwidth is much higher than the bit rate or symbol rate. One form is frequency hopping, another is direct sequence spread spectrum. In the latter case, each channel transmits its bits as a coded channel-specific sequence of pulses called chips. Number of chips per bit, or chips per symbol, is the spreading factor.

This coded transmission typically is accomplished by transmitting a unique time-dependent series of short pulses, which are placed within chip times within the larger bit time. All channels, each with a different code, can be transmitted on the same fiber or radio channel or other medium, and asynchronously demultiplexed. Advantages over conventional techniques are that variable bandwidth is possible (just as in statistical multiplexing), that the wide bandwidth allows poor signal-to-noise ratio according to Shannon-Hartley theorem, and that multi-path propagation in wireless communication can be combated by rake receivers.

Code Division Multiplex techniques are used as an channel access scheme, namely Code Division Multiple Access (CDMA), e.g. for mobile phone service and in wireless networks, with the advantage of spreading intercell interference among many users. Confusingly, the generic term Code Division Multiple access sometimes refers to a specific CDMA based cellular system defined by Qualcomm.

Fig 1.15 Code Devision Multiplexing Technique
Summary

- Data communication is the transmission of electronic data over some media. The media may be cables, microwaves.
  - Four basic elements are needed for any communication system.
    1. Sender
    2. Medium
    3. Receiver
    4. Protocols
  - Data may be transfer from one device to another by means of some communication media. The electromagnetic or light waves that transfer data from one device to another device in encoded form are called signals.
  - The transfer of data in the form of electrical signals or continuous waves is called analog signal or analog data transmission.
  - The transfer of data in the form of digit is called digital signal or digital data transmission. Digital signals consist of binary digits 0 & 1.
  - A communication network is a set of devices (often referred to as nodes) connected by communication links. It provides a service, the transfer of information between users located at various geographical points.
  - A point-to-point connection is a dedicated communication link between two systems or processes.
  - Point-to-multipoint (PMP) communication refers to communication that is accomplished through a distinct and specific form of one-to-many connections,
    - Simplex communication is permanent unidirectional communication.
    - Half-duplex link can communicate in only one direction, at a time. Two way communications is possible, but not simultaneously.
    - Full duplex communication is two-way communication achieved over a physical link that has the ability to communicate in both directions simultaneously.
  - Bandwidth in computer networking refers to the data rate supported by a network connection or interface. One most commonly expresses bandwidth in terms of bits per second (bps).
• A twisted pair consists of two insulated copper wires typically about 1 mm thick. The wires are twisted together in a helical form.

• Microwave communication is a method of transmitting information or energy by the use of radio waves whose wavelengths are conveniently measured in small numbers of centimeter; these are called microwaves.

• Optical fiber carries much more information than conventional copper wire and is in general not subject to electromagnetic interference and the need to retransmit signals.

• Synchronous data transmission is 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 in step (synchronized) with one another.

• Asynchronous transmission works in spurts and must insert a start bit before each data character and a stop bit at its termination to inform the receiver where it begins and ends.

• The Isochronous format for data transmission is a procedure or protocol in which each information character or byte is individually synchronized or framed by the use of Start and Stop Elements, also referred to as start bits and stop bits.

• A parallel interface refers to a multiline channel, each line capable of transmitting several bits of data simultaneously.

• A serial interface uses a serial port, a single line capable of only transmitting one bit of data at a time; a computer mouse connection is a good example.

• In simplex mode the communication can take place only in one direction. The receiver receives the signal from the transmitting device.

• In half-duplex mode the communication channel is used in both directions, but only in one direction at a time.

• In full duplex the communication channel is used in both directions at the same time.

• Multiplexing is a technique of simultaneous transmission of multiple signals over a single data link.

• Space-division multiplexing is achieved by multiple antenna elements forming a phased array antenna, space-division multiplexing simply implies different point-to-point wires for different channels.
• FDM achieves the combining of several digital signals into one medium by sending signals in several distinct frequency ranges over a single medium.

• Time-division multiplexing (TDM) is a digital (or in rare cases, analog) technology.

• Code division multiplexing (CDM) or spread spectrum is a class of techniques where several channels simultaneously share the same frequency spectrum, and this spectral bandwidth is much higher than the bit rate or symbol rate.

### Short Answer Type Questions

1. What is data communication? List types of data communications.

2. Write various modes of data transmission.

3. Define bandwidth.

4. List various communication channels.

5. Write various methods of data transmission.

6. What is Isynchronous Data Transmission?

7. Write various forms of Data Transmission?

8. What is parallel and serial interface?

9. What is multiplexing? Write various types of multiplexing.

### Long Answer Type Questions

1. Explain various types of data communications.

2. Write about transmission modes

3. Explain synchronous and Asynchronous and Isochronous data transmission methods.

4. Explain various types of multiplexing with neat diagrams.

5. Explain different methods of Data Transmission.

6. Explain about various communication channels.
UNIT 2

Network Types and Topologies

Structure

2.0 Introduction
2.1 Advantages & Disadvantages
2.2 Types of Networks (LAN, MAN, WAN, Private, Value added)
2.3 Network Topology

Learning Objectives

After studying this unit, the student will be able to

- Understand about computer network and its usage.
- Understand about the advantages of computer network.
- Understand about different types of networks.
- Understand about different Network topologies.

2.0 Introduction

A computer network is a group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users. Networks are commonly categorized based on their characteristics.

Networks are used for the following key reasons
• To facilitate communication via email, video conferencing, instant messaging, etc.
• To enable multiple users to share a single hardware device like a printer or scanner.
• To enable file sharing across the network
• To allow for the sharing of software or operating programs on remote systems.
• To make information easier to access and maintain among network users.

2.1 Advantages and Disadvantages

File Sharing: The major advantage of a computer network is that allows file sharing and remote file access. A person sitting at one workstation of a network can easily see the files present on the other workstation, provided he is authorized to do so. It saves the time which is wasted in copying a file from one system to another, by using a storage device. In addition to that, many people can access or update the information stored in a database, making it up-to-date and accurate.

Resource Sharing: Resource sharing is also an important benefit of a computer network. For example, if there are four people in a family, each having their own computer, they will require four modems (for the Internet connection) and four printers, if they want to use the resources at the same time. A computer network, on the other hand, provides a cheaper alternative by the provision of resource sharing. In this way, all the four computers can be interconnected, using a network, and just one modem and printer can efficiently provide the services to all four members. The facility of shared folders can also be availed by family members.

Increased Storage Capacity: As there is more than one computer on a network which can easily share files, the issue of storage capacity gets resolved to a great extent. A standalone computer might fall short of storage memory, but when many computers are on a network, memory of different computers can be used in such case. One can also design a storage server on the network in order to have a huge storage capacity.

Increased Cost Efficiency: There are many softwares available in the market which are costly and take time for installation. Computer networks resolve this issue as the software can be stored or installed on a system or a server and can be used by the different workstations.
2.1.1 Disadvantages of Computer Networks

Security Issues: One of the major drawbacks of computer networks is the security issues involved. If a computer is standalone, physical access becomes necessary for any kind of data theft. However, if a computer is on a network, a computer hacker can get unauthorized access by using different tools. In case of big organizations, various network security software’s are used to prevent the theft of any confidential and classified data.

Rapid Spread of Computer Viruses: If any computer system in a network gets affected by computer virus, there is a possible threat of other systems getting affected too. Viruses get spread on a network easily because of the interconnectivity of workstations. Such spread can be dangerous if the computers have important database which can get corrupted by the virus.

Expensive Set Up: The initial set up cost of a computer network can be high depending on the number of computers to be connected. Costly devices like routers, switches, hubs, etc., can add up to the bills of a person trying to install a computer network. He will also have to buy NICs (Network Interface Cards) for each of the workstations, in case they are not inbuilt.

Dependency on the Main File Server: In case the main File Server of a computer network breaks down, the system becomes useless. In case of big networks, the File Server should be a powerful computer, which often makes it expensive.

2.2 Types of Networks

- Local Area Networks (LAN)
- Personal Area Networks (PAN)
- Home Area Networks (HAN)
- Wide Area Networks (WAN)
- Campus Networks
- Metropolitan Area Networks (MAN)
- Enterprise Private Networks
- Internetworks
- Backbone Networks (BBN)
- Global Area Networks (GAN)
- The Internet
2.2.1 Local Area Networks

A local area network (LAN) supplies networking capability to a group of computers in close proximity to each other such as in an office building, a school, or a home. A LAN is useful for sharing resources like files, printers, games or other applications. A LAN in turn often connects to other LANs, and to the Internet or other WAN.

Most local area networks are built with relatively inexpensive hardware such as Ethernet cables, network adapters, and hubs. Wireless LAN and other more advanced LAN hardware options also exist.

The most common type of local area network is an Ethernet LAN. The smallest home LAN can have exactly two computers; a large LAN can accommodate many thousands of computers. Many LANs are divided into logical groups called subnets. An Internet Protocol (IP) “Class A” LAN can in theory accommodate more than 16 million devices organized into subnets.

Major Characteristics of LAN

• Every computer has the potential to communicate with any other computers of the network.

• High degree of interconnection between computers.

• Easy physical connection of computers in a network.

• Inexpensive medium of data transmission.

• High data transmission rate.

Advantages

• The reliability of network is high because the failure of one computer in the network does not effect the functioning for other computers.

• Addition of new computer to network is easy.

• High rate of data transmission is possible.

• Peripheral devices like magnetic disk and printer can be shared by other computers.

Disadvantages

• If the communication line fails, the entire network system breaks down.
2.2.2 Metropolitan Area Networks

A metropolitan area network (MAN) is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN). The term is applied to the interconnection of networks in a city into a single larger network (which may then also offer efficient connection to a wide area network). It is also used to mean the interconnection of several local area networks by bridging them with backbone lines. The latter usage is also sometimes referred to as a campus network.

Examples of metropolitan area networks of various sizes can be found in the metropolitan areas of London, England; Poland, Geneva and Switzerland. Large universities also sometimes use the term to describe their networks. A recent trend is the installation of wireless MANs.

Advantages

• Sharing of resources such as printers; hence cost effective.

• We can send local emails.

2.2.3 Wide Area Networks

A WAN spans a large geographic area, such as a state, province or country. WANs often connect multiple smaller networks, such as local area networks (LANs) or metro area networks (MANs).

The world’s most popular WAN is the Internet. Some segments of the Internet, like VPN-based extranets, are also WANs in themselves. Finally, many WANs are corporate or research networks that utilize leased lines.

Advantages

• These are similar to those of LAN’s except the scale of sharing etc. becomes far greater and can be world-wide.

Disadvantages

• Again these are similar to those of LAN’s except that issues such as security become even more important as potential hackers could break into a computer system from anywhere in the world rather than having to physically be in a building.

• Encryption of secure data such as financial transactions is necessary because it is even easier to intercept data.
2.2.4. Personal Area Networks

A wireless personal area network (WPAN for short) is a low-range wireless network which covers an area of only a few dozen metres. This sort of network is generally used for linking peripheral devices (like printers, cellphones, and home appliances) or a personal assistant (PDA) to a computer, or just two nearby computers, without using a hard-wired connection. There are several kinds of technology used for WPANs:

The main WPAN technology is Bluetooth, launched by Ericsson in 1994, which offers a maximum throughput of 1 Mbps over a maximum range of about thirty metres.

2.2.5 Value Added Networks

Value Added Networks simplify the communication process by reducing the number of parties that you have to communicate with. VANs insert themselves between trading partners. They typically operate on a mailbox scenario where a company would send a transaction to a VAN and the VAN would then place the transaction in the mailbox of the receiver. The receiver would then contact the VAN and pick up any transactions it might have and then send anything it might need to send. It is very similar to email, but rather than being unstructured text, it is used for structured standardized data. Easylink operates a Value Added Network that provides this ‘mail boxing’ type of service and transmits the data using the Internet.

2.3 Network Topology

A network topology describes the arrangement of systems on a computer network. It defines how the computers, or nodes, within the network are arranged and connected to each other.

Some common network topologies include star, ring, line, bus, and tree configurations.

These topologies are defined below

1. **Star**: One central node is connected to each of the other nodes on a network. Similar to a hub connected to the spokes in a wheel.

2. **Ring**: Each node is connected to exactly two other nodes, forming a ring. Can be visualized as a circular configuration. Requires at least three nodes.

3. **Line**: Nodes are arranged in a line, where most nodes are connected to two other nodes. However, the first and last node are not connected like they are in a ring.
4. **Bus**: Each node is connected to a central bus that runs along the entire network. All information transmitted across the bus can be received by any system in the network.

5. **Tree**: One “root” node connects to other nodes, which in turn connect to other nodes, forming a tree structure. Information from the root node may have to pass through other nodes to reach the end nodes.

### 2.3.1 Mesh Topology

In a mesh topology, every device has a dedicated point-to-point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects. Here, if we have $n$ nodes, then we need to connect to $n-1$ nodes and $n(n-1)$ physical links. However, if each physical link allows communication in both directions (duplex mode).

![Fig 2.1 Mesh Topology](image)

**Advantages**

- Eliminates traffic problems in links sharing.
- If one link becomes unusable, it does not incapacitate the entire system. Thus, acts as robust.
- It has privacy and security.
- Point-to-point link make fault identification and fault isolation easy.
Disadvantages

• Installation and reconnection are difficult.

• The hardware required to connect each link (I/O ports and cable) is expensive.

• It is generally too costly and complex for practical networks.

2.3.2 Star Topology

In local area networks where the star topology is used, each machine is connected to a central hub. The star topology allows each machine on the network to have a point to point connection to the central hub. All of the traffic which transverses the network passes through the central hub. The hub acts as a signal booster or repeater which in turn allows the signal to travel greater distances.

Advantages

• Easy to install and reconfigure and Less expensive

• No disruptions to the network when connecting or removing devices.

• Easy to detect faults and to remove parts.

• Includes robustness, that is, if one link fails, only that link is affected, other links remain active.

Disadvantages

• If the hub, switch, or concentrator fails, nodes attached are disabled.
• If the hub fails, the whole system is dead.
• Requires more cable length than a bus topology.
• More expensive than bus topologies because of the cost of the hubs, etc.

2.3.3 Ring Topology

In local area networks where the ring topology is used, each computer is connected to the network in a closed loop or ring. The signal passes through each machine or computer connected to the ring in one direction, from device to device, until it reaches its destination. Each machines or computers connected to the ring act as signal boosters or repeaters. When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.

Fig 2.3 Ring Topology

Advantages
• It is relatively easy to install and reconfigure.
• Easy to identify the problem if the entire network shuts down.

Disadvantages
• Only one machine can transmit on the network at a time.
• The failure of one machine will cause the entire network to fail.
2.3.4 Tree Topology

The type of network topology in which a central ‘root’ node (the top level of the hierarchy) is connected to one or more other nodes that are one level lower in the hierarchy (i.e., the second level) with a point-to-point link between each of the second level nodes and the top level central ‘root’ node, while each of the second level nodes that are connected to the top level central ‘root’ node will also have one or more other nodes that are one level lower in the hierarchy (i.e., the third level) connected to it, also with a point-to-point link, the top level central ‘root’ node being the only node that has no other node above it in the hierarchy.

Advantages

• Point-to-point wiring for individual segments.

• Supported by several hardware and software vendors.

Disadvantages

• Overall length of each segment is limited by the type of cabling used.

• If the backbone line breaks, the entire segment goes down.

• More difficult to configure and wire than other topologies.

2.3.5 Bus Topology

In local area networks where bus technology is used, each machine is connected to a long, single cable. The cable acts as a backbone to link all the devices in a network. Each computer or server is connected to the single bus cable through drop lines and some kind of connector. A terminator is required at
each end of the bus cable to prevent the signal from bouncing back and forth on the bus cable.

2.5 Bus Topology

**Advantages**

- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than mesh or star topologies.
- It is cheaper than any other topologies.

**Disadvantages**

- If the network cable breaks, the entire network will be down.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.
- Not meant to be used as a stand-alone solution in a large building.
- Include difficult reconnection and fault isolation.
- The managing cost of network is too high.
- Addition of new devices requires modification or replacement of the backbone.

2.3.6 Hybrid Topology

Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard
topologies (e.g., bus, star, ring, etc.). A hybrid topology is always produced when two different basic network topologies are connected.

**Advantages**

- It provides a better result by it.
- It can be designed in many ways for various purposes.

**Disadvantages**

- It is costly.
- Difficult to identify the problem if the entire network shuts down.

### 2.3.7 The Internet

The Internet is a worldwide collection of computer networks, cooperating with each other to exchange data using a common software standard. Through telephone wires and satellite links, Internet users can share information in a variety of forms.

The size, scope and design of the Internet allows users to
• Connect easily through ordinary personal computers and local phone numbers.

• Exchange electronic mail (E-mail) with friends and colleagues with accounts on the Internet.

• Post information for others to access, and update it frequently;

• Access multimedia information that includes sound, photographic images and even video; and

• Access diverse perspectives from around the world.

Advantages

• You have information at your fingertips, and you don’t even have to know how to spell, or know your ABCs. Someone out there knows the answers to everything you can think of.

• You can send mail across the world within minutes where snail mail used to take 3-4 days in the states and 2 weeks overseas.

• You are connected to a lot of people who have similar interests if you know the right place to find them on the internet. A lot more difficult in person.
Disadvantages

• You cannot always trust the answers you get over the internet when you are looking for information.

• You spend too much time in front of a machine, and not enough time in front of “real” people.

• You need a credit card if you want to buy something either to pay a third party sight, or to pay direct the company you are interested in. IN person, you can always pay by cash.

Summary

• Networking of computers facilitates resource sharing, sharing of information, and, can be used as a communication medium, and for backup and support.

• Computer Network is interconnection of two or more computers that can exchange data.

• LAN, MAN, and WAN are the network types classified on the basis of the size of network, the transmission technology, and the network topology.

• Network topology is the name given to the way in which the devices (called nodes) are physically connected in a network.

• Bus, Star, Mesh, Tree and Ring are the five common LAN topologies.

• The bus topology is commonly referred to as a linear bus; all of the devices on a bus topology are effectively connected by one single cable.

• In a ring topology, the nodes are connected in a ring and data travels in one direction using a control signal called a ‘token’.

• Star Topology It is made up of a central connection point that is a device, such as a hub, switch, or router, where all the cabling segments actually meet.

• Mesh topology is similar to the star topology. Mesh topology provides redundancy between devices in a star topology. A network can be fully meshed or partially meshed depending on the level of redundancy needed.

Short Answer Type Questions

1. What is a Network?

2. Write various advantages of networks.
3. List various disadvantage of Networks.
4. List various types of Networks.
5. Expand LAN, WAN, MAN.
6. Expand BBN, GAN.
7. What is Network Topology? List types of topologies?
8. Write any two advantages and two disadvantages of topologies.

Long Answer Type Questions

1. Explain different types of computer networks.
2. Explain any three network topologies with their advantages and disadvantages.
UNIT 3

LAN Components

Structure

3.0 Introduction
3.1 Server, Clients, File Server
3.2 Ethernet Cards, HUBS, Switches, Routers, Gateways
3.3 Modem and types – V-SAT, ATMS
3.4 Adapters – Functions and types
3.5 Multiplexers Functions and Types

Learning Objectives

After studying this unit, the student will be able to

• Know about a Server & Client.
• Know the Client-Server Architecture.
• Know different Network Interfaces.
• Know different types of Modems
• Know the functionalities of Adapters.
• Know the functionalities of Multiplexers.
3.0 Introduction

LAN is made up of hardware as well as software components. Hardware consists of interface cards in all the machines and cables that tie them together. The software includes the drivers for all peripherals and network O.S. that manages the network. The components of a LAN are discussed in detail.

3.1 Servers, Clients and File Server

3.1.1. Servers

A server is a software program, or the computer on which that program runs, that provides a specific kind of service to client software running on the same computer or other computers on a network.

A single computer can have multiple server software applications running on it. Also, it is possible for a computer to be both a client and a server simultaneously; this is accomplished by connecting to itself in the same way that a separate computer would.

Many large enterprises employ numerous dedicated server machines. A collection of servers in one location is commonly referred to as a server farm. If very heavy traffic is expected, load balancing is usually employed to distribute the requests among the various servers so that no single machine is overworked.

Due to the continual demand for ever more powerful servers in ever decreasing spaces, higher density configurations have been developed. In particular, blade server incorporate a number of sets of server hardware, sometimes as many as nine, each housed inside a high-density module known as a blade, within the space typically occupied by a single computer.

Different types of Servers

• Web server: It stores files related to web sites and serves (i.e., sends) them across the Internet to clients (i.e., web browsers) when requested by a user. By far the most popular web server program is Apache, which is claimed to host more than 68 percent of all web sites on the Internet. As is the case with other server software, Apache can run on computers which are used for multiple purposes, such as ordinary desktop computers, as well as on dedicated hardware.

• File server: It is a software, or hardware plus software, that is dedicated to storing files and making them accessible for reading and writing to clients (i.e., users) across a network.

• Print server: It is a software or hardware that manages one or more printers.
- **Network server**: It manages network traffic.
- **Name server**: It maps user and computer names to machine addresses.
- **Database server**: It allows clients to interact with a database.
- **Application server**: It runs applications for clients.

### 3.1.2 Clients

A client is an application or system that accesses a service made available by a server. The server is often (but not always) on another computer system, in which case the client accesses the service by way of a network. The term was first applied to devices that were not capable of running their own stand-alone programs, but could interact with remote computers via a network. These dumb terminals were clients of the time-sharing mainframe computer.

Clients are generally classified as either “fat clients”, “thin clients”, or “hybrid clients”.

<table>
<thead>
<tr>
<th></th>
<th>Local storage</th>
<th>Local processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat client</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Hybrid client</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Thin client</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

### Fat Clients

A fat client, also known as a rich client or thick client, is a client that performs the bulk of any data processing operations itself, and does not necessarily rely on the server. The fat client is most common in the form of a personal computer, as the personal computers or laptops can operate independently.

Programming languages and/or development tools for rich clients typically include Delphi, .NET Framework, Java and Visual Studio.

### Thin Clients

A thin client is a minimal sort of client. Thin clients use the resources of the host computer. A thin client’s job is generally just to graphically display pictures provided by an application server, which performs the bulk of any required data processing. Programming environments for thin clients include JavaScript/AJAX (client side automation), ASP, JSP, Ruby on Rails, Python’s Django, PHP and
other (depends on server-side backend and uses HTML pages or rich media like Flash, Flex or Silverlight on client).

**Hybrid Clients**

A hybrid client is a mixture of the above two client models. Similar to a fat client, it processes locally, but relies on the server for storage data. This approach offers features from both the fat client (multimedia support, high performance) and the thin client (high manageability, flexibility).

### 3.1.3. Client-Server Model

The client/server model is a computing model that acts as a distributed application which partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients. Often clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. A server machine is a host that is running one or more server programs which share their resources with clients. A client does not share any of its resources, but requests a server’s content or service function. Clients therefore initiate communication sessions with servers which await incoming requests.

![Fig 3.1 Client Server Model](image)

The client/server characteristic describes the relationship of cooperating programs in an application. The server component provides a function or service to one or many clients, which initiate requests for such services. Functions such as email exchange, web access and database access are built on the client/server model.

Users accessing banking services from their computer use a web browser client to send a request to a web server at a bank. That web server runs a program which may in turn, forward the request to its own database client program, which sends a request to the bank’s database server (which runs on another computer) to retrieve the account information.
The balance and transaction records are returned to the bank database client, which in turn serves it back to the user’s web browser client, displaying the results to the user. The client–server model has become one of the central ideas of network computing. Many business applications being written today use the client–server model, as do the Internet’s main application protocols, such as HTTP, SMTP, Telnet, and DNS.

3.1.4. File Server

A file server is a computer attached to a network that has the primary purpose of providing a location for shared disk access, i.e. shared storage of computer files (such as documents, sound files, photographs, movies, images, databases, etc.) that can be accessed by the workstations that are attached to the same computer network.

The term server highlights the role of the machine in the client–server scheme, where the clients are the workstations using the storage. A file server is not intended to perform computational tasks, and does not run programs on behalf of its clients. It is designed primarily to enable the storage and retrieval of data while the computation is carried out by the workstations. File servers are commonly found in schools and offices, where users use a LAN to connect their client computers.

A file server may be dedicated or non-dedicated. A dedicated server is designed specifically for use as a file server, with workstations attached for reading and writing files and databases.

File servers may also be categorized by the method of access: Internet file servers are frequently accessed by File Transfer Protocol (FTP) or by HTTP (but are different from web servers, that often provide dynamic web content in addition to static files). Servers on a LAN are usually accessed by SMB/CIFS protocol (Windows and Unix-like) or NFS protocol (Unix-like systems).

3.2 Ethernet Cards, HUBS, Switches, Routers, Gateways

3.2.1. Ethernet Cards

An Ethernet card is one kind of network adapter. These adapters support the Ethernet standard for high-speed network connections via cables. Ethernet cards are sometimes known as network interface cards (NICs).

Ethernet cards are available in several different standard packages called form factors.

- Years ago, large ISA cards were the first standard for PCs, requiring users to open their computer case for installation.
• Newer Ethernet cards installed inside desktop computers use the PCI standard and are usually installed by the manufacturer.

• Smaller PCMCIA Ethernet cards that resemble credit cards are readily available for laptop and other mobile computers. These insert conveniently into slots on the side or front of the device. The PC Card is a common PCMCIA device, although only certain PC Card and PCMCIA products support Ethernet.

• Though they look more like small boxes than cards, external USB Ethernet adapters also exist. These are a convenient alternative to PCI cards for desktop computers and also commonly used with video game consoles and other consumer devices lacking PCMCIA slots.

Ethernet cards may operate at different network speeds depending on the protocol standard they support. Old Ethernet cards were capable only of the 10 Mbps maximum speed offered by Ethernet originally. Modern Ethernet adapters all support the 100 Mbps Fast Ethernet standard and an increasing number now also offer Gigabit Ethernet support at 1 Gbps (1000 Mbps).

An Ethernet card does not directly support Wi-Fi wireless networking, but home network broadband routers contain the necessary technology to allow Ethernet devices to connect via cables and communicate with Wi-Fi devices via the router.

![Ethernet Card](image)

Fig 3.2 Ethernet Card

### 3.2.2 Hubs

A common connection point for devices is a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.
A passive hub serves simply as a conduit for the data, enabling it to go from one device (or segment) to another. So-called intelligent hubs include additional features that enables an administrator to monitor the traffic passing through the hub and to configure each port in the hub. Intelligent hubs are also called manageable hubs.

A third type of hub, called a switching hub, actually reads the destination address of each packet and then forwards the packet to the correct port.

3.2.3 Switches

A network switch is a small hardware device that joins multiple computers together within one local area network (LAN). Technically, network switches operate at layer two (Data Link Layer) of the OSI model.

Network switches appear nearly identical to network hubs, but a switch generally contains more intelligence (and a slightly higher price tag) than a hub. 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.

As with hubs, Ethernet implementations of network switches are the most common. Mainstream Ethernet network switches support either 10/100 Mbps Fast Ethernet or Gigabit Ethernet (10/100/1000) standards.

### 3.2.4. Routers

Routers are small physical devices that join multiple networks together. Technically, a router is a Layer 3 gateway device, meaning that it connects two or more networks and that the router operates at the network layer of the OSI model.

Home networks typically use a wireless or wired Internet Protocol (IP) router, IP being the most common OSI network layer protocol. An IP router such as a DSL or cable modem broadband router joins the home’s local area network (LAN) to the wide-area network (WAN) of the Internet.

By maintaining configuration information in a piece of storage called the routing table, wired or wireless routers also have the ability to filter traffic, either incoming or outgoing, based on the IP addresses of senders and receivers. Some routers allow a network administrator to update the routing table from a Web browser interface. Broadband routers combine the functions of a router with those of a network switch and a firewall in a single unit.

![Fig 3.4 Router](image)

### 3.2.5. Gateways

A gateway is a network element that acts as an entrance point to another network. For example an access gateway is a gateway between telephony network and other network such as internet. LANs may have component called gateways, which assists in transferring from one LAN to another LAN.
A gateway is generally a work station or server. It is a two-way path between networks. It is used to connect different types of networks. Gateway is a work station by which we can make out connection between external network and internal network. Gateway belongs to transport layer and application layer of the OSI model.

Gateways also connect the two networks even if the protocols are different. So protocol conversion is also done by gateways. It simply stripped off the old protocol and assigns new protocol to the packets, so it is also called protocol translator. Because it takes it time for protocol conversion, it is little bit slower.

Gateways are the simple junctions between two network architectures. They repackage and convert data going from one environment to another so that one environment can understand the other environments data. So a gateway links two systems which have different communication protocols, different language and different architecture. So by that way gateways interconnects the heterogeneous networks e.g. Microsoft windows NT server to SNA (IBM’s system network architecture). Gateways never filter out the data. So it passes bad packets too.

Gateways are task specific. So they are dedicated to a particular type of transfer. They often referred to by their particular task name e.g. Windows NT server to SNA gateway.

Basically there are two types of gateways

![Fig 3.5 Gateways](image-url)
(1) Transport gateway and (2) application gateway. The former is for transport layer and the later is for application layer. Transport gateways connect two computers that use different connection oriented transport protocol. It can copy the packets to one connection to other, reformatting them as need be.

Application gateways understand the format and contents of the data and translate messages from one form to another e.g. an e-mail gateway could translate internet messages to an SMS messages on mobile phone. So it identifies the actual meaning of data.

### 3.3 Modem and types – V-SAT, ATMS

#### 3.3.1. Modem and Its types

A modem is a device or program that enables a computer to transmit data over, for example, telephone or cable lines. Computer information is stored digitally, whereas information transmitted over telephone lines is transmitted in the form of analog waves. A modem converts between these two forms.

![Fig 3.6 Modem Type](image)

**3.3.1.1 Types of Modems**

1. **Internal computer modems**

![Fig 3.7 Internal Computer Modem](image)
An internal modem is a device installed inside a desktop or laptop computer, allowing the computer to communicate over a network with other connected computers. There are two types of internal modems. One is dial-up and the other one is WiFi (wireless). The former operates over a telephone line and requires a network access phone number and logon credentials to make a connection. The latter can connect wirelessly and without credentials in certain cases. Some computers have an internal modem which can be a built-in modem or a PC card modem.

Internal computer modems are used with Dial-Up Internet connection through a couple of RJ-11 connection. Also called copper telephone lines, the RJ-11 allows computer to receive and send data. Internal computer modems are usually 56K modems which mean that the modem is able to receive 56 Kbps (56 kilobits or 56000 bits per second) of data. This kind of data transmission is called downstream transmission, came from a provider and transmitted over telephone lines. Commonly it is the standard bandwidth with telephones lines.

2. External Modems

An External modem can be used to the same purpose and in the same conditions as internal computer modem. However external modem is a small box that uses other kind of interfaces to be connected to the computer. It could be a serial modem, named thus because it uses the serial port to connect to the computer. Usually installed on the back of the computer, the serial port is an easy-to-install option for the external modem. The same small box, on the other hand, can be an USB modem which normally uses USB port usually placed on the back or in front of the computer. First of all external modem can be a Dial-Up modem but more expensive than the internal.

3. Cable Modem

Fig 3.8 Cable Modem
A type of modem that allows people to access the Internet via their cable television service. The cable modem uses a coaxial cable television lines to provide a greater bandwidth than the dial-up computer modem. An extremely fast access to the Web is providing by the cable modem with downstream transmission up to 38 Mbits/s and an upstream transmission up to 1 Mbits/s. Data can be transferred over cable lines much more quickly than over traditional phone lines. Transmission rates are typically around 1.5 megabits per second. Faster transmission is actually possible, but speed is usually restricted by the cable company’s (typically slower) connection to the Internet.

4. DSL Modem

DSL (Digital Subscriber Line) modem is exclusively used for connections from a telephone switching office to the user. DSL modem is a device used to connect a single computer or router to a DSL phone line, in order to use an ADSL service. Like other modems it is a type of transceiver. It is also called a DSL Transceiver or ATU-R. The acronym NTBBA (network termination broadband adapter, network termination broadband access) is also common in some countries. Some of the ADSL modems also manage the connection and sharing of the ADSL service with a group of machines: in this case, the unit is termed a DSL router or residential gateway.

3.3.2 V-SAT

A very small aperture terminal (VSAT), is a two-way satellite ground station or a stabilized maritime VSAT antenna with a dish antenna that is smaller than 3 meters. The majority of VSAT antennas range from 75 cm to 1.2 m. Data rates typically range from 56 kbit/s up to 4 Mbit/s. VSAT's access satellite(s) in geosynchronous orbit to relay data from small remote earth stations (terminals)
to other terminals (in mesh topology) or master earth station “hubs” (in star topology).

VSATs are most commonly used to transmit narrowband data (point of sale transactions such as credit card, polling or RFID data; or SCADA), or broadband data (for the provision of satellite Internet access to remote locations, VoIP or video). VSATs are also used for transportable, on-the-move (utilising phased array antennas) or mobile maritime communications.

Most VSAT networks are configured in one of these topologies:

A star topology, using a central uplink site, such as a network operations center (NOC), to transport data back and forth to each VSAT terminal via satellite,

A mesh topology, where each VSAT terminal relays data via satellite to another terminal by acting as a hub, minimizing the need for a centralized uplink site,

A combination of both star and mesh topologies. Some VSAT networks are configured by having several centralized uplink sites (and VSAT terminals stemming from it) connected in a multi-star topology with each star (and each terminal in each star) connected to each other in a mesh topology. Others configured in only a single star topology sometimes will have each terminal connected to each other as well, resulting in each terminal acting as a central hub. These configurations are utilized to minimize the overall cost of the network, and to alleviate the amount of data that has to be relayed through a central uplink site (or sites) of a star or multi-star network.

### 3.3.3 ATMS

Asynchronous Transfer Mode (ATM) is a telecommunications concept defined by ANSI and ITU (formerly CCITT) standards for carriage of a complete range of user traffic, including voice, data, and video signals, and is designed to unify telecommunication and computer networks. It uses asynchronous time-division multiplexing, and it encodes data into small, fixed-sized cells. This differs from approaches such as the Internet Protocol or Ethernet that use variable sized packets or frames.

ATM provides data link layer services that run over a wide range of OSI physical Layer links. ATM has functional similarity with both circuit switched networking and small packet switched networking. It was designed for a network that must handle both traditional high-throughput data traffic (e.g., file transfers), and real-time, low-latency content such as voice and video.
ATM uses a connection-oriented model in which a virtual circuit must be established between two endpoints before the actual data exchange begins.

ATM supports different types of services via ATM adaptation layers (AAL). Standardized AALs include AAL1, AAL2, and AAL5, and the rarely used AAL3 and AAL4. AAL1 is used for constant bit rate (CBR) services and circuit emulation. Synchronization is also maintained at AAL1. AAL2 through AAL4 are used for variable bit rate (VBR) services and AAL5 for data. Which AAL is in use for a given cell is not encoded in the cell. Instead, it is negotiated by or configured at the endpoints on a per-virtual-connection basis.

ATM operates as a channel-based transport layer, using virtual circuits (VCs). This is encompassed in the concept of the Virtual Paths (VP) and Virtual Channels. Every ATM cell has an 8- or 12-bit Virtual Path Identifier (VPI) and 16-bit Virtual Channel Identifier (VCI) pair defined in its header. Together, these identify the virtual circuit used by the connection.

The length of the VPI varies according to whether the cell is sent on the user-network interface (on the edge of the network), or if it is sent on the network-network interface (inside the network). Another key ATM concept involves the traffic contract. When an ATM circuit is set up each switch on the circuit is informed of the traffic class of the connection.

ATM traffic contracts form part of the mechanism by which “quality of service” (QoS) is ensured. There are four basic types (and several variants) which each have a set of parameters describing the connection are listed below.

- **CBR** - Constant bit rate: a Peak Cell Rate (PCR) is specified, which is constant.

- **VBR** - Variable bit rate: an average or Sustainable Cell Rate (SCR) is specified, which can peak at a certain level, a PCR, for a maximum interval before being problematic.

- **ABR** - Available bit rate: a minimum guaranteed rate is specified.

- **UBR** - Unspecified bit rate: traffic is allocated to all remaining transmission capacity.

### 3.4 Adapters – Functions and types

#### 3.4.1 Network Interface Controller (NIC)

A network interface controller (also known as a network interface card, network adapter, LAN adapter and by similar terms) is a computer hardware component that connects a computer to a computer network. Early network
interface controllers were commonly implemented on expansion cards that plugged into a computer bus; the low cost of the Ethernet standard means that most newer computers have a network interface built into the motherboard.

The NIC may use one or more of four techniques to transfer data

• Polling is where the CPU examines the status of the peripheral under program control.

• Programmed I/O is where the microprocessor alerts the designated peripheral by applying its address to the system’s address bus.

• Interrupt-driven I/O is where the peripheral alerts the microprocessor that it is ready to transfer data.

• Direct memory access is where an intelligent peripheral assumes control of the system bus to access memory directly. This removes load from the CPU but requires a separate processor on the card.

3.4.2 Network Adapter

A network adapter interfaces a computer to a network. The term “adapter” was popularized originally by Ethernet add-in cards for PCs.

Modern network adapter hardware exists in several forms. Besides traditional PCI Ethernet cards, some network adapters are PCMCIA devices (also known as “credit card” or “PC Card” adapters) or USB devices. Some wireless network adapter gear for laptop computers are integrated circuit chips pre-installed inside the computer.

Windows and other operating systems support both wired and wireless network adapters through a piece of software called a “device driver.” Network drivers allow application software to communicate with the adapter hardware. Network device drivers are often installed automatically when adapter hardware is first powered on.

A few network adapters are purely software packages that simulate the functions of a network card. These so-called virtual adapters are especially common in virtual private networking (VPN).

Types of Network Adapters

A network adapter is typically a small unit of hardware. Several types of hardware adapters exist.

• Traditional PCI adapters fit inside a desktop personal computer (often called a NIC).
• A newer type of PCI adapter, “PC Card” adapters (sometimes called PCMCIA cards) insert into the side of a notebook computer.

• A USB adapter plus into a standard USB port of any computer

• A media adapter connects to the Ethernet port of an Xbox or Playstation game console or other home entertainment product, providing a bridge to Wi-Fi wireless capability.

• Newer notebook computers contain integrated wireless adapter chips

Every common adapter supports either Wi-Fi (wireless) or Ethernet (wired) standards. Special-purpose adapters that support very specialized network protocols also exist, but these are not found in homes or most business networks.

### 3.5 Multiplexers Functions and Types

A multiplexer (MUX) is a device allowing one or more low-speed analog or digital input signals to be selected, combined and transmitted at a higher speed on a single shared medium or within a single shared device. Thus, several signals may share a single device or transmission conductor such as a copper wire or fiber optic cable. A MUX functions as a multiple input, single output switch.

In telecommunications the combined signals, analog or digital, are considered a single output higher speed signal transmitted on several communication channels by a particular multiplex method or technique. With two input signals and one output signal, the device is referred to as a 2-to-1 multiplexer; with four input signals it is a 4-to-1 multiplexer; etc.

For analog signals in telecommunications (and signal processing), a TDM (time division multiplexer) may select multiple samples of separate analog signals and combine them into one PAM (pulse amplitude modulated) wide-band analog signal.

For digital signals in telecommunications on a computer network or with digital video, several variable bit-rate data streams of input signals (using packet mode communication) may be combined, or multiplexed, into one constant bandwidth signal. With an alternate method utilizing a TDM, a limited number of constant bit-rate data streams of input signals may be multiplexed into one higher bit-rate data stream.

A multiplexer requires a demultiplexer to complete the process, i.e. to separate multiplex signals carried by the single shared medium or device.
Often an multiplexer and a demultiplexer are combined into a single device (also often just called a multiplexer) allowing the device to process both incoming and outgoing signals. Alternately, a multiplexer’s single output may be connected to a demultiplexer’s single input over a single channel. Either method is often used as a cost-saving measure. Since most communication systems transmit in both directions, the single combined device, or two separate devices (in latter example), will be needed at both ends of the transmission line.

**Summary**

- A **server** is a software program, or the computer on which that program runs, that provides a specific kind of service to **client**
- A **client** is an application or system that accesses a service made available by a server. The server is often (but not always)
- A **file server** is a computer attached to a network that has the primary purpose of providing a location for shared disk access
- An **Ethernet card** is one kind of network adapter.
- Hubs are commonly used to connect segments of a LAN.
- A **network switch** is a small hardware device that joins multiple computers together within one local area network (LAN).
- A **gateway** is generally a work station or server. It is a two-way path between networks. It is used to connect different types of networks
- Gateway is a work station by which we can make out connection between external network and internal network
- A **modem** is a device or program that enables a computer to transmit data over, for example, telephone or cable lines
- A **very small aperture terminal (VSAT)**, is a two-way satellite-ground station or a stabilized maritime Vsat antenna with a dish antenna that is smaller than 3 meters
- VSATs are most commonly used to transmit narrowband data (point of sale transactions such as credit card, polling or RFID data; or SCADA), or broadband data (for the provision of satellite Internet access to remote locations, VoIP or video). VSATs are also used for transportable, on-the-move (utilising phased array antennas) or mobile maritime communications.
- **Asynchronous Transfer Mode (ATM)** is a telecommunications concept defined by ANSI and ITU (formerly CCITT) standards for carriage of a complete
range of user traffic, including voice, data, and video signals, and is designed to unify telecommunication and computer networks.

- Early network interface controllers were commonly implemented on expansion cards that plugged into a computer bus; the low cost and ubiquity of the Ethernet standard means that most newer computers have a network interface built into the motherboard.

- A multiplexer (MUX) is a device allowing one or more low-speed analog or digital input signals to be selected, combined and transmitted at a higher speed on a single shared medium or within a single shared device. Thus, several signals may share a single device or transmission conductor such as a copper wire or fiber optic cable. A MUX functions as a multiple input, single output switch.

**Short Answer Type Questions**

1. What are LAN Components?
2. Write various types of LAN Components.
3. Define: Server and Client
4. What is a file server?
5. What are Ethernet Cards?
6. What are Hubs and Switches?
7. What is Router?
8. What are Gateways?
9. What is a Modem and list types of Modems?
10. Write briefly about ATM.
11. What is an adapter? What is the function of an Adapter?
12. List types of Adapters.
13. What is a multiplexer? Write any two functions of it.
14. Expand V-SAT, ATM, FTP, EDI.

**Long Answer Type Questions**

1. Explain briefly about any three LAN Components.
2. Explain the function of Modem with a neat diagram.
3. Discuss briefly about: Hubs and Switches.
4. Write about V-SAT and ATM.
5. Discuss about (a) Routers (b) Gateways.
4.1. Introduction to Internet, Advantages, Browsers

Internet in simple terms is a network of the interlinked computer networking worldwide, which is accessible to the general public. These interconnected computers work by transmitting data through a special type of packet switching which is known as the IP or the internet protocol.

Internet is such a huge network of several different interlinked networks relating to the business, government, academic, and even smaller domestic
networks, therefore internet is known as the network of all the other networks. These networks enable the internet to be used for various important functions which include the several means of communications like the file transfer, the online chat and even the sharing of the documents and websites on the WWW, or the World Wide Web.

4.1.2 Advantages of Internet

There are many advantages to using the internet such as

1. Email

   E-mail is an online correspondence system. With e-mail you can send and receive instant electronic messages, which works like writing letters. Your messages are delivered instantly to people anywhere in the world, unlike traditional mail that takes a lot of time. 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.

2. Information

   Any kind of information on any topic under the sun is available on the Internet. The ‘search engines’ on the Internet can help you to find data on any subject that you need. 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.

3. 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.

4. Buy or sell products

   The internet is a very effective way to buy and sell products all over the world. Along with getting information on the Internet, you can also shop online. There are many online stores and sites that can be used to look for products as well as buy them using your credit card. You do not need to leave your house and can do all your shopping from the convenience of your home.

5. Online Chat

   There are many ‘chat rooms’ on the web that can be accessed to meet new people, make new friends, as well as to stay in touch with old friends.
6. Downloading Software

This is one of the most happening and fun things to do via the Internet. You can download innumerable, games, music, videos, movies, and a host of other entertainment software from the Internet, most of which are free.

4.1.3 Disadvantages of the Internet

There are certain cons and dangers relating to the use of Internet that can be summarized as:

1. Personal Information

If you use the Internet, your personal information such as your name, address, etc. can be accessed by other people. If you use a credit card to shop online, then your credit card information can also be ‘stolen’ which could be akin to giving someone a blank check.

2. Pornography

This is a very serious issue concerning the Internet, especially when it comes to young children. There are thousands of pornographic sites on the Internet that can be easily found and can be a detriment to letting children use the Internet.

3. Spamming

This refers to sending unsolicited e-mails in bulk, which serve no purpose and unnecessarily clog up the entire system. Such illegal activities are frustrating for all Internet users, and so instead of just ignoring it, we should make an effort to try and stop these activities so that using the Internet can become that much safer.

4.1.4 Browsers

A browser is software that is used to access the internet. A browser lets you visit websites and do activities within them like login, view multimedia, link from one site to another, visit one page from another, print, send and receive email, among many other activities. The most common browser software titles on the market are: Microsoft Internet Explorer, Mozilla Firefox, Apple Computer’s Safari, and Opera. Browser availability depends on the operating system your computer is using (for example: Microsoft Windows, Linux, Ubuntu, Mac OS, among others).
4.1.4.1 Types of Web Browsers

1. Internet Explorer

   It was developed by Microsoft in 1994 and released in 1995 as a supportive package to Microsoft Windows line of operating systems. According to statistics, its usage share from 1999 to 2003-04 was around 95%. Microsoft occasionally releases updates for the previous versions of IE, which have some enhanced capabilities. IE has come up a preview release of Internet Explorer 10. The ‘favicon’, which is the short form of favorite icon, was introduced first in IE, and was later adopted by many other browsers. Initially, IE did not support tabbed browsing. But today, it can be used even in the older versions, by installing toolbars.

   **Features:** There are regular Microsoft updates that IE supports. Favicon allows an image to be used as a bookmark. It supports Integrated Windows Authentication.

2. Mozilla Firefox

   It is owned by Mozilla Corporation and was the result of an experimentation. ‘Mozilla Firefox’ was officially announced in February 2004. It was earlier named Phoenix, Firebird, and eventually Firefox. It is the second-most famous browser after Internet Explorer, as there were around 100 million downloads within a year of its release. Until November 2008, 700 million downloads were recorded. Since the release of Firefox, the sale of Internet Explorer has gone down drastically. It has around 22% of the market share at present. It has undergone many updates and version changes that were made to improve usability to the universal users.

   **Features:** As it is an open source software, it allows everyone to access the code. It supports tabbed browsing that allows the user to open multiple sites in a single window. Session storage is also an important feature of Firefox, which allows the user to regain access to the open tabs after he has closed the browser window.

3. Safari

   This is a web browser from Apple Inc., which is compatible with Mac OS X, Microsoft Windows, and the iPhone OS. Safari was released by Apple in January 2003 as a public beta. If you need to fill an online form with your personal information, AutoFill is a feature that automatically does that for you, with the help of information that is stored in your address book or Outlook.
**Features:** The Safari 4 beta had many features like VoiceOver screen reader, that reads aloud everything that is on the screen, including text and web links. It also has features like CSS Canvas, LiveConnect, XML 1.0, and JavaScript support, and Cover Flow. ‘Grammar Checking’ is an interesting built-in feature, which performs a grammar check on the typed text and gives suggestions to correct your sentence if wrong. Also, there is a resizable web search box option available.

4. **Opera**

This browser was developed by Opera Software in 1996. It is a well-known browser that is mainly used in Internet-activated mobile phones, PDAs, and smartphones. Opera Mini and Opera Mobile are the browsers used in smartphones. It is compatible with many operating systems such as Solaris, Linux, Mac OS X, and Microsoft Windows. It is also compatible with Symbian and Windows Mobile operating systems for smartphones and PDAs. The company claims that Opera is the fastest browser in the world.

**Features:** It also has some common functions like zoom and fit-to-width, content blocking, tabs and sessions, download manager with BitTorrent, and mouse gestures.

5. **Google Chrome**

This web browser was developed by Google. Its beta and commercial versions were released in September 2008 for Microsoft Windows. The browser versions for Mac OS X are under development. The browser options are very similar to that of Safari, the settings locations are similar to Internet Explorer 7, and the window design is based on Windows Vista.

**Features:** The main standout feature is the malware and phishing warning that the browser suggests when the user wants to browse a site. Also, there is a user tracking option available with Chrome.

6. **Netscape Navigator**

It was developed by Netscape Communications Corporation and was most popular in the 1990s. Exceptional features were provided at the time of its release, which helped it to rise to fame with a market share of more than 50% in the 1990s. It was compatible with almost every operating system. Since 2002, it has almost disappeared from the market due to strong competition from rivals like Internet Explorer, Mozilla Firefox, Safari, etc. It had undergone many version changes to maintain its stake in the market, none of which were very successful.
4.2. Internet Services - Messaging, Email and FTP

4.2.1 Message

A message is a string of bytes that is meaningful to the applications that use it. Messages are used to transfer information from one application program to another (or between different parts of the same application). The applications can be running on the same platform, or on different platforms.

Voice message refers to a message that could be sent to a destination using voice media. Voice itself could be ‘packaged’ and sent through the IP backbone so that it reaches its marked ‘address’. In a technical sense, the process of sending ‘voice packets’ is a semi passive way of communication. However, given the speed at which it could be delivered can make the communication sound seamless.

4.2.1.1 Message lengths

The default maximum message length is 4 MB, although you can increase this to a maximum length of 100 MB (where 1 MB equals 1 048 576 bytes).

It might take several messages to send all the information that an application requires.

4.2.2 E-mail (Electronic Mail)

E-mail is an electronic version of sending a letter. You can send e-mail from your computer at any time of the day to any address around the world and your electronic letter will arrive at its destination seconds after you send it... even if the receiver lives on the other side of the world.

E-mail system have two basic parts, the user agents and the message transfer agents. A user agent is normally a program that accepts a variety of commands for composing, receiving and replying to messages. The message transfer system is concerned with transferring messages from the originator to the recipient.

4.2.2.1 Advantages of E-mail

1. **Fast**: Messages can be sent anywhere around the world in an instant.
2. **Inexpensive**: Transmission usually costs nothing, or at the most, very little.
3. **Simple**: Easy to use, after initial setup.
4. **Efficient**: Sending to a group can be done in one step.
5. **Versatile**: Pictures, power-points or other files can be sent too.
6. **Printable** : The hard copy is easy to obtain. We can correspond and save e-mail message and also we get electronic copy of message.

### 4.2.2.2 Sending an E-mail

To send an e-mail message, a user must provide the message, the destination address and other parameters like *subject* of the mail and any file *attached* to the message etc.,

An attachment is simply an additional file sent with an email message. An attachment can be an image file, a Word document, or one of many other supported file types. When your recipients open your message, they can double-click on the attached file to open it with the program assigned to that file type on their computer. If they do not have a program installed that can open that type of file, they may not be able to open the attachment.

Also note that some email providers place limits on the size of the files that can be attached to email messages, while others block certain types of attachments (such as executable files with the .exe extension) to prevent viruses.

To attach a file to an email, you will first click on New in Mail’s toolbar to open a new message window and then click on the Attach icon after addressing your message and entering an appropriate subject line and body text.

The Attach icon is a paper clip. You can also choose File, Attach File to add attachments.
When you select one of these options, a window will open to allow you to navigate your hard drive and find the file(s) you want to attach to your message.

When your recipient gets the email with your attachment, there will be a paper clip icon next to the subject line in their mailbox to let them know that the email contains an attachment.

**4.2.2.3 Steps to Create e-mail message**

1. Load outlook express and then connect to the Internet.
2. Click in box in “Folders” box view the message you have received.
3. Click a message you want to read out. Look express displays the contents of the message.

**4.2.2.4 Steps to (or) Procedure for sending and receiving an e-mail**

1. Open Word.
2. From main menu select “File” and click “New”.
3. From the general tab select “e-mail message” and click OK (or) click on e-mail icon.
4. Write the e-mail address of the recipient in the space followed by “TO”.
5. Enter the “subject” of the letter in the space provided.
6. Type the message in the space provided.
7. In order to attach an existing file click on “Attach File” button.
8. Click on “send” button to send the e-mail.

**4.2.2.5 Steps to receive an e-mail**

1. All the received e-mails are stored in an Inbox folder.
2. Selecting the inbox all the received mails are listed on the screen.
3. Select the received mail clicking on it for reading.

**4.2.3 FTP**

A network protocol defines rules and conventions for communication between network devices. Protocols for computer networking all generally use packet switching techniques to send and receive messages in the form of packets. Network protocols include mechanisms for devices to identify and make
connections with each other, as well as formatting rules that specify how data is packaged into messages sent and received. Some protocols also support message acknowledgement and data compression designed for reliable and/or high-performance network communication.

Hundreds of different computer network protocols have been developed each designed for specific purposes and environments. There are different types of network protocols are used for different purposes like FTP (File Transfer Protocol), HTTP (Hyper Text Transfer Protocol), TCP (Transmission Control Protocol), UDP (User Datagram Protocol) and IP (Internet Protocol).

File Transfer Protocol, or FTP, is a protocol used for transferring files from one computer to another - typically from your computer to a web server. FTP is the preferred method of exchanging files because it’s faster than other protocols like HTTP or POP. If you need to exchange large files, you should consider FTP.

FTP data is sent and received through computer port 21 and under the TCP protocol. The transfer is asynchronous, meaning not at the same time, and therefore faster than other protocols.

**Objectives of FTP Were**

1. To promote sharing of files (computer programs and/or data),
2. To encourage indirect or implicit (via programs) use of remote computers,
3. To shield a user from variations in file storage systems among hosts, and
4. To transfer data reliably and efficiently.

FTP is designed mainly for use by programs though it is usable directly by a user at a terminal. To transfer files with FTP, you use a program often called the “client.” The FTP client program initiates a connection to a remote computer running FTP “server” software. After the connection is established, the client can choose to send and/or receive copies of files, singly or in groups. To connect to an FTP server, a client requires a username and password as set by the administrator of the server. Many public FTP archives follow a special convention for that accepts a username of “anonymous.”

Simple FTP clients are included with most network operating systems, but most of these clients (such as FTP.EXE on Windows) support a relatively unfriendly command-line interface. Many alternative freeware/shareware third-party FTP clients have been developed that support graphic user interfaces (GUIs) and additional convenience features. In any FTP interface, clients identify
the FTP server either by its IP address (such as 192.168.0.1) or by its host name (such as ftp.about.com).

FTP supports two modes of data transfer: plain text (ASCII), and binary. You set the mode in the FTP client. A common error when using FTP is attempting to transfer a binary file (such as a program or music file) while in text mode, causing the transferred file to be unusable.

4.3 Introduction to Internet Security

Internet security is a branch of computer security specifically related to the Internet, often involving browser security but also network security on a more general level as it applies to other applications or operating systems on a whole. Its objective is to establish rules and measures to use against attacks over the Internet. The Internet represents an insecure channel for exchanging information leading to a high risk of intrusion or fraud, such as phishing.

4.3.1 Malicious software and antivirus

Malicious software is software that is intentionally included or inserted in a system for harmful purpose. There are different types of malicious programmes exist in the internet. Those are viruses, Trojan horse, worms, logic bomb etc.,

4.3.1.1 Virus

A Virus is a piece of software that can infect other programs by modifying them; the modification includes a copy of the virus program, which can then go on to infect other programs. A virus can do anything that other programs do. The only difference is that it attaches itself to another program and executes secretly when the host program is run. Once a virus is executing, it can perform any function, such as erasing files and programs. Different types of viruses are listed below.

- **Parasitic virus**: The traditional and still most common form of virus. A parasitic virus attaches itself to executable files and replicates, when the infected program is executed, by finding other executable files to infect.

- **Memory-resident virus**: Lodges in main memory as part of a resident system program. From that point, the virus infects every program that executes.

- **Boot Sector virus**: Infects a master boot record or boot record and spreads when a system is booted form the disk containing the virus.

- **Polymorphic virus**: A virus that mutates with every infection, making detection by the signature of the virus impossible.
4.3.1.2 Worms

A worm is a program that can replicate itself and send copies from computer to computer across network connections. Upon arrival, the worm may be activated to replicate and propagate again. A worm actively seeks out more machines to infect and each machine that is infected serves as an automated launching pad for attacks on other machines.

Network worm programs use network connections to spread from system to system. Once active within a system, a network worm can behave as a computer virus or bacteria. To replicate itself, a network worm uses some sort of network vehicle. Examples are:

- Electronic mail facility: A worm mails a copy of itself to other systems.
- Remote execution capability: A worm executes a copy of itself on another system.
- Remote login capability: A worm logs onto a remote system as a user and then uses commands to copy itself from one system to the other.

4.3.1.3 Trojan Horses

A Trojan horse, or Trojan, is a malicious application that tricks as a authentic file or helpful program but whose real purpose is, for example, to grant a hacker unauthorized access to a computer. Trojans do not attempt to inject themselves into other files like a computer virus. Trojan horses may steal information, or harm their host computer systems. Trojans may use drive-by downloads or install via online games or internet-driven applications in order to reach target computers.

The term is derived from the Trojan Horse story in Greek mythology because Trojan horses employ a form of “social engineering,” presenting themselves as harmless, useful gifts, in order to persuade victims to install them on their computers.

A Trojan may give a hacker remote access to a targeted computer system. Operations that could be performed by a hacker on a targeted computer system may include:

- Use of the machine as part of a botnet (e.g. to perform automated spamming or to distribute Denial-of-service attacks)
- Electronic money theft
- Data theft (e.g. retrieving passwords or credit card information)
- Installation of software, including third-party malware
• Downloading or uploading of files on the user’s computer
• Modification or deletion of files
• Keystroke logging
• Watching the user’s screen
• Crashing the computer
• Anonymising internet viewing

4.3.2 Phishing and hacking

Phishing is an e-mail fraud method in which the perpetrator sends out legitimate-looking email in an attempt to gather personal and financial information from recipients. Typically, the messages appear to come from well-known and trustworthy Web sites. The e-mail directs the user to visit a Web site where they are asked to update personal information, such as passwords and credit card, social security, and bank account numbers, that the legitimate organization already has. The Web site, however, is bogus and set up only to steal the user’s information.

Hacking is an activity that used by a hacker to steal the information from any of the device or computer system. Also a hacker can use the system to work as a server to route the information for the own purpose. Hackers can use the contact information of system and send spam emails to that email ids. To avoid hacking we should need to use good firewall like Norton Internet Security 2011. Computer hacking is the most popular form of hacking nowadays, especially in the field of computer security, but hacking exists in many other forms, such as phone hacking, brain hacking, etc. and it’s not limited to either of them.

4.3.3 Antivirus software

Antivirus software is a computer program that detects, prevents, and takes action to disarm or remove malicious software programs, such as viruses and worms. You can help protect your computer against viruses by using antivirus software, such as Microsoft Security Essentials.

Computer viruses are software programs that are deliberately designed to interfere with computer operation; record, corrupt, or delete data; or spread themselves to other computers and throughout the Internet.

To help prevent the most current viruses, you must update your antivirus software regularly. You can set up most types of antivirus software to update automatically.
Summary

- The internet in simple terms is a network of the interlinked computer networking worldwide, which is accessible to the general public.

- There many advantages to using the internet such as Email, Information, Services, Buy or sell products, Online Chat, Downloading Software.

- A browser is software that is used to access the internet.

- The most common browser software titles on the market are: Microsoft Internet Explorer, Mozilla Firefox, Apple Computer’s Safari, and Opera.

- A message is a string of bytes that is meaningful to the applications that use it. Messages are used to transfer information from one application program to another.

- E-mail is an electronic version of sending a letter. You can send e-mail from your computer at any time of the day to any address around the world and your electronic letter will arrive at its destination seconds after you send it... even if the receiver lives on the other side of the world.

- A network protocol defines rules and conventions for communication between network devices.

- File Transfer Protocol, or FTP, is a protocol used for transferring files from one computer to another - typically from your computer to a web server.

- Internet security is a branch of computer security specifically related to the Internet, often involving browser security but also network security on a more general level as it applies to other applications or operating systems on a whole.

- A Virus is a piece of software that can infect other programs by modifying them; the modification includes a copy of the virus program, which can then go on to infect other programs.

- A worm is a program that can replicate itself and send copies from computer to computer across network connections.

- A Trojan horse, or Trojan, is a malicious application that tricks as a authentic file or helpful program but whose real purpose is, for example, to grant a hacker unauthorized access to a computer.

- Phishing is an e-mail fraud method in which the perpetrator sends out legitimate-looking email in an attempt to gather personal and financial information from recipients.
Antivirus software is a computer program that detects, prevents, and takes action to disarm or remove malicious software programs, such as viruses and worms.

### Short Answer Type Questions

1. What is an Internet?
2. Write advantages of Internet.
3. What is a Browser? List types of browsers.
4. What is a Message?
5. What is an E-mail?
6. Write any four uses of E-mail.
7. What is an attachment?
8. What is voice messaging?
9. What is Internet Explorer?
10. What is FTP?
11. What is a Protocol and Write types of Network Protocols?
12. What is Internet Security?
13. What is a virus?
14. What is a Trojan?
15. What is Hacking?
16. What is a Worm?
17. Expand FTP, E-Mail, WWW, TCP/IP
18. Expand ISDN, HTTP, FTP, NIC.

### Long Answer Type Questions

1. What is an Internet? Explain any three advantages and three disadvantages of Internet.
2. Explain various Web Browsers.
3. Write various advantages and disadvantages of e-mail.
4. How do you send and receive an E-mail with attachment.
5. Write about Internet Security.
Structure

5.1 Introduction
5.2 HTML basic elements and attributes
5.3 HTML heading, body, title, paragraphs, formatting and fonts tags.
5.4 Tags for Images and tables.
5.5 Creating lists and frames.
5.6 Creating Hyperlinks.
5.7 Tags to create forms and form objects.

Learning Objectives

After studying this unit, the student will be able to

- Know HTML and its usage
- Study of different HTML tags.
- Know how to design a website

5.1 Introduction

“HTML” means “HyperText Markup Language”. HTML was created by Tim Berners-Lee, the inventor of the WWW, and has been around since the very beginning of the web, and has changed a bit over that time, although it hasn’t really gotten any more complicated.
HTML is the markup language that’s used to create web pages. It simply describes a web page’s content and its structure.

**5.1.1 Advantages of HTML**

1. It is widely used.
2. Every browser supports HTML language.
3. Easy to learn and use.
4. It is by default in every windows so you don’t need to purchase extra software.

**5.1.2 Disadvantages of HTML**

1. It can create only static and plain pages so if we need dynamic pages then HTML is not useful.
2. Need to write lot of code for making simple webpage.
3. Security features are not good in HTML.
4. If we need to write long code for making a webpage then it produces some complexity.

**5.2 HTML basic elements and attributes**

An HTML element is everything from the start tag to the end tag. The start tag is often called the *opening tag*. The end tag is often called the *closing tag*.

**5.2.1 HTML Element Syntax**

- An HTML element starts with a start tag / opening tag
- An HTML element ends with an end tag / closing tag
- The element content is everything between the start and the end tag
- Some HTML elements have empty content
- Empty elements are closed in the start tag
- Most HTML elements can have attributes

**5.2.2 Attributes**

Each element may have a list of attributes which define the properties of the element. Element attributes are placed within the opening tag of the element,
for example: `<table bgcolor="blue"> </table>`

Here the table element has one attribute ‘bgcolor="blue”’, this attribute sets the background color property for the element.

Each element in html has its own specific attributes that relate to that particular elements function. For example the font `<font>` element can have attributes that relate to font, such as size, font type and color. Where as the `<table>` element can have attributes like ‘border’ and ‘cellspacing’ etc.

However there are many attributes that are common to more than one element, but not to all elements.

On the other hand there are attributes that are common to all html elements, such as ‘class’, ‘id’ etc. These kind of attributes are known as ‘core’ or ‘standard’ attributes.

When declaring an element it is optional whether you set attributes in the opening tag. Each element will have default properties which will be used if attributes are not declared. Often these default properties are sufficient and no attributes need to be specified.

### 5.3 HTML heading, body, title, paragraphs, formatting and fonts tags

#### 5.3.1 Structure of an HTML Program.

In every HTML program has a rigid structure. The entire web page is enclosed within `<HTML></HTML>` tags. Within these tags two separate sections are created using the `<HEAD></HEAD>` tags and the `<BODY></BODY>` tags. These sections are described below.

#### 5.3.2 Document Head

Information placed in this section is essential to the inner workings of the document and has nothing to do with the content of the document. With the exception of information contained within the `<TITLE></TITLE>` tags, all information placed within the `<HEAD></HEAD>` tags is not displayed in the browser. The HTML tags used to indicate the start and end of the head section are.

```
<HEAD>
<TITLE></TITLE>
</HEAD>
```

The `<TITLE>` tag sets the title of the document which will be displayed in the title bar of the browser window.
5.3.3 Document Body

The tags used to indicate the start and end of the main body of textual information are

<BODY>
</BODY>

Page defaults like background color, text color, font size, font weight and so on can be specified as attributes of the <BODY> tag. The attributes that the <BODY> tag takes are:

**BG Colour:** Changes the default background color to whatever color is specified with this tag. The user can specify a color by name or its equivalent hexadecimal number.

For example, `<body bgcolor="#FF00003 text="#FFFFFF">`

**Background:** Specifies the name of the gif/png/jpg file that will be used as the background of the document. This gif/png/jpg tiles up across the page to give a background.

For example, `<body background="winter.jpg" text="#FFFFFF">`

**Text:** Changes the body text color from its default value to the color specified with this attribute.

**Note:** “winter.jpg” is an image which should be placed in your system.

**Example**

```html
<html>
<head>
<title>
First Page
</title>
</head>
<body>
This is My First Web Page
</body>
</html>
```
Type the above program in Notepad or Editplus.

Save the program.

Open Internet Explorer à File à OpenàChoose BrowseàSelect your fileàClick OK.

Then the output displays as follows.

**Output**

![Output Image]

**Fig 5.1 Document Body**

### 5.3.4 Paragraph Tag (<p>)

The `<p>` tag is responsible for setting a paragraph.

- `<p>` indicates the start of a paragraph.
- `</p>` indicates the end of a paragraph.

The browser will automatically set a blank line above and below the paragraph.

**Example**

```html
<html>
<head>
<title>Paragraph Example</title>
</head>
<body>
  Paragraph Example
</body>
</html>
```
5.3.5 Formatting Tags

Formatting tags are used to change the format of text displayed on a webpage, e.g., to change the text in bold, italic etc.

The tags listed in the table below can be used to change the format of text. Remember to include the closing tags at the end of the formatted text.

Example

```html
<html>
<head>
<title>
</title>
</head>
<body>
<p>This is First Paragraph</p>
<p>This is Second Paragraph</p>
</body>
</html>
```
Formatting Tag Example

```html
<title></title>
</head>
<body>
  <p><b>Computer</b> is an electronic device which accepts <i>input</i> from <em>input devices</em>, <u>process the information</u> and <strong>displays output on output device</strong>.</p>
  <p>Solve the equation $(x-2)^2+(x+2)^2$</p>
  <p>$H_{2}O$</p>
  <p><strike>My Name in Strike Through</strike></p>
  <p><small>Small Text</small></p>
  <p><big>Big Text</big></p>
</body>
</html>

<table>
<thead>
<tr>
<th>Tag</th>
<th>Function</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;b&gt;</td>
<td>bold text</td>
<td>&lt;i&gt;This is bold.&lt;/i&gt;</td>
</tr>
<tr>
<td>&lt;big&gt;</td>
<td>big text</td>
<td>I am big</td>
</tr>
<tr>
<td>&lt;del&gt;</td>
<td>deleted text</td>
<td></td>
</tr>
<tr>
<td>&lt;em&gt;</td>
<td>emphasized text</td>
<td>This is emphasized text</td>
</tr>
<tr>
<td>&lt;i&gt;</td>
<td>italic text</td>
<td>This is italic</td>
</tr>
<tr>
<td>&lt;ins&gt;</td>
<td>inserted text</td>
<td>inserted text</td>
</tr>
<tr>
<td>&lt;small&gt;</td>
<td>small text</td>
<td>I am small</td>
</tr>
<tr>
<td>&lt;strong&gt;</td>
<td>strong text</td>
<td>&lt;i&gt;I am strong!&lt;/i&gt;</td>
</tr>
<tr>
<td>&lt;sub&gt;</td>
<td>subscript</td>
<td>$Text_{\text{subscript}}$</td>
</tr>
<tr>
<td>&lt;sup&gt;</td>
<td>superscript</td>
<td>$Text^{\text{superscript}}$</td>
</tr>
<tr>
<td>&lt;u&gt;</td>
<td>underlined text</td>
<td>This is underlined text</td>
</tr>
<tr>
<td>&lt;strike&gt;</td>
<td>Element displayed with strike through</td>
<td>Strike through</td>
</tr>
</tbody>
</table>
Output

![Fig 5.3 Formatting Tag](image)

### 5.3.6 Font Tags

The tag is used for text Styling. The Tag contains various attributes like face, color and size. The color attribute indicates the color of the text, size attribute indicates the size of the text being formatted. If you want to change the size of the text larger then set size="+x". If you want to change the size of the text smaller then set size="-x", where x represents the number of font point sizes. The attribute face refers to the type of font.

**Example**

```html
<html>
<head>
<title>
Font Tag Example
</title>
</head>
<body>
</body>
```
<font color="red" size="+10" face="Algerian">The printed text is in red color, 10 point size and also Algerian style font. </font>

</body>

</html>

Output

![The printed text is in red color, 10 point size and also Algerian style font.](image)

5.3.7 Headers

These are also formatting tags to vary the text size. There are six header tags H1 through H6. <h1> defines the most important heading. <h6> defines the least important heading.

Example

<html>
<head>
<title>
Header Tag Example
</title>
</head>
<body>
</body>
</html>
5.4 Tags for Images and tables

5.4.1 Image Tag

The image tag is used to place an image on the web page. The tag contains the attributes like src, width, height, align, alt, border, vspace and hspace.

- The attribute `src` means `source` and tells the browser where the image file is.
• The attributes height and width specifies the size of the image.

• The attribute align specifies the position of the image i.e., left, right, top, middle, bottom, absmiddle, absbottom, baseline, texttop.

• The alt attribute provides alternative information for an image if a user for some reason cannot view it.

• You can create space between the image and surrounding text by defining vspace(vertical spacing) and hspace(horizontal spacing).

• The border attribute places a border around the image.

Example

```html
<html>
<head>
<title>
Image Tag Example
</title>
</head>
<body>

<img src="f:\flower.JPEG" border="5" width=""200" height=""200"
alt="Browser not supported" hspace="100" vspace="100">

</body>
</html>
```

Output

![Image Tag Example](f:\flower.JPEG)

Fig 5.6 Image Tag
5.4.2 Table Tag

The `<table>` tag defines an HTML table. An HTML table consists of the `<table>` element and one or more `<tr>`, `<th>`, and `<td>` elements. The `<tr>` element defines a table row, the `<th>` element defines a table header, and the `<td>` element defines a table cell. The attributes used in `<table>` tag are “align=left,center or right”, border and bgcolor. The attributes used in `<tr>` tag are “align=left,center or right”, colspan and rowspan. For example, `<td colspan=2>` will take up two columns and `<td rowspan=2>` will take up two rows.

Example

```html
<html>
<head>
<title>
Tabel tag example
</title>
</head>
<body>
<table bgcolor="#cc00bb" border="5" align="center">
<tr><th>Sl.No.</th><th>V egetables</th><th> Fruits</th></tr>
<tr><td>     1.   </td><td>Brinjal</td><td>Orange</td></tr>
<tr><td>     2.    </td><td>Potato</td><td>Apple</td></tr>
</table>
</body>
</html>
```
5.5 Creating lists and frames

5.5.1 Creation of lists

There are three types of lists in HTML

• Ordered Lists

  These are sometimes called numbered lists, and list items that have a specific numerical order or ranking.

• Unordered Lists

  These are sometimes called bulleted lists, because they have small bullet icons in front of the list items. They are for lists that don’t have a required order.

• Definition Lists

  These are lists of items that have two parts, a term to be defined and the definition.

5.5.1 (a) HTML - Unordered Lists

An unordered list (<ul>) signifies to a web browser that all list items contained inside the <ul> tag should be rendered with a bullet preceding the
text. The default bullet type for most web browsers is a full disc (black circle), but this can be adjusted using an HTML attribute called type. To render a list with a different bullet type, add a type attribute to the unordered list element.

```html
<ul type="square">
    <ul type="disc">
        <ul type="circle">
            For example,
            <ul>
                <li>Milk</li>
                <li>Toilet Paper</li>
                <li>Cereal</li>
                <li>Bread</li>
            </ul>
        </ul>
    </ul>
</ul>
```

5.5.1 (b) HTML – Ordered Lists

An ordered list is defined using the `<ol>` tag, and list items placed inside of an ordered list are preceded with numbers instead of bullets. The numbering of an HTML list can be changed to letters or Roman Numerals by once again adjusting the type attribute.

```html
<ol type="a">
    <ol type="A">
        <ol type="i">
            <ol type="I">
                For Example,
                <ol>
                    <li>Find a Job</li>
                    <li>Get Money</li>
                    <li>Move Out</li>
                </ol>
            </ol>
        </ol>
    </ol>
</ol>
```
The start attribute allows you to further customize an HTML ordered list by setting a new starting digit for the ordered list element.

```html
<ol start="4">
    <li>Buy Food</li>
    <li>Enroll in College</li>
    <li>Get a Degree</li>
</ol>
```

### 5.5.1 (c) HTML - Definition Term Lists

HTML definition lists (`<dl>`) are list elements that have a unique array of tags and elements; the resulting listings are similar to those you’d see in a dictionary.

```html
<dl>
    <dt><b>Computer</b></dt>
    <dd>It is an Electronic Device.</dd>
    <dt><b>Maruthi</b></dt>
    <dd>It is one type of car Model.</dd>
</dl>
```

#### For Example

```html
<html>
<head>
<title>Lists Example</title>
</head>
```

#### Example
<body>
<h1>Unorder list example</h1>
<ul>
<li>Milk</li>
<li>Toilet Paper</li>
<li>Cereal</li>
<li>Bread</li>
</ul>
<h1>Ordered List Example</h1>
<ol>
<li>Find a Job</li>
<li>Get Money</li>
<li>Move Out</li>
</ol>
<h1>Definition List Example</h1>
<dl>
<dt><b>Computer</b></dt>
<dd>It is an Electronic Device.</dd>
<dt><b>Maruthi</b></dt>
<dd>It is one type of car Model.</dd>
</dl>
</body>
<html>
5.5.2 Creation of Frames

Framed Layout is used to broken the browser window into multiple regions called frames. Each frame can contain different HTML documents. The `<frameset>` tag is a container for frames and replaces the body tag and `<frame>` tag is used to place the contents into the frame.

The attributes used in the `<frameset>` tag are rows or cols. If the window is to be divided into horizontal stripes then the row attribute should be used. If the window is to be divided into vertical stripes then the cols attribute should be used.

For Example, if you want to divide the browser window into two rows then you must specify like `<frameset rows="30%,70%">`.

`<frame>` sets a single frame in the framed page. `<frame>` always goes inside a `<frameset>` element. The src attribute, which is required, indicates the URL of the page that goes in the frame. In most situations you should also use name to give the frame a name so that links can target the frame.

Example

```html
<html>
<head>
```

Frames Examples

<frameset rows="40%,*">
  <frame src="frame1.html">
  <frame src="frame2.html">
</frameset>
</html>

Frame1.html

<html>
<head>
<title>frame1</title>
</head>
<body>
<marquee><h1>Computer Science & Engineering</h1></marquee>
</body>
</html>

Frame2.html

<html>
<head>
<title>frame2</title>
</head>
<body>
<marquee><h1>Computer Science & Engineering</h1></marquee>
</body>
</html>
5.6. Creating HyperLinks

5.6.1. External Linking

The most important capability of the HTML is the ability to create hyperlinks to documents and thereby make the world wide web as a collection of linked documents. The links are created using anchor `<a>` tag. This element requires an attribute to mark the location of the object to get linked. The address of the object is specified using `href` attribute. The `href` attribute of the tag tells the browser to get another html document on the web.

Example

```html
<html>
<head>
<title>
anchor tag example
</title>
</head>
<body>
<a href="http:\www.yahoo.com">YAHOO</a>
</body>
</html>
```
<br>
<a href="http:\www.google.com">GOOGLE</a><br>
<br>
<a href="fonts.html">font example</a>
</body>
</html>

Fonts.html

<html>
<head>
<title>
Font Tag Example
</title>
</head>
<body>

<font color="red" size="10" face="Algerian">The printed text is in red color, 10 point size and also Algerian style font. </font>
</body>
</html>

Output

![Creating Hyperlink](image)

Fig 5.10 Creating Hyperlink
5.6.2 Internal Linking

HTML has facilities to include internal links also by assigning a location name to any individual point in an HTML document. This location name can then be added to the page’s URL. For internal linking also, the anchor tag is used.

   <a name="name"></a>

To refer to the location use

   <a href="#name">text</a>

Example

   <html>
   <head>
   <title> Internal Linking Example </title>
   </head>
   <body>
   <p><a href="#heading1">Link to heading 1</a></p>
   <p><a href="#heading2">Link to heading 2</a></p>
   <h1 id="heading1">heading 1</h1>
   <p>Text text text text</p>
   <h1 id="heading2">heading 2</h1>
   <p>Text text text text</p>
   </body>
   </html>
5.7 Tags to create forms and form objects.

A form is simply an area that can contain form fields. Form fields are objects that allow the visitor to enter information - for example text boxes, drop-down menus or radio buttons. When the visitor clicks a submit button, the content of the form is usually sent to a program that runs on the server.

HTML web forms are a composition of buttons, checkboxes, and text input fields embedded inside of HTML documents with one goal in mind: to capture user input. By doing things such as providing fields for user data such as names, phone number, and email addresses, web forms give users the opportunity to interact directly with a webpage.

5.7.1 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.

5.7.2 Text Fields

Text fields are one line areas that allow the user to input text.

Syntax: <input type="text">

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

How the HTML code above looks in a browser:
First name: 
Last name: 

5.7.3 Password Field

Password fields are similar to text fields. The difference is that what is entered into a password field shows up as dots on the screen. This is, of course, to prevent others from reading the password on the screen.

Syntax: <input type="password">

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

How the HTML code above looks in a browser:
Password: 

5.7.4 Radio Buttons

Radio buttons are used when you want to let the visitor select one - and just one - option from a set of alternatives. If more options are to be allowed at the same time you should use check boxes instead.

Syntax:<input type="radio">

<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
5.7.5. Checkboxes

Check boxes are used when you want to let the visitor select one or more options from a set of alternatives. If only one option is to be selected at a time you should use radio buttons instead.

Syntax: `<input type="checkbox">`

<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

5.7.6 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.

Syntax: `<input type="submit">`

<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: [ ]

If you type some characters in the text field above, and click the “Submit” button, the browser will send your input to a page called “html_form_action.asp”. The page will show you the received input.

5.7.7. Reset Button

When a visitor clicks a reset button, the entries are reset to the default values.
Syntax: `<input type="reset">`

`<form>`

Username: `<input type="text" name="user">`
`<input type="reset" value="Reset">`
`</form>`

How the HTML code above looks in a browser:

Username: 

Example

`<html>`
`<head>`
`<title>`

Form tag example
`</title>`
`</head>`
`<body>`
`<form>`

Username: `<input type="text" name="user">`<br>
Password: `<input type="password" name="pwd">`<br>
Gender:
`<input type="radio" name="sex" value="male">Male`<br>`<input type="radio" name="sex" value="female">Female`<br>
Hobbies:
`<input type="checkbox" name="hobbies">Playing Cricket`<br>`<input type="checkbox" name="hobbies">Reading Books`<br>`<input type="checkbox" name="hobbies">Watching T.V.>`

Bottom of Form

`<input type="submit" value="Submit">`
Output

Fig 5.12 Tags to Create forms and form objects

Summary

- “HTML” means “HyperText Markup Language”.
- HTML is the markup language that’s used to create web pages. It simply describes a web page’s content and its structure.
- An HTML element starts with a start tag / opening tag.
- An HTML element ends with an end tag / closing tag.
- Each element may have a list of attributes which define the properties of the element. Element attributes are placed within the opening tag of the element.
- The entire web page is enclosed within <HTML></HTML> tags. Within these tags two separate sections are created using the <HEAD></HEAD> tags and the <BODY></BODY> tags.
- The <p> tag is responsible for setting a paragraph.
• The tag is used for text styling. The tag contains various attributes like face, color and size. The color attribute indicates the color of the text, size attribute indicates the size of the text being formatted.

• There are six header tags H1 through H6.

• The image tag is used to place an image on the web page.

• The <table> tag defines an HTML table. An HTML table consists of the <table> element and one or more <tr>, <th>, and <td> elements. The <tr> element defines a table row, the <th> element defines a table header, and the <td> element defines a table cell.

• Formatting tags are used to change the format of text displayed on a webpage e.g., to change the text in bold, italic etc.,

• An unordered list (<ul>) signifies to a web browser that all list items contained inside the <ul> tag should be rendered with a bullet preceding the text

• An ordered list is defined using the <ol> tag, and list items placed inside of an ordered list are preceded with numbers instead of bullets.

• HTML definition lists (<dl>) are list elements that have a unique array of tags and elements; the resulting listings are similar to those you’d see in a dictionary.

• Framed Layout is used to broken the browser window into multiple regions called frames.

• The links are created using anchor <a></a> tag.

• A form is simply an area that can contain form fields. Form fields are objects that allow the visitor to enter information.

**Short Answer Type Questions**

1. Define HTML.

2. Write the syntax for Element in HTML.

3. What is the use of Paragraph tag?

4. What are the attributes used in Font tag?

5. Write any three advantages of HTML.

6. Write different header tags available in HTML.

7. What is a hyperlink?
8. Write different HTML tags.
9. What is a frame?

**Long Answer Type Questions**

1. Write the structure of an HTML Program.
2. Write various advantages and disadvantages of HTML.
3. Explain different formatting tags available in HTML.
4. Explain the purpose of Image tag and write the attributes used in image tag.
5. Explain `<table>` with an example.
6. Define a list. Explain various types of lists used in HTML.
7. How the frames can be created in HTML.
8. Explain the concept of Internal Linking.
9. Explain the concept of External Linking.
10. Define form. Explain various form objects used in HTML.
Structure

6.1 Introduction to DHTML
6.2 Components of DHTML
6.3 Events – Mouse Events
6.4 Layer Tag in DHTML
6.5 The style Object of IE
6.6 Dynamic Contents of IE4
6.7 Introduction to CSS

Learning Objectives

After studying this unit, the student will be able to

- Uses of DHTML
- Disadvantages of DHTML
- Learn about DOM
- Differences between HTML & DHTML
- Various components of DHTML
- Learn about Scripts
• Understand about various layers in DHTML
• Know about various Mouse Events
• Know about Layer tag and Style Object
• Uses of CSS.

6.1 Introduction to DHTML

DHTML is a way for you to change the way your pages look. You can instantly change the color of a page with the click of the mouse or without the click of a mouse. You can cause things to happen just by moving the mouse around the page. You can also create a slideshow for your site, create an announcement page that moves on to your real site by itself, and make your pages do strange things while loading and more.

Dynamic Hyper Text Markup Language (DHTML) is a combination of Web development technologies used to create dynamically changing websites. Web pages may include animation, dynamic menus and text effects. The technologies used include a combination of HTML, JavaScript or VB Script, CSS and the document object model (DOM).

Advantages

• Dynamic content, which allows the user to dynamically change Web page content
• Dynamic positioning of Web page elements.
• Dynamic style, which allows the user to change the Web page’s color, font, size or content.

Disadvantages

• It can be difficult to develop and debug because of lack of Web browser and technological support.
• DHTML scripts may not work correctly in various Web browsers.
• The Web page layout may not display correctly when it is developed to display in different screen size combinations and in different browsers.

6.1.1 Differences between HTML and DHTML

HTML

1. HTML means Hyper Text Markup Language.
2. It is referred as a static HTML and static in nature.
3. A plain page without any styles and Scripts called as HTML.
4. HTML sites will be slow upon client-side technologies.
5. HTML is error free language.
6. HTML is not interactive and will not respond to the user actions.

DHTML
1. DHTML means Dynamic Hyper Text Markup Language.
2. It is referred as a dynamic HTML and dynamic in nature.
3. A page with HTML, CSS, DOM and Scripts called as DHTML.
4. DHTML sites will be fast enough upon client-side technologies.
5. DHTML is not an error free language.
6. DHTML gives the designers to create visually outstanding HTML documents that directly interact with the user.

6.2 Components of DHTML
DHTML requires four independent components to work. They are HTML, Cascading Style Sheets, Scripting and the Document Object Model.

6.2.1 HTML
HTML defines the structure of a Web page, using such basic elements as headings, forms, tables, paragraphs and links. On December 18, 1997, HTML 4.0 attained “recommended” status at the W3C. Changes and enhancements introduced in HTML 4.0 made DHTML possible. For more information refer UNIT V.

6.2.2 CSS
Similar to a template in a word-processing document, a style sheet controls the formatting of HTML elements. Like in traditional desktop publishing, one can use style sheet to specify page margins, point sizes and leading. Cascading Style Sheets is a method to determine precedence and to resolve conflicts when multiple styles are used.

6.2.3 Scripting
Scripting provides the mechanisms to interpret user actions and produce client-side changes to a page. For example, scripts can interpret mouse actions (such as the mouse passing over a specified area of a page through the event model) and respond to the action by using a set of predefined instructions (such
as highlighting the text activated by the mouse action). Although DHTML can communicate with several scripting languages, JavaScript is the de facto standard for creating cross-browser DHTML pages.

**Ascripting language is characterized by the following properties**

- **Ease of use.** Scripting languages are intended to be very fast to pick up and author programs in. This generally implies relatively simple syntax and semantics.

- **OS facilities - especially file system and related, built in with easy interfaces.** Scripting is usually aimed at desktops, limiting the portability needs of the pre-built libraries.

- **Interpreted from source code - to give the fastest turnaround from script to execution.** On a desktop, the performance of even a slow interpreter is often non-problematic. In comparison, non-scripting languages intended for large programs are often precompiled in at least some sense for superior performance.

- **Relatively loose structure.** It would be difficult to use Java as a scripting language due to the rules about which classes exist in which files - contrast to Python, where it’s possible to simply define some functions in a file.

### 6.2.4 DOM

The DOM outlines Web page content in a way that makes it possible for HTML elements, style sheets and scripting languages to interact with each other. The W3C defines the DOM as “a platform- and language-neutral interface that will allow programs and scripts to dynamically access and update the content, structure, and style of documents. The document can be further processed and the results of that processing can be incorporated back into the presented stage.”

The name “Document Object Model” was chosen because it is an “object model” in the traditional object oriented design sense: documents are modeled using objects, and the model encompasses not only the structure of a document, but also the behavior of a document and the objects of which it is composed. In other words, the nodes in the above diagram do not represent a data structure; they represent objects, which have functions and identity.

- **The interfaces and objects used to represent and manipulate a document.**
- **The semantics of these interfaces and objects - including both behavior and attributes.**
- **The relationships and collaborations among these interfaces and objects.**
The structure of SGML documents has traditionally been represented by an abstract data model, not by an object model. In an abstract data model, the model is centered around the data. In object oriented programming languages, the data itself is encapsulated in objects that hide the data, protecting it from direct external manipulation. The functions associated with these objects determine how the objects may be manipulated, and they are part of the object model.

### 6.3 Events – Mouse Events

Dynamic HTML allows to create really interactive web-pages. It becomes possible using events in HTML. HTML can process events from keyboard and mouse, and also some specific events, for example, occurring where form’s data was changed. For processing of events data you may use JavaScript or VBScript.

Events are generated by the browser when the user clicks an element, when the page loads, when a form is submitted, etc. An event handler allows you to execute code when an event occurs. These event handlers allow executing specific script code in response to user or system initiated actions. Most events relate to the browser GUI, such as mouse movements, button or key clicks and updates to form inputs. The DOM provides methods for capturing events so that you can perform your own actions in response to them. It also provides an event object which contains information specific to a given event that can be used by an event processing code.

**For example**

```html
<h1 onclick="style.color='red'">Click on this text</h1>
```

In the above line onclick is an event. Whenever we click on the text enclosed with in the header will be changed as red color. This is called as event handling.

If you want to see the output for above event handling, first open notepad and type the following program and save the file with an extension .html. Writing the program in HTML and DHTML is same and the file extension is also same.

**Program**

```html
<html>
<head>
<title>
</title>
</head>
</html>
```
Event Handling

```html
<h1 onclick="style.color='red'">Click on this text</h1>
```

Output

![Fig 6.1](image1)

After clicking the text displayed on the webpage it turns into red color like as follows.

![Fig 6.2](image2)
6.3.1 Mouse Events

A change in the state of a mouse, such as a button being pressed or the mouse being moved is called Mouse Event.

- **onmousedown**: Occurs where mouse button is pressed.
- **onmousemove**: Occurs where mouse points moves above an element.
- **onmouseup**: Occurs where mouse button is released.
- **onmouseout**: Occurs when mouse pointer moves out of an element.
- **onclick**: Occurs on a mouse click.
- **onmousemove**: Occurs on a mouse double click.

**Example program for MouseDown and MouseUp event.**

```html
<html>
<head>
<title>Mouse UP and DOWN events</title>
</head>
<body>
<h1 id="text" onMousedown="text.style.color='blue'" onMouseup="text.style.color='red'" when mouse pressed it will in blue color and when mouse released it will in red color">when mouse pressed it will in blue color and when mouse released it will in red color</h1>
</body>
</html>
```
Output

If you place the cursor on the text and press the mouse button it will turn into blue color and the output is as follows.

Fig 6.3

Fig 6.4
After pressing the button you should release the mouse button then the entire text will turn into red color and the output looks like.

![Example program for MouseOver and MouseOut events](image)

Output

Example program for MouseOver and MouseOut events.

```html
<html>
<head>
<title>
MouseOver and MouseOut Events.
</title>
</head>
<body>
<h1 id="text" onMouseover="text.style.color='brown'" onMouseout="text.style.color='Yellow'">when mouse moves on it, it will in brown color and when mouse move out, it will in Yellow color</h1>
</body>
</html>
```

When mouse moves on the text then it will turn into brown color like as follows.
When mouse come out from the text it will turn into yellow color like as follows.

Example program for onclick and ondblclick events.

```html
<html>
<head>
<title>
</title>
</head>
</html>
```
Mouse Click and Double Click Events.

```html
<title></title>
</head>
<body>
<h1 onclick="style.color='pink'">Click me single time</h1>
<h1 ondblclick="style.color='green'">Click me double time</h1>
</body>
</html>

Output

![Image of a web page with 'Click me single time' and 'Click me double time' buttons, one in pink and one in green color]

When you click on the text “Click me single time” then the text will turn into pink color.
When you click on the text “Click me double time” then the text will turn into green color.
6.4 Layer Tag in DHTML

The <layer> tag is used to position and animate (through scripting) elements in a page. A layer can be thought of as a separate document that resides on top of the main one, all existing within one window. This new tag is dynamic in that it can be positioned anywhere on a web page (without relation to other content), moved around, its content inside updated on demand, and more.

The basic syntax of the <layer> tag is as

```html
<layer>Text inside layer</layer>
```

The tag is a content tag, which means you can add into it content (like ). The text inside the layer floats above other text, and overlaps them. Imagine a layer as a sheet of paper that resides on top of the rest of the page, and does not take up space within the flow of the document.

6.4.1 Layer attributes

A layer by itself can’t be more boring, not to mention useless. Fortunately, there’s more to it. Layers support attributes that allow you to position it using the x,y coordinates-system, give it a background, clip it (make only certain area of the layer visible), hide it from view, and so on. I’ve listed the most important layer attributes below.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>The name of the layer, used to identify it in your script</td>
</tr>
<tr>
<td>left</td>
<td>The position of the layer in relationship to the x coordinates</td>
</tr>
<tr>
<td>top</td>
<td>The position of the layer in relationship to the y coordinates</td>
</tr>
<tr>
<td>width</td>
<td>The width of the layer, in px or %</td>
</tr>
<tr>
<td>height</td>
<td>The height of the layer, in px or %</td>
</tr>
<tr>
<td>bgColor</td>
<td>The background color of the layer</td>
</tr>
<tr>
<td>background</td>
<td>The background image of the layer</td>
</tr>
<tr>
<td>src</td>
<td>The external html document contained inside the layer</td>
</tr>
</tbody>
</table>

Here is a sample layer that uses some of the above attributes

```html
<layer id="mylayer" width=100px height=70px bgColor="yellow"><h3>A layer</h3></layer>
```
**Program**

```html
<html>
<head>
<title>
Layer Example
</title>
</head>
<body>
<layer>
<layer left=2 top=2>
<h1><font color=gray>AYER1</font></h1>
</layer>
<layer left=0 top=0>
<h1>AYER2</h1>
</layer>
</layer>
</body>
</html>
```

**Output**

![Output Figure 6.11](image)

Fig 6.11
6.5 The style Object of IE

HTML elements in IE 4 now all support a style object, which is essentially the “dynamic” object used to manipulate the look and “feel” of that element. Like the <layer> tag, elements can also be assigned an “id” attribute, which can then be used to identify it during scripting. For example

```html
<div id="adiv">
```

In your script, the syntax required to access the style object of “adiv” would look like this adiv.style

The style object contains many properties, and by manipulating these properties, you can alter the look of an element, dynamically. I’ll show some of these properties now.

**Important properties of the style object**

- **backgroundColor**: The background color of the element
- **backgroundImage**: The background image of the element
- **color**: The color of the element
- **position**: The position type of the element. Accepted values are “absolute” and relative
- **pixelWidth**: The width of the element
- **pixelHeight**: The height of the element
- **pixelLeft**: The position of the element in relation to the x coordinates
- **pixelTop**: The position of the element in relation to the y coordinates

The properties above only represent a subset of the total supported properties, but are the most commonly used ones. By accessing these properties, we can change the look and style of most HTML elements.

**Program**

```html
<html>
<head>
<title>
Layer Example
</title>
</head>
</html>
```
Output

![Fig 6.12](image1)

When the mouse moves over the text then the color changed in red color and the output look likes.

![Fig 6.13](image2)
By using color property of style object you can change the color of the text. Here “sometext” is the id of the “move your mouse here” text. So the line `sometext.style.color='red'` will change the color of the text into red.

### 6.6 Dynamic Contents of IE4

Before Microsoft Internet Explorer 4.0, once a Web page was loaded into a user’s browser, changing the information displayed on the page required another round-trip to the server. The user interacted with the page (submitted a form, or clicked a link to another page), and the server delivered a new page to the client. Any customization of the information (such as building the page on the fly from a template) required that the server spend additional time processing a page request. Furthermore, the only way to maintain the context for the page’s content was to use frame sets, where one frame’s content stays constant and another frame changes its content based on the user’s activity on the initial page.

Dynamic content is all about changing the content of the HTML document—inserting and deleting elements or the contents of an element before or after the document has been loaded.

**Here are the dynamic content properties of IE**

<table>
<thead>
<tr>
<th>Dynamic content properties of IE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>innerText</strong></td>
</tr>
<tr>
<td><strong>outerText</strong></td>
</tr>
<tr>
<td><strong>innerHTML</strong></td>
</tr>
<tr>
<td><strong>outerHTML</strong></td>
</tr>
</tbody>
</table>

If you’ve never seen the above four properties before, distinguishing between them can undoubtedly become confusing. Here’s a diagram with a sample HTML content `<div id="test">`, and the reach each of the four properties hold over it.

```
<innerHTML>
  <div id="test"><b>This is a sample HTML content</b></div>
</innerHTML>

innerText

outerText/outerHTML
```
Both innerText and innerHTML represent what’s contained inside the element, though the later includes its HTML makeup as well. The outer properties operate in the same manner, except that their range covers the element itself, or replace that list with a list of links to the actual sections in the document.

Consider another example,

```html
<div id="myDiv">This is a division element that contains some <span style="color: red">red text</span></div>
```

By comparing with above diagram, the inner text is “This is a division element that contains some red text”.

The inner html is “This is a division element that contains some <span style="color: red">red text</span>”.

The outer html is “div id="myDiv">This is a division element that contains some <span style="color: red">red text</span></div>”.

### 6.7 Introduction to CSS

CSS stands for Cascading Style Sheets. It is a way to divide the content from the layout on web pages. A CSS (cascading style sheet) file allows you to separate your web site’s HTML content from its style. As always you use your HTML file to arrange the content, but all of the presentation (fonts, colors, background, borders, text formatting, link effects & so on...) are accomplished within a CSS.

**With CSS, you will be able to**

- Define the look of your pages in one place rather than repeating yourself over and over again throughout your site. (Ever get tired of defining colors and fonts each time you start a new cell in a table? Those days are over with CSS!)

- Easily change the look of your pages even after they’re created. Since the styles are defined in one place you can change the look of the entire site at once. (Ever get tired of replacing tags throughout your site when you want to change the look of a certain element? Those days are over with CSS!)

- Define font sizes and similar attributes with the same accuracy as you have with a word processor - not being limited to just the seven different font sizes defined in HTML.

- Position the content of your pages with pixel precision.

- Redefine entire HTML tags. Say for example, if you wanted the bold tag to be red using a special font - this can be done easily with CSS.
• Define customized styles for links - such as getting rid of the underline.
• Define layers that can be positioned on top of each other (often used for menus that pop up).

The one disadvantage is
• These will only work on version 4 browsers or newer. However, more than 95% of all browsers live up to that.

6.7.1 CSS Selectors

Selectors are the names that you give to your different styles. In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles.

Program

```html
<HTML>
<HEAD>
<style type="text/css">
b.headline
{
    color:red;
    font-size:22px;
    font-family:arial;
    text-decoration:underline
}
</style>
</HEAD>
<BODY>
<b>This is normal bold</b><br>
<b class="headline">This is headline style bold</b>
</BODY>
</HTML>
```
In the above program, there are two bold tags, but we have to apply the style to second bold tag only. So we give an id to second bold tag as “headline”. Headline is an object of bold tag. We can use like b.headline and the properties assigned to it are

- **Color**: red;
- **Font-size**: 22px;
- **Font-family**: arial;
- **Text-decoration**: underline

If you observe the output, the first line of bold tag is printed as it is and the second line of bold tag text is printed with the above properties like the color of the text is changed to red, size of the text is changed to 22px, font is changed to arial type and underline applied to the text.

### 6.7.2 Types of Style Sheets

There are three types of style sheets known as

- **Internal or Embedded**: Placed right on the page whose interface it will affect.
- **External**: Placed in a separate file.
- **Inline**: Placed inside a tag it will affect.
6.7.2.1 Internal or Embedded Style Sheet

Use an internal stylesheet when you want an HTML document to have a unique style. An internal stylesheet is defined using the <style> tag and goes in the head section of an HTML document.

The <style> tag specifies the content type of a stylesheet with its type attribute which should be set to “text/css”. In internal style sheet once if you specify the style property to any tag then it will apply to all the tags defined with in the body section

Syntax:

```
<style type="text/css">
styles go here
</style>
```

Program

```
<html>
<head>
<style type="text/css">
    p {
        color: green
    }
</style>
</head>
<body>
    <p>The text in this paragraph will be green. </p>
    <p>This paragraph too. </p>
</body>
</html>
```
6.7.2.2 External Style Sheet

Use an external stylesheet when you want to apply one style to many pages. If you make one change in an external stylesheet, the change is universal on all the pages where the stylesheet is used.

An external stylesheet is declared in an external file with a .css extension. It is called by pages whose interface it will affect. External stylesheets are called using the <link> tag which should be placed in the head section of an HTML document. This tag takes three attributes.

Attributes of the <link> tag:

- **Rel** - When using an external stylesheet on a webpage, this attribute takes the value “stylesheet”
- **Type** - When using an external stylesheet on a webpage, this attribute takes the value “text/css”
- **Href** - Denotes the name and location of the external stylesheet to be used.

In external style sheet, you have to create two files one is for specifying styles to the tags and other is the file where you want to apply the above styles. First program will be typed in a notepad and give an extension .html and the second program will be typed in notepad and give and extension .css and then run the html program you will get the output.
Program

```html
<html>
<head>
<link rel="stylesheet" type="text/css" href="style1.css" />
</head>
<body>
<p>
The text in this paragraph will be blue.
</p>
</body>
</html>
```

**style1.css**

```css
p { color:blue }
```

Output

![Output](image)

**6.7.2.3 Inline Style Sheet**

Use inline stylesheets when you want to apply a style to a single occurrence of an element. Inline stylesheets are declared within individual tags and affect those tags only. Inline stylesheets are declared with the `style` attribute.
Program
<html>
<head>
</head>
<body>
<p style="color:red"> The text in this paragraph will be red</p>
<p style="color:green"> The text in this paragraph will be green</p>
</body>
</html>

Output

![HTML Output](image)

Fig 6.17

Summary

- Dynamic Hyper Text Markup Language (DHTML) is a combination of Web development technologies used to create dynamically changing websites. Web pages may include animation, dynamic menus and text effects.
- It can be difficult to develop and debug because of lack of Web browser and technological support.
- HTML is referred as a static HTML and static in nature
• DHTML is referred as a dynamic HTML and dynamic in nature.

• DHTML requires four independent components to work. They are HTML, Cascading Style Sheets, Scripting and the Document Object Model.

• HTML defines the structure of a Web page, using such basic elements as headings, forms, tables, paragraphs and links.

• A style sheet controls the formatting of HTML elements.

• Scripting provides the mechanisms to interpret user actions and produce client-side changes to a page. Although DHTML can communicate with several scripting languages like JavaScript, VBScript etc.,

• The name “Document Object Model” was chosen because it is an “object model” in the traditional object oriented design sense: documents are modeled using objects, and the model encompasses not only the structure of a document.

• Events are generated by the browser when the user clicks an element, when the page loads, when a form is submitted, etc.

• An event handler allows you to execute code when an event occurs. These event handlers allow executing specific script code in response to user or system initiated actions.

• A change in the state of a mouse, such as a button being pressed or the mouse being moved is called Mouse Event.

• There are several mouse events used like

  - `onmousedown` - Occurs where mouse button is pressed.

  - `onmousemove` - Occurs where mouse points moves above an element.

  - `onmouseup` - Occurs where mouse button is released.

  - `onmouseout` - Occurs when mouse pointer moves out of an element

  - `onclick` - Occurs on a mouse click

  - `ondblclick` - Occurs on a mouse double click

• The `<layer>` tag is used to position and animate (through scripting) elements in a page. A layer can be thought of as a separate document that resides on top of the main one, all existing within one window.

• The style object contains many properties, and by manipulating these properties, you can alter the look of an element, dynamically.
• A CSS (cascading style sheet) file allows you to separate your web sites HTML content from its style.

• Selectors are the names that you give to your different styles. In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles.

• There are three types of style sheets known as

  • Internal or Embedded- Placed right on the page whose interface it will affect.
  • External - Placed in a separate file.
  • Inline - Placed inside a tag it will affect.

**Short Answer Type Questions**

1. Define DHTML. List out the components of DHTML.
2. Write any three differences between HTML and DHTML.
3. Write the advantages and disadvantages of DHTML.
4. Define Event and Event Handling.
5. Define DOM.
6. What are the advantages of CSS?
7. What are the attributes of a Layer Tag?

**Long Answer Type Questions**

1. Explain about DOM in DHTML.
2. Write the differences between HTML and DHTML.
3. Write a program for event handling.
4. Explain about Layer Tag.
5. Explain various mouse events in DHTML.
6. Write advantages and disadvantages of CSS.
7. Explain about CSS selector.
8. Write about Inline Style Sheet.
9. Write about External Style Sheet.
10. Write about Internal Style Sheet.