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10 Communication and Network Concepts

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10.1 INTRODUCTION

In the history of mankind, networking in any form has always given better results, better outcomes and better utilization of resources. For instance, you always have benefitted from *human networks e.g.*, you want to buy a certain book, which is not available at the bookshop near you. But your friend, who lives in a different part of the city, says he can buy it for you as this book is available in the bookshop near his house. You happily agree to this and the next day in school, he hands over the book to you and you pay to him the book-price. Both are happy–he is happy to help ; you are happy to get the book and to have a helping friend. :). See, networking is so useful ; in fact, networking is useful in all forms – computer networking is no exception. Connections among humans make human network and connections among computers make **computer networks**.

In this chapter, we shall talk about the basics of computer networks, their structures, types, devices, protocols etc.

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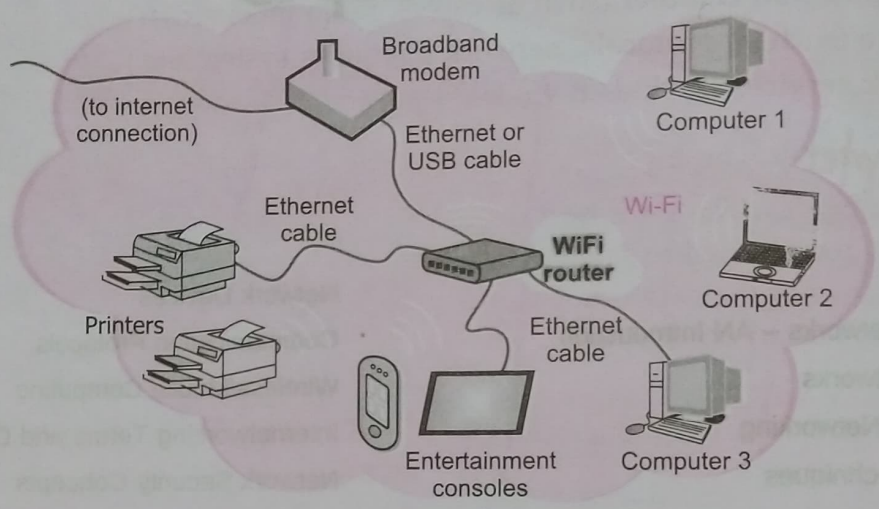
10.2 COMPUTER NETWORKS – AN INTRODUCTION

Two or more autonomous[1] **computing devices** connected to one another in order to exchange information or share resources, form a **computer network**. For example, if in your home, you can connect your *smartphone*, your *laptop* with your *smart TV*, *gaming console* and a *printer* simultaneously either using cables or through WiFi, it will be termed as a **Computer Network**.

COMPUTER NETWORK

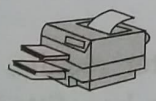
A **computer network** is a collection of interconnected autonomous computing devices so as to exchange information or share resources.

Figure 10.1 shows a sample computer network.



Advantages of Networks

★ **Share resources :** such as printers and scanners. This is cheaper than buying equipment for each computer.



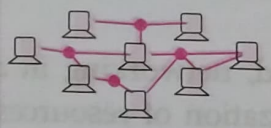
★ **Share storage** – being able to access files from any machines on the network can share data.

★ **Can share software :** Software can be installed centrally rather than on each machine. Metering software can then be used to limit the number of copies being run at any one time. This is much cheaper than buying licenses for every machine.

★ **Improve communications** Messages can be sent - *e.g.*, internal email

Disadvantages of Networks

★ The systems are more sophisticated and **complex** to run. This can add to **costs** and you may need specialist staff to run the network.



★ If networks are badly managed, services can become unusable and productivity falls.

★ If software and files are held centrally, it may be impossible to carry out any work if the central server fails. People become reliant on the communications, if these fail, it can cause havoc.

★ File security is more important especially if connected to WANs *e.g.*, protection from viruses.

Figure 10.1 (*a*) A sample computer network. (*b*) Advantages and disadvantages of computer networks.

Computer networks are very useful in many ways. They facilitate **resource sharing** (resources such as storage, software etc. on the network can be shared), **enhanced communication** (communicating with devices on a network is easier), **cost reduction** (resource sharing cuts on costs) and so forth. Figure 10.1(*b*) shows some advantages and disadvantages of computer networks.

NOTE

Please note that now onwards, we shall use the terms 'computer network' and 'network' interchangeably.

1. It means that no computing device on a network can start, stop or control other device(s).

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10.2.1 Components of a Computer Network

Merely by joining two computers with a cable won't form a network. In fact, there are many components that together make a network. We are briefly discussing below, the major components of a computer network.

Major components of a Computer Networks are :

(*a*) **Hosts/Nodes** (such as PC, laptops, smartphones etc.)
(*b*) **Servers**
(*c*) **Client**
(*d*) **Network hardware** (such as *NIC, router, switch, hub* etc.)
(*e*) **Communication channel** (such as cables, radio-links etc.)
(*f*) **Software** (such as protocols, network operating system etc.)
(*g*) **Network services** (such as BNS, File-sharing etc.).

Let us talk about these, briefly.

(*a*) **Host or Nodes.** The term **host** or **node** refers to the computers that are attached to a network and are seeking to share the resources of the network. Of course, if there were no nodes (also called *workstations*), there would be no network at all.

So your PCs, laptops, smartphones etc. when connect to a network become hosts.

NOTE

A computer becomes a workstation of a network as soon as it is attached to a network.

(*b*) **Server.** A **Server** is a very important computer in a network. A **server** is responsible for making the networking tasks happen. In other words, a server facilitates networking tasks like *sharing of data, resource-sharing, communication among hosts* etc.

SERVER

Server A computer that facilitates the sharing of data, software, and hardware resources (*e.g.*, printers, modems etc.) on the network, is termed as a Server.

On small networks, sometimes, all the shareable stuff (like files, data, software etc.) is stored on the server. A network can have more than one server also. Each server has a unique name on the network and all users of network identify the server by its unique name.

On big networks, there can be servers dedicated to specialized tasks *e.g.*, a **file server** only handles files' related requests ; a **printer server** only handles printing requests and so on.

(*c*) **Clients.** Client is a related term. A client computer is a host computer that requests for some services from a server. In other words, a *server computer* serves the requests of client *computers*.

(*d*) **Network Hardware.** Other than hosts and wiring, a network requires specialized hardware to carry out various roles, such as establishing corrections, controlling network traffic etc. There are many different types of hardware that are required in a network. Some examples of network hardware are :

- **NIC (Network Interface Unit).** It is a network card attached to a host so as to establish network connections. Every NIC card has a unique physical address called the MAC address, which is a 6 byte (48 bits) address assigned by the NIC manufacturer. An NIC is also called Network Interface Unit (NIU) or Terminal Access Point (TAP)
- ***Hub, switch, router.*** These are connectivity devices.
- many others.

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(*e*) **Communication channel.** Hosts in a network interact with other hosts and server(s) through a ***communication channel*** or ***communication medium***. The communication channels can either be **wired** or **wireless** :

- **Wired Communication channels**. When hosts and server(s) are connected with one another through **guided media** like *network cables*, it is called a **wired communication channel/medium**. Examples of wired communication media are : **twisted-pair cables, coaxial cables, firbre-optic cables**.
- **Wireless Communication channels.** When hosts and server(s) are connected with one another through **unguided media** like ***radio waves***, satellite etc., it is called a wireless communication channel/medium. Examples of wireless communication media are : ***Microwaves, radio waves, satellites, infrared waves, laser*** etc.

(*f*) **Software.** The software layers of a network make networking possible. These comprise of network protocols, network operating system etc.

A **protocol** refers to a pre-decided set of rules using which all parties of a network connect and interact with one another.

A **network operating system** is a specialized operating system that can handle networking tasks.

(*g*) **Network Services.** These refer to the applications that provide different functionalities over a network, such as DNS (Domain Name System), File sharing, VoIP (Voice over IP) and many more.

Armed with this basic knowledge of computer networks, let us further our discussion by talking about types of networks.

10.3 TYPES OF NETWORKS

A computer network means a group of 'networked' computers *i.e.*, computers that are linked by means of a communication system. A network can mean a small group of linked computers to a chain of a few hundred computers of different types (*e.g.*, PCs, minis, mainframes etc.) spread around the world. Thus, networks vary in size, complexity and geographical spread.

Let us discuss types of networks based on these parameters.

10.3.1 Types of Networks based on Geographical Spread

Based on network span or geographical spread, networks can be divided into *two* basic types:

(*i*) LAN (Local Area Network)
(*ii*) WAN (Wide Area Network)
(*ii*) PAN (Personal Area Network)
(*iv*) PAN (Metropolitan Area Network)

10.3.1A Local Area Network (LAN)

Small computer networks that are confined to a localised area (*e.g.*, an office, a building or a factory) are known as *Local Area Networks* (LANs). The key purpose of a LAN is to serve its users in resource sharing. The hardware as well as software resources are shared through LANs. For instance, LAN users can share data, information, programs, printers, hard-disks, modems etc. Fig. 10.1(*a*) shows a Local Area Network.

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In a typical LAN configuration, one computer is designated as the **file server**[2]. It stores all of the software that controls the network, as well as the software that can be shared by the computers attached to the network. Computers connected to the server are called workstations. On most LANs, cables are used to connect the ***network interface cards***[3] in each computer.

Figure 10.1(*a*) that you have seen earlier shows a LAN.

NOTE

Traditionally, LANs are said to have geographical spread of upto 1 km.

10.3.1B Wide Area Network (WAN)

The networks spread across countries or on a very big geographical area are known as WANs. A *Wide Area Network* (WAN) is a group of computers that are separated by large distances and tied together. It can even be a group of LANs that are spread across several locations and connected together to look like one big LAN. The WANs link computers to facilitate fast and efficient exchange of information at lesser costs and higher speeds.

Computers connected to a wide-area network are often connected through public networks, such as the telephone system. Sometimes they can be connected through *leased lines*[4] or satellites. The largest WAN in existence is the *Internet*.

Figure 10.2 shows you a LAN and a WAN.

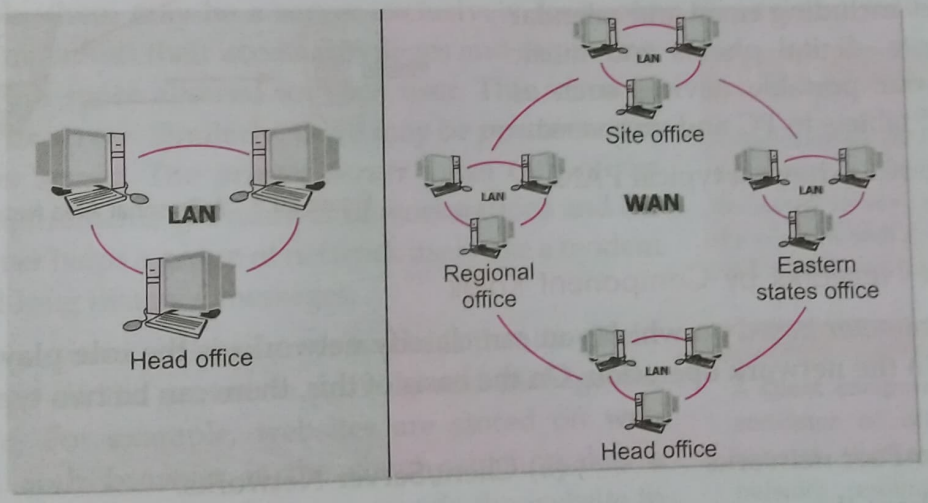

Figure 10.2 LAN *vs.* WAN.

There has been traditionally another type of networks – **MAN (Metropolitan Area Network)**, which refers to a network that is spread over an area as big as a city. But these days, this term has become redundant.

NOTE

The Internet is a giant WAN. The web is also a WAN. Please note that Web (World Wide Web) is a part of the Internet, not the complete Internet.

2. A *server* is a computer that just serves the requests of doing some tasks, made by other computers in its network. A *file server* serves the requests related to file sharing, storing etc. A *print server* serves the printer related requests, and so on.
3. The *network interface card* (NIC) provides the physical connection between the network and the computer workstation.
4. A leased line is a permanent telephone connection between two points set up by a government-regulated organization that provides telecommunications services to the public.

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Following table (10.1) lists some basic differences between LAN and WAN.

Table 10.1 LAN *vs.* WAN

S.No.	LAN	WAN
1.	It is spread over a small area.	It is spread over a very large area.
2.	It usually costs less to set it up.	It costs higher to set it up.
3.	It is usually a single network.	It is usually a network of many networks.

10.3.1C Personal Area Network (PAN)

A personal area network (PAN) is the interconnection of information technology devices within the range of an individual person, typically within a range of 10 meters.

For example, a person traveling with a laptop, a personal digital assistant (PDA), and a portable printer could interconnect them without having to plug anything in, using some form of wireless technology such as *Wifi*. Typically, this kind of personal area network could also be interconnected without wires to the Internet or other networks. You can use PAN networks to transfer files including email and calendar appointments, digital photos and music etc from your portable devices such as phones and tablets to PC and vice versa.

Figure (Fig. 10.3) shows a typical PAN.

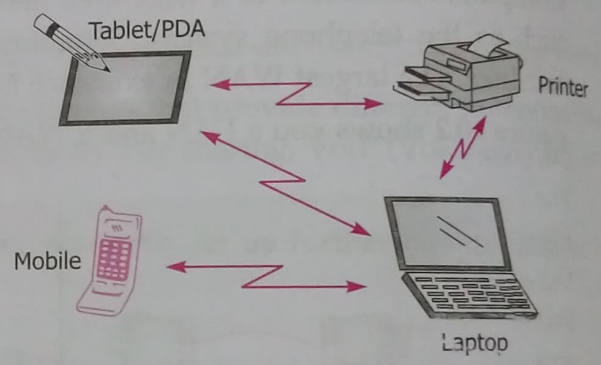

Figure 10.3 A Personal Area Network (PAN)

10.3.2 Types of Networks by Component Roles

Another parameter based on which you can classify networks is the **role played by network computers in the network operation**. On the basis of this, there can be two types of computer networks :

(*i*) Peer-to-Peer networks (*ii*) Client/Server Networks.

Let us talk about these network types one by one.

10.3.2A Peer-to-Peer (P2P) Networks

Peer refers to someone with equal standing, *e.g.*, look at these example sentences :

The staff is trained by peers.

Peer group of children is really important.

The peer-to-peer network literally implements the meaning of the word 'peer', *i.e.*, each computer on a peer-to-peer network is equal. That is, each computer can play the role of a **client** or a **server**. In other words, there is no computer designated as in charge of network operation. Each computer controls its own information and plays role of either a client or a server depending upon what is needed at that point of time.

The computers that serve on a peer-to-peer computer are often termed as **non-dedicated servers**.

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On small networks, a workstation that can double up as a server, is known as *non-dedicated* server since it is not completely dedicated to the cause of serving. Such servers can facilitate the resource-sharing among work-stations on a proportionately smaller scale. Since one computer works as a workstation as well as a server, it is slower and requires more memory. Recall that the (small) networks using such a server are known as *PEER-TO-PEER* networks.

NOTE

Peer-to-peer networks are popular as home networks and for use in small companies as they are inexpensive and easy to install, but they are limited in scope and are difficult to secure.

Typically a peer-to-peer network has upto ten computers (an accepted limit).

10.3.2B The Client-Server Networks

Unlike peer-to-peer networks, bigger networks prefer to have centralized control. They do this by clearly designating servers and clients. Such networks are called **client-server networks** or even **master-slave networks**.

On bigger network installations, there is a computer reserved for the server's job and its only job is to help workstations access data, software and hardware resources. It does not double-up as a workstation and such a server is known as *dedicated* server. The networks using such a server are known as *MASTER-SLAVE* networks.

On a network, there may be several servers that allow workstations to share specific resources. For example, there may be a server exclusively for serving files-related requests like storing files, deciding about their access privileges and regulating the amount of space allowed for each user. This server is known as ***file server***. Similarly, there may be ***printer server*** and ***modem server***. The ***printer server*** takes care of the printing requirements of a number of workstations and the ***modem server*** helps a group of network users use a modem to transmit long distance messages.

NOTE

A **dedicated server** operates solely as a server on a network while a **non-dedicated server** can shuttle between the client as well as server roles.

The key point about a client-server model is that the **client** is dependent on the **server** to provide and manage the information. For example, websites are stored on **web servers**. A **web browser** is the client which makes a request to the server, and the server sends the website to the browser.

CLIENT COMPUTER

A **Client computer** (or a **client**) is a computer or other device on the network that requests and utilizes network resources. A **Server** is a computer on network, dedicated to processing client requests.

Table 10.2 Differences between Client-server and P2P Networks

	Client-server	P2P
Security	The server controls security of the network.	No central control over security.
Management	The server manages the network. Needs a dedicated team of people to manage the server.	No central control over the network. Anyone can set up.
Dependency	Clients are dependent on the server.	Clients are not dependent on a central server.
Performance	The server can be upgraded to be made more powerful to cope with high demand.	If machines on the network are slow they will slow down other machines.
Backups	Data is all backed up on the main server.	Each computer has to be backed up. Data can easily be deleted by users.

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10.4 EVOLUTION OF NETWORKING

Evolution of networking started way back in 1969 by the development of first network called ARPANET, which led to the development of Internet. Let us learn how first network evolved to today's Internet.

10.4.1 ARPANET

The seeds of today's Internet were planted in 1969, when *U.S. Department of Defense* sponsored a project named ARPANET (acronym for **Advanced Research Projects Agency NETwork**). The goal of this project was to connect computers at different universities and U.S. defense (American spelling for defence is defense). Soon the engineers, scientists, students and researchers who were part of this system, began exchanging data and messages on it. The users of this system were also able to play long distance games and socialize with people who shared their interests. ARPANET started with a handful of computers but it expanded rapidly. In mid 80's, another federal agency, the *National Science Foundation*, created a new, high- capacity network called **NSFnet**, which was more capable than ARPANET.

> **NOTE**
>
> First network was ARPANET (Advanced Research Projects Agency NETwork).

NSFnet allowed only the academic research on its network and not any kind of private business on it. So many private companies built their own networks, which were later interconnected along with ARPANET and NSFnet to form Internet.

It was the *Inter networking i.e.*, the linking of these two and some other networks (*i.e.*, the ARPANET, NSFnet and some private networks) that was named **Internet**.

The original ARPANET was shut down in 1990, and the government funding for NSFnet discontinued in 1995. But the commercial Internet services came into picture, which are still running the Internet. Figure 10.4 illustrates the evolution of Internet.

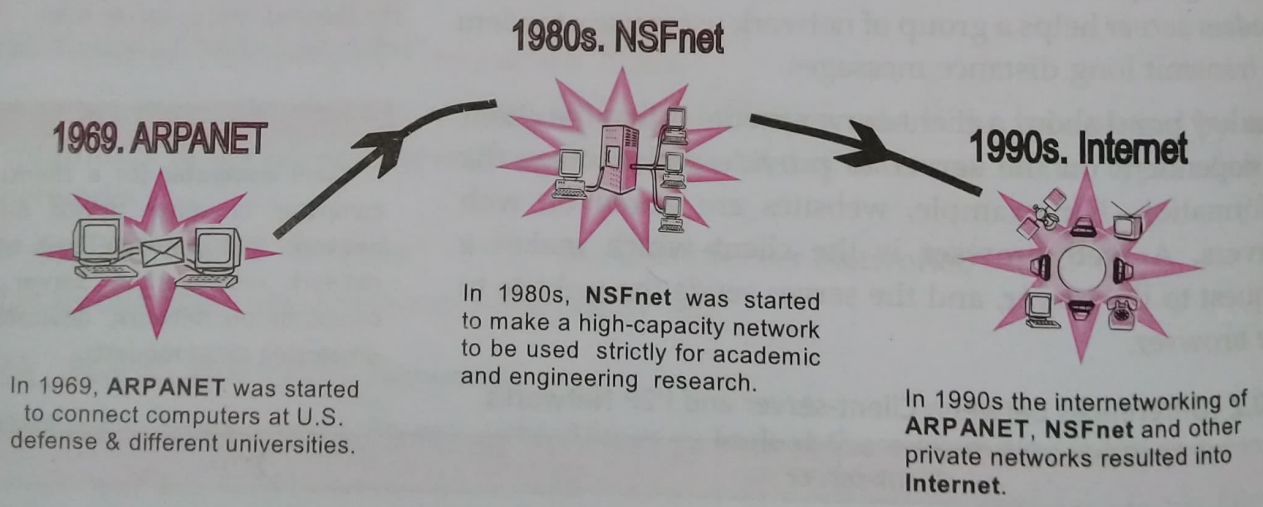

Figure 10.4 Evolution of Internet.

10.4.2 The Internet

Let us now clearly define Internet.

The Internet is a worldwide network of computer networks that evolved from the first network ARPAnet (Advanced Research Projects Agency network). The Internet is made up of many networks each run by a different company and

> **INTERNET**
>
> The Internet is a world-wide network of computer networks.

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interconnected at peering points. It is an interconnection of large and small networks around the globe. The common use of Internet standards allows users connected to one network to communicate with users on another network.

The Internet is a super-network. It connects many smaller networks together and allows all the computers to exchange information with each other. To accomplish this all the computers on the Internet have to use a common set of rules for communication. Those rules are called protocols, and the Internet uses a set of protocols called TCP/IP (Transmission Control Protocol/Internet Protocol).

How Does Internet Work ?

In Internet, most computers are not connected directly to the Internet. Rather they are connected to smaller networks, which in turn are connected through **gateways** to the Internet **backbone**.

Two new terms you have encountered just now – **gateway** and **backbone**. Let me define these two terms.

Figure 10.5 shows you a backbone.

GATEWAY

A Gateway is a device that connects dissimilar networks.

BACKBONE

A Backbone is central interconnecting structure that connects one or more networks just like the trunk of a tree or the spine of a human being.

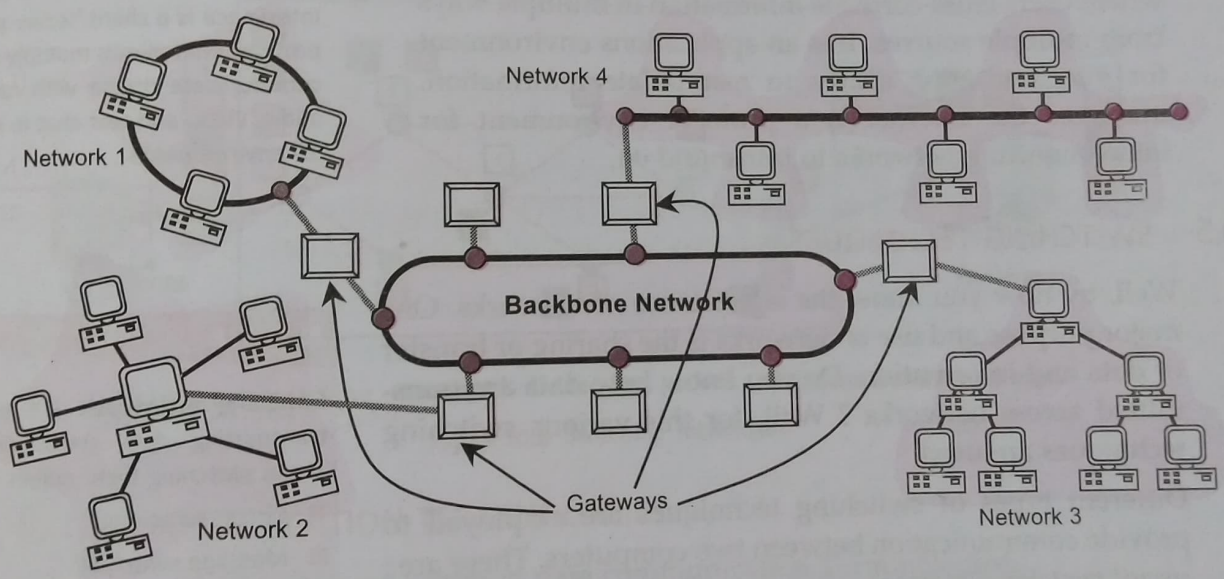

Figure 10.5 A backbone used to connect various LANs.

Let us now see how Internet functions :

(*i*) At the source computer, the message or the file/document to be sent to another computer is firstly divided into very small parts called **Packets**. A *packet* generally contains some information.

(*ii*) Each packet is given a number serialwise *e.g.*, 1, 2, 3.

(*iii*) All these packets are then sent to the address of destination computer.

(*iv*) The destination computer receives the packets in random manner. (It may even receive packet 10 before packet 1 arrives). If a packet is garbled or lost, it is demanded again.

(*v*) The packets are reassembled in the order of their number and the original message/file/document is obtained.

Let us now see what all helps Internet in doing so.

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Internet Functioning

The reason that the Internet works at all is that every computer connected to it uses the **same set of rules for communication**. Do you know that set of rules is called **protocol** ?

The communication protocol used by Internet is **TCP/IP**.

- The **TCP** (*i.e.*, **Transmission Control Protocol**) part is responsible for dividing the file/message into packets on the *source computer*. It (TCP) is also responsible for reassembling the received packets at the *destination or recipient computer*.
- The **IP** (*i.e.*, **Internet Protocol**) part is responsible for handling the address of destination computer so that each packet is routed (sent) to its proper destination. You shall learn about TCP/IP in details later in the chapter.

The future of Internet is said to be in *Interspace*. Let us know what *Interspace* is.

10.4.3 The Interspace

InterSpace is a client/server software program that allows multiple users to com- municate online with real-time audio, video and text chat in dynamic 3D environments. *InterSpace* provides the most advanced form of communication available on the Internet today.

The *Interspace* is a vision of what the Internet will become, where users cross-correlate information in multiple ways from multiple sources. It is an applications environment for interconnecting spaces to manipulate information, much as the Internet is a protocol environment for interconnecting networks to transmit data.

INTERSPACE

InterSpace is a client/server software program that allows multiple users to communicate online with real- time audio, video and text chat in dynamic 3D environments.

10.5 SWITCHING TECHNIQUES

Well, by now you know the significance of networks. One major purpose and use of networks is the sharing or transfer of data and information. Do you know how data are trans- mitted across networks ? Well, for this various switching techniques are used.

Different types of switching techniques are employed to provide communication between two computers. These are : *circuit switching, message switching* and *packet switching*.

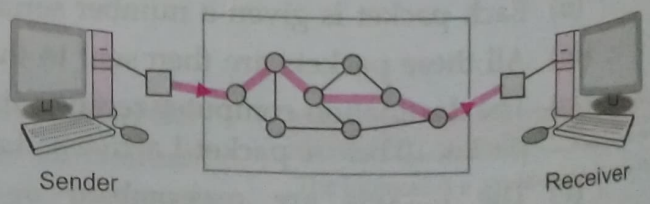
NOTE

Switching techniques are used for transmitting data across networks. Three switching tech- niques are :

- Circuit switching
- Message switching
- Packet switching.

10.5.1 Circuit Switching

In this technique, first the complete physical connection between two computers is established and then data are transmitted from the source computer to the destination computer. That is, when a computer places a telephone call, the switching equipment within the telephone system seeks out a physical copper path all the way from sender telephone to the receiver's telephone. The important property of this switching technique is to setup an end-to-end path (connection) between computer before any data can be sent.



(*a*) Circuit switching – a complete physical connection is established between the sender and the receiver

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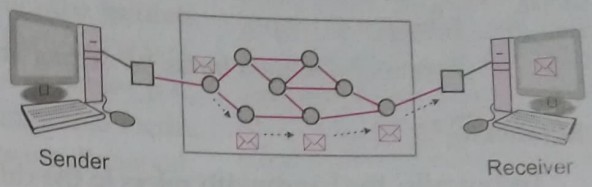
10.5.2 Message Switching

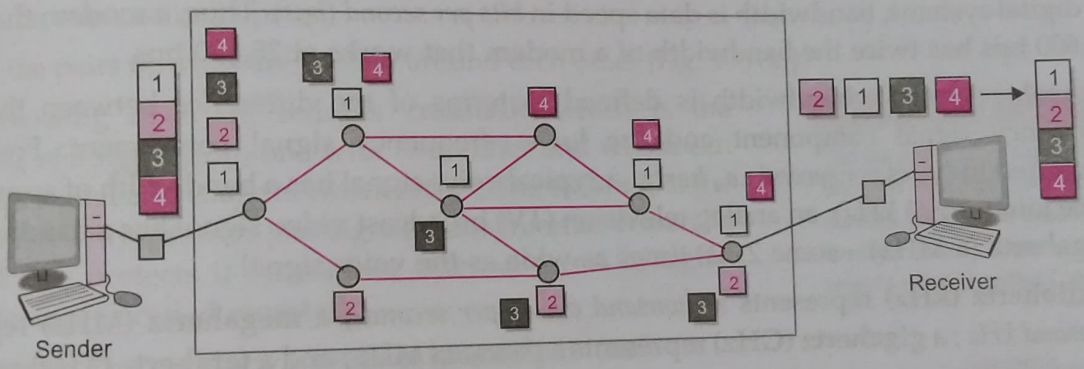
In this technique, the source computer sends data or the message to the switching office first, which stores the data in its buffer. It then looks for a free link to another switching office and then sends the data to this office. This process is continued until the data are delivered to the destination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



(*b*) Message switching – full message travel across different intermediate hops or switching offices.

10.5.3 Packet Switching

With message switching, there is no limit on block size, in contrast, packet switching places a tight upper limit on block size. A fixed size of packet which can be transmitted across the network is specified. Another point of its difference from message switching is that data packets are stored on the disk in message switching whereas in packet switching, all the packets of fixed size are stored in main memory. This improves the performance as the access time (time taken to access a data packet) is reduced, thus, the throughput (measure of performance) of the network is improved.



(*c*) Packet switching – message is divided into packets and packets travel across hops.

Figure 10.6 Switching Techniques

10.6 DATA COMMUNICATION TERMINOLOGIES

Let us now talk about some common data communication Terminologies.

1. Data Channel

Channel is the medium used to carry information or data from one point to another.

2. Baud

It is the unit of measurement for the information carrying capacity of a communi- cation channel. The baud is synonymous with bps (bits per second), another unit of measuring data transfer rates.

3. Bits Per Second (bps)

It refers to the speed at which data transfer is measured. It is generally used to measure the speed of information through a high speed phone lines or modems.

Bytes per second are denoted as **Bps** – notice the capital B. Small b *i.e.*, **bps** stands for *bits per second*.

- The rate of a *thousand* **bits** *per second* is known as kbps *i.e.*, kilo bits per second. (*Small k in kbps*).

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- A rate of a *thousand* **bytes** *per second* is denoted by **Kbps** (*Kilo bytes per second*). Notice the capital K.
- A rate of a *million* **bits** *per second* is denoted through **mbps** – mega bits per second. (*Small m in mbps*).
- A rate of a *million* **bytes** *per second* is denoted as **Mbps**. (*Capital M in Mbps*).

4. Bandwidth

Technically, the bandwidth refers to the difference between the highest and lowest frequencies of a transmission channel. Or in other words, the bandwidth refers to the width of allocated band of frequencies to a channel.

Generally speaking, bandwidth is directly proportional to the amount of data transmitted or received per unit time. In a qualitative sense, bandwidth is proportional to the complexity of the data for a given level of system performance. For example, it takes more bandwidth to download a photograph in one second than it takes to download a page of text in one second. Large sound files, computer programs, and animated videos require still more bandwidth for acceptable system performance.

> High bandwidth channels are called **broadband** channels and low bandwidth channels are called **narrowband** channels.

In digital systems, bandwidth is data speed in *bits per second* (*bps*). Thus, a modem that works at 57,600 bps has twice the bandwidth of a modem that works at 28,800 bps.

In analog systems, bandwidth is defined in terms of the difference between the highest-frequency signal component and the lowest-frequency signal component. Frequency is measured in *cycles per second i.e.*, ***hertz***. A typical voice signal has a bandwidth of approximately three kilohertz (3 kHz); an analog television (TV) broadcast video signal has a bandwidth of six megahertz (6 MHz) – some 2,000 times as wide as the voice signal.

A **kilohertz (kHz)** represents a *thousand cycles per second* ; a **megahertz (MHz)** represents a *thousand kHz* ; a **gigahertz (GHz)** represents a *thousand MHz* ; and a **terahertz (THz)** represents a *thousand GHz.*

5. Data Transfer Rates

The data transfer rate represents the amount of data transferred per second by a communications channel or a computing or storage device.

Data rate is measured in units of *bits per second* (**bps**), *bytes per second* (**Bps**), or **baud**.

When applied to data rate, the multiplier prefixes "kilo-", "mega-", "giga-", "tera-" etc. (and their abbreviations, "k", "M", "G", "T" etc.) always denote powers of 1000. For example, 64 kbps is 64,000 bits per second. This contrasts with units of storage where they stand for powers of 1024, *e.g.*, 1 KB = 1024 bytes.

Similarly, **1 MB** = 1024 *kilobytes* ; **1 GB** = 1024 *megabytes* ; **1 TB** = 1024 *gigabytes*

10.7 TRANSMISSION MEDIA

By *transmission media* or *communication channels* of network, it is meant that the 'connecting cables' or '*connecting media*' are being talked about. The cables that connect two or more workstations are the communication channels.

In LANs (*Local Area Networks i.e.*, very small networks) many different types of media are in use. Copper conductors in the form of twisted pair or coaxial are by far the most common.

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More recently, very serious consideration has been given to the use of optical fiber technology in LANs. Other media *e.g.*, microwave transmission, infrared, telephone line etc. are also used. We can group the communication media in two categories : **guided** media and **unguided** media. The **guided** media include cables and **unguided** media include waves through air, water or vacuum. The basic types of cables (*i.e.*, guided media) are being discussed below. The unguided media (microwaves, radiowaves and satellites) are also being discussed.

NOTE

We can group the communication media in two categories : **guided** media and **unguided** media. The **guided** media include cables and **unguided** media include waves through air, water or vacuum.

10.7.1 Twisted Pair Cable

The most common form of wiring in data communication application is the twisted pair cable. As a *voice grade medium* (VGM), it is the basis for most internal office telephone wiring. It consists of two identical wires wrapped together in a double helix.

Problems can occur due to differences in the electrical characteristics between the pair (*e.g.*, length, resistance, capacitance). For this reason, LAN applications will tend to use a higher quality cable known as *data grade medium* (DGM).

Different types and categories of twisted-pair cable exist, but they all have *two* things in common :

- the wires come in pairs
- the pairs of wires are twisted around each other [Fig. 10.7(*a*)].

The twisting of wires reduces **crosstalk**, which is the *bleeding of a signal* from one wire to another and which can corrupt signal and cause network errors. The twisting of the wires not only protects the signal from internal crosstalk, but it also protects it form other external forms of signal interference is called **crosstalk**.

CROSSTALK

The *bleeding of a signal* from one wire to another and which can corrupt signal and cause network errors. This form of signal interference is called Crosstalk.

Advantages. The main advantages of twisted pair cable are :

(*i*) It is simple.
(*ii*) It is easy to install and maintain.
(*iii*) It is physically flexible.
(*iv*) It has a low weight.
(*v*) It can be easily connected.
(*vi*) It is very inexpensive.

Disadvantages. Despite having such advantages, the data transmission characteristics of twisted pair cable are not so good. The major disadvantages are :

(*i*) Because of high attenuation, it is incapable carrying a signal over long distances without the use of *repeaters*.
(*ii*) Its low bandwidth capabilities make it unsuitable for broadband applications.
(*iii*) It supports maximum data rates 1 Mbps without conditioning and 10 Mbps with conditioning.

Figure 10.7(*a*) shows a twisted pair cable.

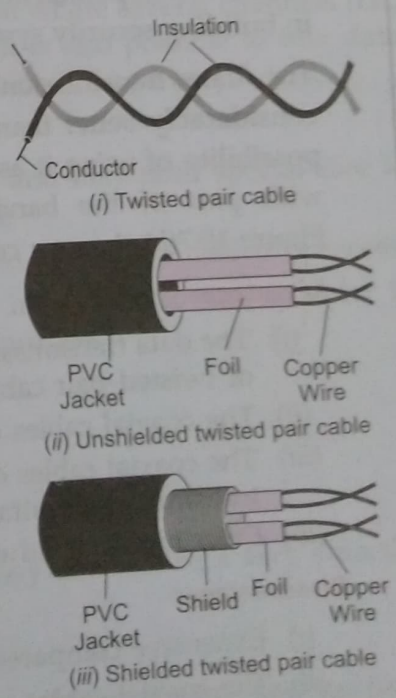

Figure 10.7 (*a*) Twisted pair cable.

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Types of Twisted Pair Cables

There are *two* types of twisted pair cables available. These are :

(*i*) ***Unshielded Twisted Pair (UTP) Cable.*** UTP cabling is used for variety of electronic communications. It is available in following *eight* categories :

Type	Description	Type	Description
CAT1	Voice-grade communications only ; No data transmission	CAT5	Data-grade transmission upto 1000 Mbps
CAT2	Data-grade transmission upto 4 Mbps	CAT6	Data-grade transmission upto 10000 Mbps
CAT3	Data-grade transmission upto 10 Mbps	CAT7	Data-grade transmission upto 10 Gbps
CAT4	Data-grade transmission upto 16 Mbps	CAT8	Data-grade transmission upto 40 Gbps

The UTP cables can have maximum segment length of 100 metres.

(*ii*) ***Shielded Twisted Pair (STP) Cable.*** This type of cables comes with shielding of the individual pairs of wires, which further protects it from external interference. But these also, like UTP, can have maximum segment length of 100 meters. The *advantage* of STP over UTP is that it offers greater protection from interference and crosstalk due to shielding. But it is definitely heavier and costlier than UTP and requires proper grounding at both ends.

10.7.2 Coaxial Cable

This type of cable consists of a solid wire core surrounded by one or more foil or wire shields, each separated by some kind of plastic insulator. The inner core carries the signal, and the shield provides the ground. The coaxial cable has high electrical properties and is suitable for high speed communication. While it is less popular than twisted pair, it is widely used for television signals. In the form of (CATV) cable, it provides a cheap means of transporting multi-channel television signals around metropolitan areas. It is also used by large corporations in building security systems.

The data transmission characteristics of coaxial cable are considerably better than those of twisted pair. This opens the possibility of using it as the basis for a shared cable network, with part of the bandwidth being used for data traffic. Figure 10.7(*b*) shows a coaxial cable.

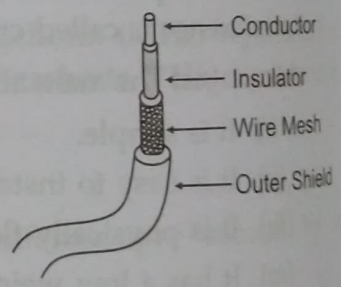

Figure 10.7 (*b*) Coaxial cable

Advantages

(*i*) The data transmission characteristics of coaxial cables are considerably better than those of twisted-pair cables.

(*ii*) The coaxial cables can be used as the basis for a shared cable network.

(*iii*) The coaxial cables can be used for broadband transmission *i.e.*, several channels can be transmitted simultaneously (as with cable TV).

(*iv*) Offer higher bandwidths-upto 400 MBPS.

Disadvantages

(*i*) Expensive compared to twisted pair cables.

(*ii*) The coaxial cables are not compatible with twisted pair cables.

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Types of Coaxial Cables

The *two* most commonly used types of coaxial cable are **thicknet** and **thinnet**.

(*i*) ***Thicknet.*** This form of coaxial cable is thicker than thinnet. The thicknet coaxial cable segments (while joining nodes of a network) can be upto 500 meters long.

(*ii*) ***Thinnet.*** This form of coaxial cable is thinner and it can have maximum segment length of 185 meters *i.e.*, using this cables, nodes having maximum distance of 185 meters can be joined.

10.7.3 Optical Fibers

Optical fibers consist of thin strands of glass or glass like material which are so constructed that they carry light from a source at one end of the fiber to a detector at the other end. The light sources used are either light emitting diodes (LEDs) or laser diodes (LDs). The data to be transmitted is modulated onto the light beam using frequency modulation techniques. The signals can then be picked up at the receiving end and demodulated. The bandwidth of the medium is potentially very high. For LEDs, this ranges between 20 and 150 mbps and higher rates are possible using LDs.

The fiber cable consists of *three* pieces : (*i*) **the core**, *i.e.*, the glass or plastic through which the light travels (*ii*) **the cladding**, which is a covering of the core that reflects light back to the core, and the (*iii*) **protective coating**, which protects the fiber cable from hostile environment [see Fig. 10.7(*c*)].

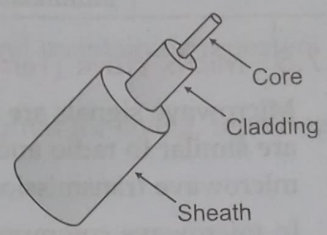

Figure 10.7 (*c*) The Fiber Optic cable.

Advantages

(*i*) It is immune to electrical and magnetic interference *i.e.*, noise in any form because the information is travelling on a modulated light beam.

(*ii*) It is highly suitable for harsh industrial environments.

(*iii*) it guarantees secure transmission and has a very high transmission capacity.

(*iv*) Fiber optic cables can be used for broadband transmission where several channels (*i.e.*, bands of frequency) are handled in parallel and where it is also possible to mix data transmission channels with channels for telescope, graphics, TV and sound.

Disadvantages

(*i*) Installation problem. Fiber optic cables are quite fragile and may need special care to make them sufficiently robust for an office environment.

(*ii*) Connecting either two fibers together or a light source to a fiber is a difficult process.

(*iii*) Because of noise immunity, optical fibers are virtually impossible to tap. In order to incept the signal, the fiber must be cut and a detector inserted.

(*iv*) Light can reach the receiver out of phase.

(*v*) Connection losses are common problems.

(*vi*) Fiber optic cables are more difficult to solder.

(*vii*) They are the most expensive of all the cables.

Despite its shortcomings, optical fiber is an important technology and will be a very attractive transmission indeed.

Types of Fibre Optic Cables

Fibre optic cable can be either **single node** that supports a segment length of upto 2 kms and bandwidth of upto 100 Mbps or **Multinode** with a segment length of 100 kms and bandwidth of 2 Gbps.

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10.7.4 Guided Media Compared

Let us now compare the cost, ease and performance offered by each of the media, we have studied so far.

Table 10.2 *Comparison table for guided media*

Type	Type Sub Type	Maximum Segment Length	Bandwidth Supported	Installation	Cost	Interference
Twisted Pair Cable	UTP	100 m	40 Gbps	easy	cheapest	high
	STP	100 m	500 Mbps	moderate	moderate	moderate
Coaxial Cable	Thinnet	185 m	10 Mbps	easy	cheap	moderate
	Thicknet	500 m	10 Mbps	hard	moderate	low
Fiber Optic Cable	Singlenode	2 km	100 Mbps	very hard	expensive	none
	Multinode	100 km	2 Gbps	very hard	expensive	none

10.7.5 Micro Wave (Terrestrial Microwave)

Microwave signals are used to transmit data without the use of cables. The microwave signals are similar to radio and television signals and are used for long distance communication. The microwave transmission consists of a *transmitter, receiver* and the *atmosphere*.

In microwave communication, parabolic antennas are mounted on towers to send a beam to other antennas tens of kilometers away. The higher the tower, the greater the range. With a 100-meter high tower, distances of 100 km between towers are feasible. The microwave transmission is line-of-sight[5] transmission.

Advantages

(*i*) It proves cheaper than digging trenches for laying cables and maintaining repeaters and cables if cables get broken by a variety of causes.

(*ii*) It offers freedom from land acquisition rights that are required for laying, repairing the cables.

(*iii*) It offers ease of communication over difficult terrain.

(*iv*) Microwaves have the ability to communicate over oceans.

Disadvantages

(*i*) Microwave communication is an insecure communication.

(*ii*) Signals from a single antenna may split up and propagate by slightly different paths to the receiving antenna. When these out-of-phase signals recombine, they interfere, reducing the signal strength.

(*iii*) Microwave propagation is susceptable to weather effects like rains, thunder storms etc.

(*iv*) Bandwidth allocation is extremely limited in case of microwaves.

(*v*) The cost of design, implementation, and maintenance of microwave links is high.

10.7.6 Radio Wave

The transmission making use of radio frequencies is termed as *radio-wave transmission*. We all are familiar with radios and their working. When certain radio frequencies are allocated to

5. A Line-of-Sight signal passes through the atmosphere, originates from a dish antenna, travels in a straight line free of material obstacles and received by another dish antenna.

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private businesses for direct voice communication, they can make use of it for private business purposes. In general, private citizens and business users are licensed to operate in the range of about 10 miles.

All radios today, however, use **continuous sine waves** to transmit information (audio, video, data). Each different radio signal uses a different sine wave **frequency**, and that is how they are all separated. Any radio setup has *two* parts :

- The **transmitter**
- The **receiver**

The transmitter takes some sort of message (it could be the sound of someone's voice, pictures for a TV set, data for a radio modem or whatever), encodes it onto a sine wave and transmits it with radio waves. The receiver receives the radio waves and decodes the message from the sine wave it receives. Both the transmitter and receiver use **antennas** to radiate and capture the radio signal.

Advantages

(*i*) Radio-wave transmission offers mobility.

(*ii*) It proves cheaper than digging trenches for laying cables and maintaining repeaters and cables if cables get broken by a variety of causes.

(*iii*) It offers freedom from land acquisition rights that are required for laying, repairing the cables.

(*iv*) It offers ease of communication over difficult terrain.

Disadvantages

(*i*) Radio-wave communication is an insecure communication.

(*ii*) Radio-wave propagation is susceptible to weather effects like rains, thunder storms etc.

Security of such communication links is almost nonexistent. Even so, the equipment has many advantages and is widely used by taxi, repair, courier, and delivery services.

10.7.7 Satellite (Sattelite Microwave)

Radio wave can be classified by frequency and wavelength. When the frequency is higher than 3 GHz, it is named microwave. Satellite communication is special case of microwave relay system. Satellite communication use the synchronous satellite to relay the radio signal transmitted from ground station. In recently, the use of wireless communication has gained more popularity. Compare to the traditional fixed wire terrestrial networks, satellite and microwave communications network features the time saving, fast-implementation and broad coverage characteristics. It provides voice, fax, data and video services as well as email, file transfer, WWW internet applications. When fixed wire terrestrial communication networks are crushed by a disaster, the satellite and microwave system as a emergency backup facility will be stressed.

In satellite communication the earth station consists of a satellite dish that functions as an antenna and communication equipment to transmit and receive data from satellites passing overhead.

A number of communication satellites, owned by both governments and private organizations, have been placed in stationary orbits about 22,300 miles above the earth's surface. These satellites act as relay stations for communication signals. The satellites accept data/signals transmitted from an earth station, amplify them, and retransmit them to another earth station. Using such a setup, data can be transmitted to the other side of the earth in only one step.

Most communication satellites have multiple, independent reception and transmission devices known as *transponders*. In a commercial communication satellite, a single transponder is usually

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capable of handling a full-colour, commercial television transmission, complete with audio. Transponders for data transmission may be even larger. Some firms that market satellite communications service own a satellite. Others lease a portion of a satellite and provide transmission facilities in smaller units to ultimate users. The security in satellite transmission is usually provided by the coding and decoding equipment.

Advantages

(*i*) The area coverage through satellite transmission is quite large.

(*ii*) The laying and maintenance of intercontinental cable is difficult and expensive and this is where the satellite proves to be the best alterative.

(*iii*) The heavy usage of intercontinental traffic makes the satellite commercial attractive.

(*iv*) Satellites can cover large areas of the Earth. This is particularly useful for sparsely populated areas.

Disadvantages

(*i*) Technological limitations preventing the deployment of large, high gain antennas on the satellite platform.

(*ii*) Over-crowding of available bandwidths due to low antenna gains.

(*iii*) The high investment cost and insurance cost associated with significant probability of failure.

(*iv*) High atmospheric losses above 30 GHz limit carrier frequencies.

10.7.8 Other Unguided Media

Apart from microwaves, radiowaves and satellites, two other unguided media are also very popular. These are **infrared** and **laser** waves. Let us briefly learn about these media here.

1. Infrared

This type of transmission uses infrared light to send data. You can see the use of this type of transmission in everyday life – TV remotes, automotive garage doors, wireless speakers etc., all make use of infrared as transmission media.

The infrared light transmits data through the air and can propagate throughout a room (bouncing off surfaces), but will not penetrate walls. The infrared transmission has become common in PDAs (Personal digital assistants) *e.g.*, hand held devices like palm pilots etc.

The infrared transmission is considered to be a secure one.

2. Laser

The laser transmission requires direct line-of-sight. It is unidirectional like microwave, but has much higher speed than microwaves. The laser transmission requires the use of a laser transmitter and a photo-sensitive receiver at each end. The laser transmission is point-to-point transmission, typically between buildings.

But lasers have a certain *disadvantage*, which is : it can be adversely affected by weather.

Check Point 10.1

1. Write two advantages and disadvantages of networks.
2. What is ARPAnet ? What is NSFnet ?
3. What do you understand by InterSpace ?
4. What is MAC address ?
5. What is a communication channel ? Name the basic types of communication channels available.
6. Define baud, bps and Bps. How are these interlinked ?
7. What are the various types of networks ?
8. What is the difference between LAN and WAN ?
9. Write two advantages and disadvantages of the following : (*i*) Optical fibres (*ii*) Satellites (*iii*) Microwaves.
10. Write two disadvantages of twisted pair cables.
11. Write an advantage and a disadvantage of using Optical fibre cable.
12. What is the difference between LAN and PAN ?

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10.8 NETWORK TOPOLOGIES

The pattern of interconnection of nodes in a network is called the **Topology**.

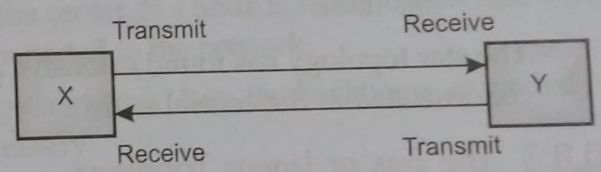
The selection of a topology for a network cannot be done in isolation as it affects the choice of media and the access method used. There are a number of factors to consider in making this choice, the most important of which are set out below :

> **TOPOLOGY**
>
> The pattern of interconnection of nodes in a network is called the Topology.

1. *Cost*. For a network to be cost effective, one would try to minimize installation cost. This may be achieved by using well understood media and also, to a lesser extent, by minimizing the distances involved.
2. *Flexibility*. Because the arrangement of furniture, internal walls etc. in offices is often subject to change, the topology should allow for easy reconfiguration of the network. This involves moving existing nodes and adding new ones.
3. *Reliability*. Failure in a network can take two forms. Firstly, an individual node can malfunction. This is not nearly as serious as the second type of fault where the network itself fails to operate. The topology chosen for the network can help by allowing the location of the fault to be detected and to provide some means of isolating it.

10.8.1 Point-to-Point Link

Before we talk about topologies in details, let us learn about point-to-point link. To understand this, refer to Fig. 10.8. A *P-P* (Point to Point) link basically relies upon two functions — transmit and receive. The main characteristic of *P-P* network is that each station receives exactly from one transmitter, and each transmitter transmits to exactly one receiver. The transmit and receive operations can occur over separate wires (for better performance) or they can take turns over the same wire using a variety of techniques.



Figur 10.8 Point-to-Point Network.

Point-to-point networks can grow in several ways. One method is simply to install a *P-P* link between each pair of computers in the network. This approach is called a *Mesh*. Many topologies have been developed, but major ones are :

- the Star topology ;
- the Ring or circular ;
- the Mesh ;
- the Bus ;
- the Tree ;
- the Fully connected ;

10.8.2 The Star Topology

This topology consists of a central node to which all other nodes are connected by a single path. (*see* Fig. 10.9). It is the topology used in most existing information networks involving data processing or voice communications. The most common example of this is IBM 370 installations. In this case multiple 3270 terminals are connected to either a host system or a terminal controller.

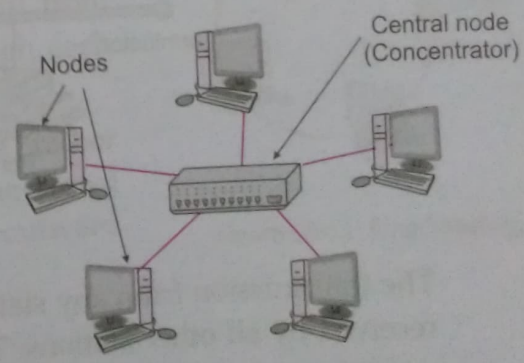


Figure 10.9 Star Topology

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Advantages of the Star Topology

- *Ease of service.* The star topology has a number of concentration points (where connections are joined). These provide easy access for service or reconfiguration of the network.
- *One device per connection.* Connection points in any network are inherently prone to failure. In the star topology, failure of a single connection typically involves disconnecting one node from an otherwise fully functional network.
- *Centralized control/problem diagnosis.* The fact that the central node is connected directly to every other node in the network means that faults are easily detected and isolated. It is a simple matter to disconnect failing nodes from the system.
- *Simple access protocols.* Any given connection in a star network involves only the central node. In this situation, contention for who has control of the medium for the transmission purposes is easily solved. Thus in a star network, access protocols are very simple.

Disadvantages of the Star Topology

- *Long cable length.* Because each node is directly connected to the center, the star topology necessitates a large quantity of cable. Whilst the cost of cable is often small, congestion in cable ducts and maintenance and installation problems can increase cost considerably.
- *Difficult to expand.* The addition of a new node to a star network involves a connection all the way to the central node.
- *Central node dependency.* If the central node in a star network fails, the entire network is rendered inoperable. This introduces heavy reliability and redundancy constraints on this node.

The star topology has found extensive application in areas where intelligence in the network is concentrated at the central node.

10.8.3 The Bus or Linear Topology

Another popular topology for data networks is the linear. This consists of a single length of the transmission medium (normally coaxial cable) onto which the various nodes are attached (see Fig. 10.10). The topology is used in traditional data communication network where the host at one end of the bus communicates with several terminals attached along its length.

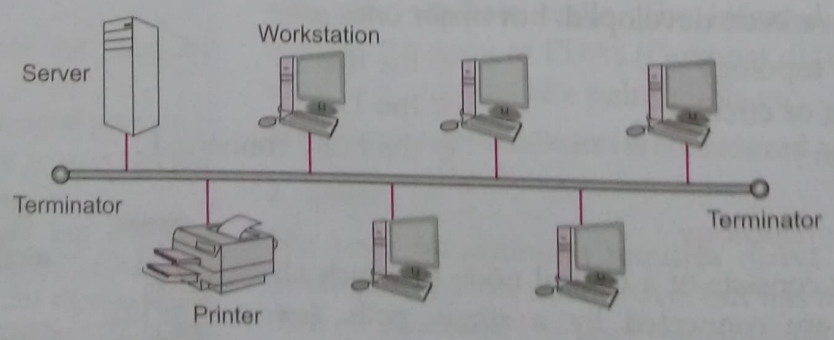

Figure 10.10 Bus Topology

The transmission from any station travels the length of the bus, in both directions, and can be received by all other stations. The bus has terminators at either end which absorb the signal removing it from the bus.

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Data is transmitted in small blocks, known as packets. Each packet has some data bits, plus a header containing its destination address. A station wanting to trans- mit some data sends it in packets along the bus. The destination device, on identifying the address on the packets, copies the data onto its disk.

Advantages of the Linear Topology

- *Short cable length and simple wiring layout.* Because there is a single common data path connecting all nodes, the linear topology allows a very short cable length to be used. This decreases the installation cost, and also leads to a simple, easy to maintain wiring layout.
- *Resilient Architecture.* The LINEAR architecture has an inherent simplicity that makes it very reliable from a hardware point of view. There is a single cable through which all the data propogates and to which all nodes are connected.
- *Easy to extend.* Additional nodes can be connected to an existing bus network at any point along its length. More extensive additions can be achieved by adding extra segments connected by a type of signal amplifier known as *repeater*.

Disadvantages of the Linear Topology

- *Fault diagnosis is difficult.* Although simplicity of the bus topology means that there is very little to go wrong, fault detection is not a simple matter. Control of the network is not centralized in any particular node. This means that detection of a fault may have to be performed from many points in the network.
- *Fault isolation is difficult.* In the star topology, a defective node can easily be isolated from the network by removing its connection at the center. If a node is faulty on the bus, it must be rectified at the point where the node is connected to the network.
- *Repeater configuration.* When BUS type network has its backbone extended using repeaters[6], reconfiguration may be necessary.
- *Nodes must be intelligent.* Each node on the network is directly connected to the central bus. This means that some way of deciding who can use the network at any given time must be performed in each node.

10.8.4 The Ring or Circular Topology

The third topology that we will consider is the ring or circular. In this case, each node is connected to two and only two neighbouring nodes. Data is accepted from one of the neighbouring nodes and is transmitted onwards to another (see Fig. 10.11). Thus data travels in one direction only, from node to node around the ring. After passing through each node, it returns to the sending node, which removes it.

It is important to note that data 'passed through' rather than 'travels past' each node. This means that the signal may be amplified before being 'repeated' on the outward channel.

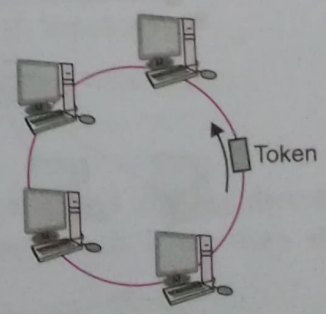

Figure 10.11 Ring Topology

6. A repeater amplifies a signal being transmitted on the network.

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Advantages of the Ring Topology

- *Short cable length*. The amount of cabling involved in a ring topology is comparable to that of a bus and is small relative to that of a star. This means that less connections will be needed, which will in turn increase network reliability.
- *No wiring closet space required*. Since there is only one cable connecting each node to its immediate neighbours, it is not necessary to allocate space in the building for wiring closets.
- *Suitable for optical fibers*. Using optical fibers offers the possibility of very high speed transmission. Because traffic on a ring travels in one direction, it is easy to use optical fibers as a medium of transmission.

Disadvantages of the Ring Topology

- *Node failure causes network failure*. The transmission of data on a ring goes through every connected node on the ring before returning to the sender. If one node fails to pass data through itself, the entire network has failed and no traffic can flow until the defective node has been removed from the ring.
- *Difficult to diagnose faults*. The fact that failure of one node will affect all others has serious implications for fault diagnosis. It may be necessary to examine a series of adjacent nodes to determine the faulty one. This operation may also require diagnostic facilities to be built into each node.
- *Network reconfiguration is difficult*. It is not possible to shut down a small section of the ring while keeping the majority of it working normally.

10.8.5 The Tree Topology

A variation of bus topology is the *tree topology*. The shape of the network is that of an inverted tree with the central root branching and subbranching to the extremities of the network (Fig. 10.1.2).

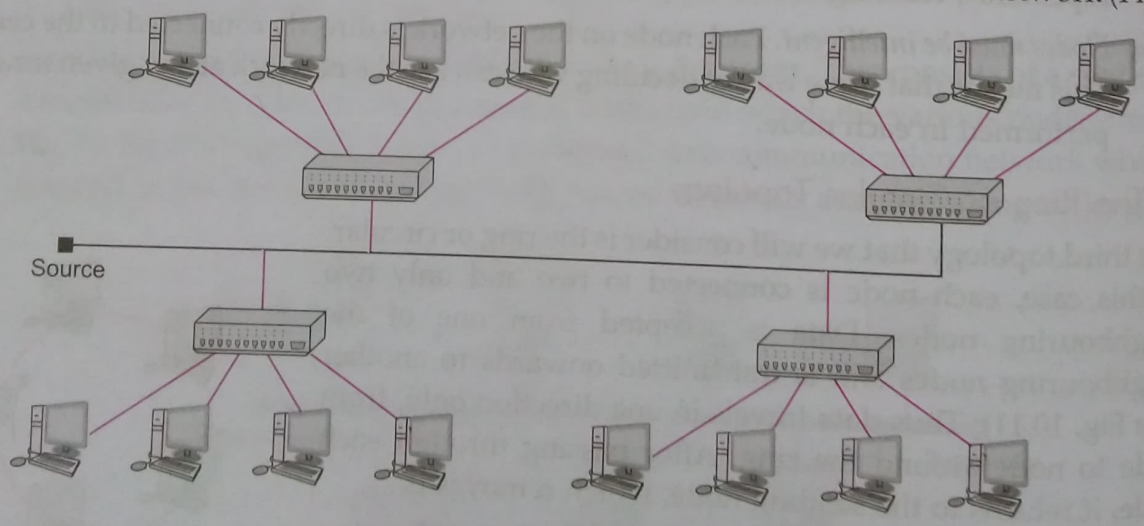

Figure 10.12 Tree Topology

Transmission in this topology takes place in the same way as in the bus topology. In both cases, there is no need to remove packets from the medium because when a signal reaches the end of the medium, it is absorbed by the terminators. Tree topology is best suited for applications which have a hierarchical flow of data and control. Since the tree topology is a modification of a 'pure' network topology, bus topology, it is a *hybrid* topology.

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Aadvantages of the Tree Topology

- It uses point-to-point wiring for individual segments.
- It is supported by several hardware and software venders.

Disadvantages of the Tree Topology

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- It is more difficult to configure and wire than other topologies.

10.8.6 Mesh Topology

In this topology, each node is connected to more than one node to provide an alternative route in the case the host is either down or too busy. It is an extension to *P-P* network. (*see* Fig. 10.13).

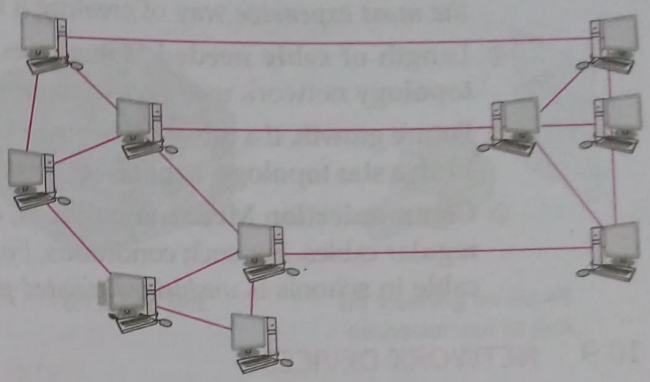


Figure 10.13 Mesh Topology

The mesh topology is excellent for long distance networking because it provides extensive back-up, rerouting and pass-through capabilities. Communication is possible between any two nodes on the network either directly or by passing through. This function is needed in the event of a line or node failure elsewhere in the network. The mesh topology is commonly used in large internetworking environments with stars, rings, and buses attached to each node. This is also ideal for distributed networks.

Advantages of Mesh Topology

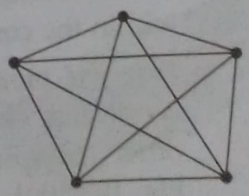
- Each connection can carry its own data load.
- It is robust and provides security and privacy.
- In this topology, fault diagnosis is easy.

Disadvantages of Mesh Topology

- Its installation and configuration is difficult.
- Cabling cost is more for mesh topology.
- Bulk wiring is required for mesh topology.

10.8.7 Fully Connected

When in a network each host is connected to other directly *i.e.*, there is a direct link between each host, then the network is said to be fully connected. This characteristic is termed as full connectivity. (Fig.)



Fully connected network.

Check Point 10.2

1. What is meant by topology ? Name some popular topologies.
2. What are the factors that must be considered before making a choice for the topology ?
3. What are the similarities and differences between bus and tree topologies ?
4. What are the limitations of star topology ?
5. When do you think, ring topology becomes the best choice for a network ?
6. Write the two advantages and two disadvantages of Bus Topology in network.
7. Give two advantages and two disadvantages of following network topologies : (*i*) Star (*ii*) Tree (*iii*) Bus.

Path Wala

10.8.8 Factors to Consider for Topology Selection

As there are many different types of topologies that can be installed for a computer network, what all factors one must consider while deciding about the preferred topology for a network? The factors that you must keep in mind for this, are :

- **Cruciality of Work**. How crucial the continuity of work is a very important factor. For instance, military networks must not fail at any cost thus **fully connected topology** is a preferred for Military networks.
- **Cost**. Keeping in mind the budget, you should decide about a topology. A **linear bus topology** network may be *the least expensive* way to install a network; **Fully connected** is *the most expensive* way of creating a network.
- **Length of cable needed.** Sometimes, length of cable must be saved on; the **linear bus topology** network uses shorter lengths of cable.
- **Future growth.** If a network has to grow in future, then the topology must support expansion. With a **star topology**, expanding a network is easily done by adding another concentrator.
- **Communication Media**. Sometimes, difficult terrains like hilly areas do not allow use of regular cables. For such conditions, *linear bus topologies* are not possible. The most common cable in schools is *unshielded twisted pair*, which is most often used with *star topologies*.

10.9 NETWORK DEVICES

In the smooth functioning of a computer network, other than computers and wiring, many devices or specialized hardware play important roles. In this section, we are discussing about these network devices/hardware.

10.9.1 Modem

Modems allow you to combine the power of your computer with the global reach of the telephone system. Modem is a device which allows a compuer to send and receive data over telephone lines or cable connections.

Because ordinary telephone lines cannot carry digital information, a modem changes the digital data from your computer into analog data, a format that can be carried by telephone lines. In a similar manner, the modem receiving the call then changes the analog signal back into digital data that the computer can digest. This shift of digital data into analog data and back again, allows two computers to "speak" with one another. Called **modulation/demodulation**, this transformation of signals is how the modem received its name.

MODEM

A Modem is a computer peripheral that allows you to connect and communicate with other computers via telephone lines.

Modulation is the process of sending data on a wave, 3 types of modulation tech- niques are used :

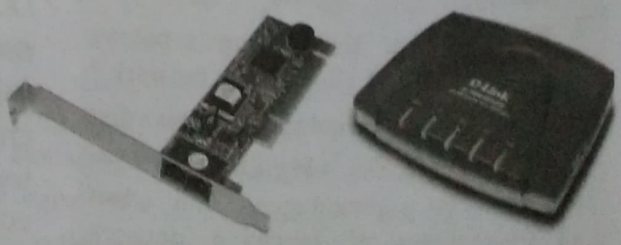
AM (*Amplitude Modulation*),

FM (*Frequency Modulation*),

PM (*Phase Modulation*)

Modems come in *two* varieties :

- ***Internal modems*** the modems that are fixed within the computer [*see* Fig. 10.14(*a*)].
- ***External modems*** the modems that are connected externally to a computer as other peripherals are connected [*see* Fig. 10.14(*b*)].



(*a*) Internal modem (*b*) External modem

Figure 10.14

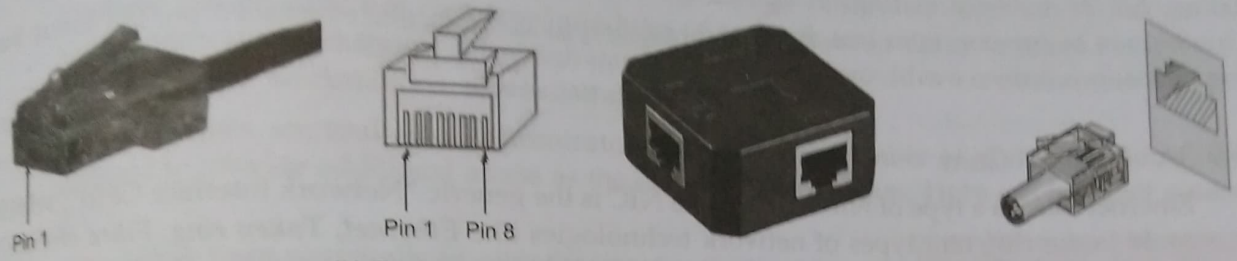
Path Wala

10.9.2 RJ-45

RJ-45 is short for **Registered Jack-45**. RJ-45 is an eight-wire connector, which is commonly used to connect computers on the local area networks *i.e.*, LANs especially **Ethernets**. (Ethernet is a LAN architecture developed by *Xerox Corp* along with DEC and Intel. Ethernet uses either a bus or star topology and supports data transfer rates of upto 10 Mbps.)

The RJ-45 connector looks very much similar to standard telephone connector (RJ-11 connector), but it is wider than RJ-11 as it houses eight wires instead of four. RJ-45 connectors are used to connect computers in Ethernet LANs.

Fig. 10.15 shows an *RJ-45 connector*, its *end view*, *jack* and *how it is to be inserted* in its jack.



(*a*) RJ-45 connector (*b*) End view of RJ-45 (*c*) RJ-45 jack (*d*) Inserting an RJ-45 connector into its jack.

Figure 10.15

10.9.3 NIC (Network Interface Card)

A standalone computer (a computer that is not attached to a network) lives in its own world and carries out its tasks with its own inbuilt resources. But as soon as it becomes a workstation, it needs an interface to help establish a connection with the network because without this, the workstations will not be able to share network resources.

The *network-interface-card* is a device that is attached to each of the workstations and the server, and helps the workstation establish the all-important connection with the network. Each *network-interface-card* that is attached to a workstation has a unique number identifying it, which is known as the *node address*.

MAC ADDRESS

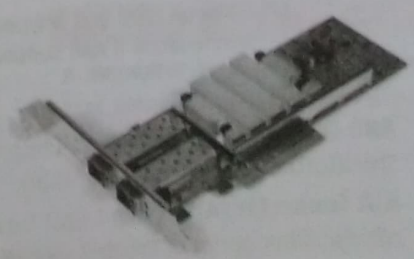
The MAC address refers to the physical address assigned by NIC manufacturer.

The NIC is also called *Terminal Access Point* (TAP). Different manufacturers have different names for the interface. The NIC is also called NIU – *Network Interface Unit*.

The NIC manufacturer assigns a unique physical address to each NIC card ; this physical address is known as **MAC address**. (Media Access Control Address)

MAC Address

The NIC manufacturer assigns a unique physical address to each NIC card ; this physical address is known as *Media Access Control* address (**MAC address**). A MAC address is a 6-byte address with each byte separated by a colon *e.g.*, a sample MAC address could be :



```
10 : B5 : 03 : 63 : 2E : FC
```

Path Wala

So, now you know that this MAC address is actually the number assigned to the network card of your computer. The first *three* bytes of MAC address are the *manufacturer-id* (assigned to the manufacturer by an international organization namely IEEE) and the last three bytes are the *card-no* (assigned by manufacturer) (*see* Fig. 10.16 below).

NOTE

The NIC manufacturer assigns a unique physical address to each NIC card ; this physical address is known as *Media Access Control* address (**MAC address**)

Manufacturer-id (This code is assigned to manufacturer by IEEE)

10 : B5 : 03 : 63 : 2E : FC

Card-no (assigned by the manufacturer)

Each MAC address is unique for each network card.

Figure 10.16 Sample MAC address.

10.9.3A Ethernet Card

Ethernet Card is a type of NIC card. While NIC is the generic "Network Interface Card", which could be for different types of network technologies like ***Ethernet, Token ring, Fibre channel, Infiband*** etc. On the other hand, **Ethernet Card** is a type of NIC, which is specific to Ethernet technology.

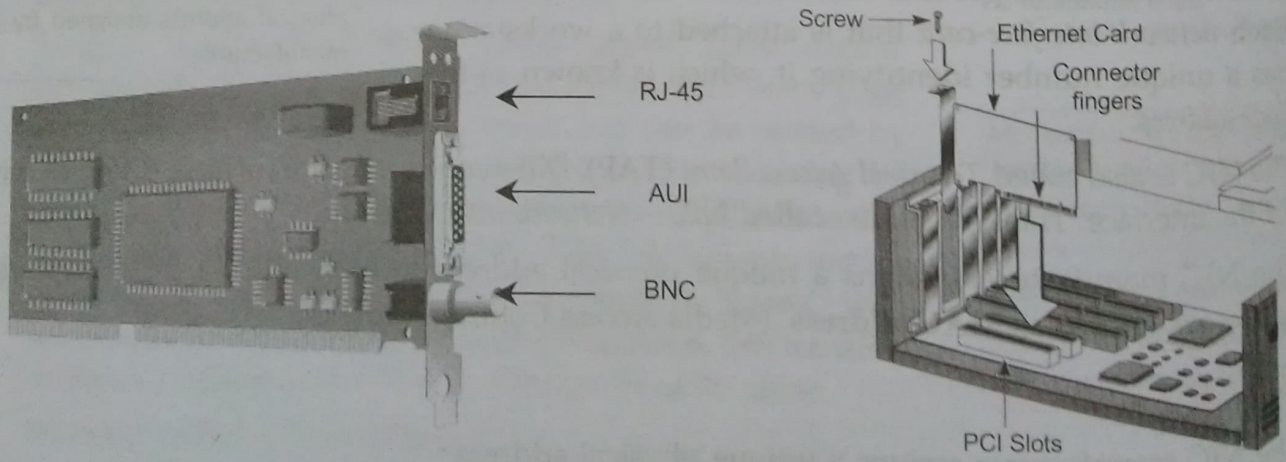
As mentioned earlier, Ethernet is a LAN architecture developed by *Xerox Corp* in association with DEC and Intel. Ethernet uses bus or star topologies and can support data transfer rates of upto 10 Gbps.

The computers that are part of Ethernet, have to install a special card called **Ethernet Card**.

NOTE

Ethernet is a LAN architecture developed by *Xerox Corp* along with DEC and Intel. Ethernet uses either a bus or star topology and supports data transfer rates of upto 10 Gbps. Ethernet can connect devices in wired LAN or WAN.

An Ethernet card contains connections for either coaxial or twisted pair cables (or both) [*see* Fig. 10.17(*a*)]. If it is designed for coaxial cable, the connection will be *BNC*[7]. If it is designed for twisted pair, it will have a RJ-45 connection. Some Ethernet cards also contain an *AUI* connector[8].



(*a*) Ethernet card and 3 types of connections it can support.

(*b*) How an Ethernet card is inserted in its slot on the motherboard.

Figure 10.17

7. **BNC Connector** (Bayone-Neill-Concelman). It is a standard connector used to connect *10Base2* coaxial cable (Ethernet specification for thin coaxial cable).
8. **AUI Connector** (Attachment Unit Interface) – A 15 pin connector found on Ethernet cards that can be used for attaching coaxial, fiber optic, or twisted pair cable.

Path Wala

This can be used to attach coaxial, twisted pair, or fiber optics cable to an Ethernet card. When this connection is used, there is always an external transceiver attached to the workstation. Figure 10.17(*b*) illustrates how an Ethernet card is inserted in its on the motherboard. Usually Ethernet cards are purchased separately from a computer, but these days many computers (such as the Macintosh) include an option for a pre-installed Ethernet card.

NOTE

NIC is the generic "Network Interface Card" for any network technologies like *Ethernet, Token ring, Fibre channel, Infiband band* etc. but Ethernet Card is a type of NIC, specific to Ethernet technology.

10.9.4 Hub

A **hub** is a hardware device used to connect several computers together. A *hub* contains multiple independent but connected modules of network and inter-networked equipment. A similar term is **concentrator**. A *concentrator* is a device that provides a central connection point for cables from workstations, servers, and peripherals.

Basically, hubs are multi-slot concentrators into which a number of multi-port cards can be plugged to provide additional access as the network grows in size. Hubs can be either *passive* or *active*.

- **Active hubs** electrically amplify the signal as it moves from one connected device to another. Active concentrators are used like *repeaters*[9] to extend the length of a network.
- **Passive hubs** allow the signal to pass from one computer to another without any change.

HUB

A **hub** is networking device having multiple ports that are used for connecting multiple computers or segments of a LAN together.

10.9.5 Switch

A switch is a device that is used to segment networks into different *subnetworks* called ***subnets*** or ***LAN segments***. Segmenting the network into smaller subnets, prevents traffic overloading in a network.

A switch is responsible for *filtering i.e.*, transforming data in a specific way and for forwarding *packets* (a piece of message being transmitted) between LAN segments. Switch can support any packet protocol. LANs that are segmented through switches are called *Switched LANs*.

How a Switch functions

To insulate the transmission from the other ports, the switch establishes a temporary connection between the source and destination, and then terminates the connection once the conversation is done.

A switch would be like a phone system with private lines in place of the hub's *party line*. For instance, *Meira Sen* at the Maurya Hotel calls *Ibrahim Soz* in another room, and the operator or phone switch connects the two of them on a dedicated line. This allows more conversations at any one time thereby allowing more guests to communicate.

10.9.6 Repeater

A *repeater* is a device that amplifies a signal being transmitted on the network. It is used in long network lines, which exceed the maximum rated distance for a single run.

REPEATER

A **Repeater** is a network device that amplifies and restores signals for long- distance transmission.

9. A repeater is a device that electrically amplifies the signal it receives and rebroadcasts it.

Path Wala

Over distance, the cables connecting a network lose the signal transmitted. If the signal degrades too much, it fails to reach the destination. Or if it does arrive, the degradation of the message makes it useless. *Repeaters* can be installed along the way to ensure that data packets reach their destination. *Repeaters* are of *two* kinds : *amplifier* and *signal repeater*. The first merely amplifies all incoming signals over the network. However, it amplifies both the signal and any concurrent noise. The second type collects the inbound packet and then retransmits the packet as if it were starting from the source station.

10.9.7 Bridge

A *bridge* is a device that lets you link two networks together. *Bridges* are smart enough to know which computers are on which side of the bridge, so they only allow those messages that need to get to the other side to cross the bridge. Bridges can handle networks that follow same protocols.

10.9.8 Router

A device that works like a bridge but can handle different protocols, is known as a *router*. For example, a router can link Ethernet to a mainframe. The router is responsible for forwarding data from one network to a different network.

If the destination is unknown to a router it sends the traffic (bound to unknown destination) to another router (using logical addresses) which knows the destination. Based on a network road map called a *routing table*, routers can help ensure that packets are travelling the most efficient paths to their destinations. If a link between two routers fails, the sending router can determine an alternate route to keep traffic moving.

A router differs from a bridge in a way that former uses logical addresses and the latter uses physical addresses.

ROUTER

A **Router** is a network device that forwards data from one network to another. A router works like a *bridge* but can handle different protocols.

10.9.8 Gateway

A *gateway* is a device that connects dissimilar networks. A gateway is actually a node on a network that serves as an entrance to another network. In enterprises, the gateway is the computer that routes the traffic from a workstation to the outside network that is serving the Web pages. In homes, the gateway is the ISP that connects the user to the Internet.

In enterprises, the gateway node often acts as a *proxy server* (a machine that is not actually a server but appears as a server) and a *firewall* (a system designed to prevent unauthorized access to or from a private network). The gateway is also associated with both a *router*, which use headers and forwarding tables to determine where packets are sent, and a *switch*, which provides the actual path for the packet in and out of the gateway.

GATEWAY

A **Gateway** is a network device that connects dissimilar networks. It establishes an intelligent connection between a local network and external networks with completely different structures.

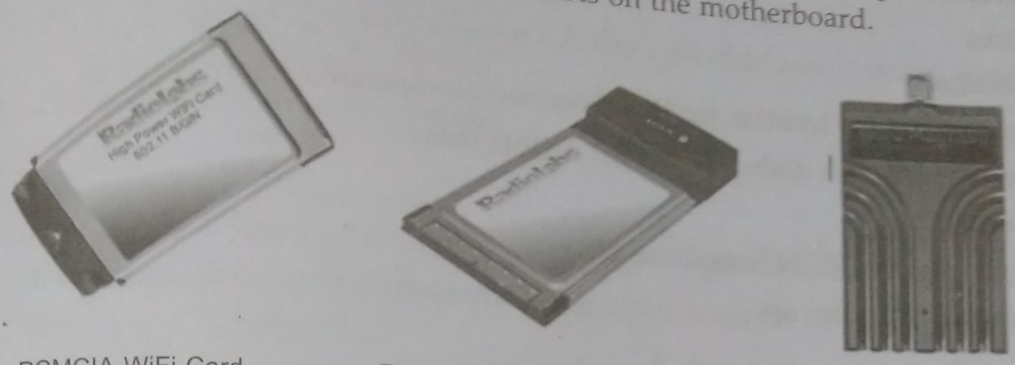
Check Point 10.3

1. What is a modem ? Name two categories of modems.
2. Define the following : (*i*) RJ-45 (*ii*) Ethernet (*iii*) Ethernet card (*iv*) hub (*v*) switch.
3. Define the following :
   (*i*) Protocol (*ii*) Host (*iii*) Repeater (*iv*) Bridge (*v*) Router (*vi*) Gateway.
4. Briefly explain file transfer protocol.
5. What is protocol ? Name some commonly used protocols.
6. What is TCP/IP ? What is HTTP ?
7. What is the purpose of using a gateway in context of networking ?
8. What is the purpose of using a repeater in context of networking ?

Path Wala

10.9.9 WiFi Card

A WiFi card is either an internal or external *Local Area Network adapter* with a built-in wireless radio and antenna. The most common WiFi cards used in desktop computers are PCI-Express WiFi cards made to fit the PCI-Express card slots on the motherboard.



PCMCIA WiFi Card | Express Card WiFi Card | USB WiFi Card

Figure 10.18 Various types of WiFi cards.

Benefits

The primary benefit of using a WiFi card in a desktop computer is that it allows you to setup your workstation or home office without considering the proximity or availability of hard line network access.

10.9.10 Network Devices and Components Checklists

1. When/why are hubs and switches required ?

Ans. Whenever one needs to form a network among multiples nodes and network devices, a device like hub or switch is needed.

2. How does a hub work ?

Ans. Hub is a multiport repeater, which broadcasts all information to all other ports. It causes unnecessary network traffic. Hence it is called non-intelligent or dumb device. [You can think of a hub as a dumb postman who does not know the house numbers, so he goes to every house and asks the owner if the letter is his ?]

Hub shares the media/bandwidth among all its connected nodes.

- Hub does not remember devices/computers connected to it, hence broadcasts all information to all connected computers, including the one that sent it.
- A hub can send or receive information, but it can't do both at a time.

Hub however is an inexpensive way to connect multiple nodes/devices to network.

The following checklists provide a general idea of the components for different types of networks.

For Building a small LAN

- Clients computers with NICs installed
- Server
- Hub
- Cabling
- Networking operating system software.

For Connecting Offices and Departments

- Clients with NICs installed
- Servers
- Hubs
- Switch
- Cabling
- Network OS software
- Router for shared Internet access (optional)

Path Wala

For Connecting Dispersed Office Sites

- Clients with NICs installed
- Servers
- Hubs
- Switches
- Routers at each location for WAN connec- tions/shared Internet access
- Access server for dialup access for remote users
- Cabling
- WAN service (ISDN/leased line etc.)
- Network OS software

Where to Place Server in a Network ?

The key to good network design is how you place clients in relation to servers. Ideally, client computers should be placed on the same "logical" network as the servers they access most often.

Here's a good rule of thumb. In a properly designed small to medium-sized network environment, **80 percent of the traffic on a given network segment is local** (destined for a target in the same workgroup), and **not more than 20 percent of the network traffic should need to move across a backbone** (the spine that connects various segments or *subnetworks*).

NOTE

In a properly designed small to medium-sized network environment, **80 percent of the traffic on a given network segment is local** (destined for a target in the same workgroup), and **not more than 20 percent of the network traffic should need to move across a backbone** (the spine that connects various segments or *subnetworks*).

For example, it a network connects the computers of three buildings having number of computers as :

Building A :	120 computers
Building B :	20 computers
Building C :	25 computers

Here as per the 80 : 20 rule, server should be placed in Building A as it hosts maximum number of computers.

Similarly, if a network connects four offices having number of computers as :

Office CP :	220
Office MR :	85
Office BR :	75
Office KG :	40

Then as per **80 : 20** rule, **Office CP** should house the server, to keep the maximum traffic local, as it has the maximum number of computers.

3. Why repeaters ?

Ans. When a signal travels along a cable, it tends to lose strength. A repeater is a device that boots or regenerates a network's signal as it passes through and rebroadcasts it.

4. When are repeaters required ?

Ans. Repeaters are mainly used for extending the range when the total length of network cable exceeds the standards set, for example, in fast ethernet, this range is 100 meters. And if you have to connect two computers that are more than 100 meters apart you need repeater.

These days, there are wireless repeaters also available. Wireless repeaters extend the range of wireless signals.

Path Wala

Choose Twisted Pair when.....

1. Low Cost – It is Cheap
2. Easy Installation — Easy to work with
3. No High Speed data requirements – It has Low data rate (Limited data rate (100MHz) and limited bandwidth (1MHz)
4. Transmission over a Short range

Other Important factors

- If used for Analog transmission —Amplifiers required every 5 km to 6 km
- If used for Digital transmission — Repeaters required every 2 km or 3 km (with fast Ethernet, every 100 mts)
- Susceptible to interference and noise

Choose Coaxial Cable when...

1. Television signal distribution has to take place
   - Ariel to TV
   - Cable TV
2. Long distance telephone transmission has to take place – Can carry 10,000 voice calls simultaneously
3. Short distance computer systems links required
4. Local area networks are to be formed among some computers

Other Important factors

- If used for Analog transmission — Amplifiers are required every 5 km to 6 km
- If used for Digital transmission — Repeaters are required every 1 km

Choose Fibre Optics when....

1. Greater Data capacity required—Data rates of hundreds of Gbps
2. Lower attenuation is required
3. Secure transmission is desired
4. Cost does not matter – most expensive of guided media

Other Important factors

- Greater repeater spacing —10s of km at least, *i.e.*, Repeater required every 10 kms

5. How does a switch work ?

Ans. A switch has same job as that of a hub's – *i.e.*, to connect multiple computers. But a switch is a smart device (not dumb as hub). It can identify the intended destination (use MAL address for this) and send the information only to the target computer(s). [Here, a switch is like a smart postman who knows the addresses of the recipients and goes only to the house where the letter is to be delivered.]

A switch does not share the media/bandwidth among all its connected computers.

- No unnecessary traffic generated
- Can send and receive information at the same time.

Switches, however, are expensive than hubs.

6. Difference between hub and switch.

Ans.

Hub	Switch
Repeats the incoming traffic to all connections	Sends traffic only to appropriate connections
Offers single lane connection, hence either send or receive at a time	Establishes two-lane communication, facilitating send and receives at the same time
Shares bandwidth among its connections	Does not share bandwidth, each connection gets full bandwidth
Inexpensive choice	Expensive than hubs

Path Wala

Choose Radio Waves when...

1. long distances are to be covered
2. Signals must be able to penetrate walls, buildings
3. Transmission must be omnidirectional (in all directions)

Other important factors

- Health hazards involved

Choose Microwave when...

1. Transmission should be in directional, in a specific direction straight line;
2. cheaper than other unguided media
3. can be used for long-distance telephone service

Other Important Factors

- Requires repeaters every 30 miles; Because of Line-of-sight transmission, curvature of the earth requires stations every 30 miles.

Choose Satellite when...

1. When the transmission has to take place over a very large area of Earth
2. Can be used for long distance Television distribution and Long-distance telephone transmission

Other important factors...

- expensive towers and repeaters
- subject to interference such as passing airplanes and rain

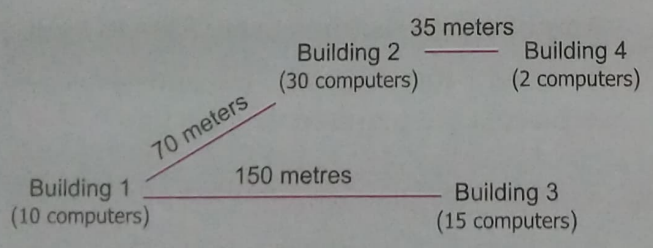
Choose Infrared when....

1. you want to transmit without any licensing hassles – no license needed

Other important factors

- cannot penetrate solid walls

7. Given the following layout, suggest and justify the placement of repeaters and switch/hub.



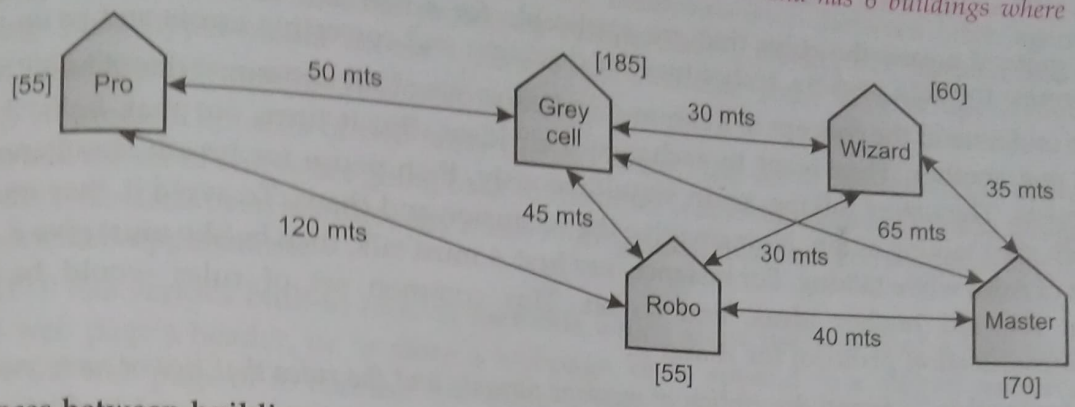
Ans. Placement of Repeater should be between Building 1 and Building 4 as their distance exceeds 100 meters.

Placement of Hub/Switch should be in Building 1, Building 2 and Building 2 as all these contain more than 2 computers.

In building2, however, the 2computers can be connected directly.

Path Wala

Example 10.1 *Lantastic corporation caters to many high profile clients and has 6 buildings where it runs its operations (shown below)*



The distances between buildings are shown through $\xleftrightarrow{\text{distance}}$ **in above diagram. The numbers in [ ] indicate number of computers in each building** *i.e.*,

- Building **Pro** has 55 computers
- Building **Wizard** has 60 computers
- Building **Master** has 70 computers
- Building **Greycell** has 185 computers
- Building **Robo** has 55 computers

Answer the following questions on the basis of above given information :

(*a*) **Suggest the possible cable layouts for the buildings.**

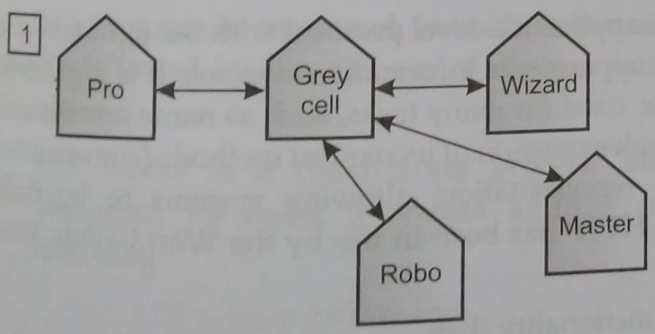
(*b*) **Where would you suggest the placement of server ?**

(*c*) **Suggest the cable type that should be used.**

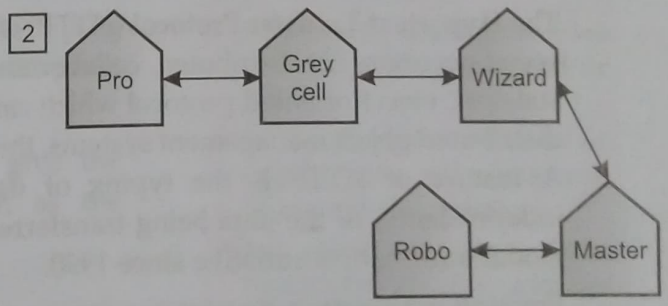
(*d*) **The management wants that the network traffic should be minimized. For this which network device would you suggest out of the following devices and why ?**

(*i*) **hub** (*ii*) **repeater** (*iii*) **bridge.**

Solution. (*a*) The possible cable layouts can be :



(Total cable length required to connect buildings through this layout = 190 mts)



(Total cable length required to connect buildings = 155 mts)

(*b*) As per **80-20** rule, the server should be placed in the building with maximum number of computers. Thus, we suggest that the server should be placed in *Grey Cell* building.

(*c*) *Thicknet coax* cable as these can support networks of upto 500 meters (1640 ft)

(*d*) To minimize traffic, we should try to stop data broadcast and for this *bridge* is ideally suited. This is because a bridge does not broadcast data rather it identifies the destination segment depending upon the receiver's MAC address.

Path Wala

10.10 NETWORK PROTOCOLS

A *protocol* means the rules that are applicable for a network. Protocol defines standardized formats for data packets, techniques for detecting and correcting errors and so on.

To understand the concept of a communication protocol, let us assume that *A* and *B* need to talk to one another. They want to exchange their ideas. But it turns out that, both, *A* and *B* are egoists. They start talking again simultaneously, then pause for breath simultaneously, and then start talking again. Now imagine the confusion and chaos. To avoid it, they must follow a set of rules while talking. For instance, say first *A* must talk, then he/she must give *B* a chance to put forward his/her ideas, and so on. This common set of rules would be known as communication protocol for *A* and *B*.

A protocol is *"a formal description of message formats and the rules that two or more machines must follow to exchange those messages."* We need protocols every time we want to do something on another computer. Every time we want to print something on a network printer we need protocols. Every time we want to download a file we need protocols. Every time we want to save our work on disk, we don't need protocols – unless the disk is on a network file server. Usually multiple protocols will be in use simultaneously. For one thing, computers usually do several things at once, and often for several people at once. Therefore, most protocols support *multitasking*[10]. Also, one operation can involve several protocols. For example, consider the NFS (Network File System) protocol. A write to a file is performed with an NFS operation, that uses another protocol to perform a function call on a remote host, that uses another protocol to deliver a datagram to a port on a remote host, that uses another protocol to deliver a datagram on an Ethernet, and so on.

PROTOCOL

A Protocol is a formal description of message formats and the rules that two or more machines must follow to exchange those messages.

Some most common protocols are being discussed below.

10.10.1 HTTP (Hypertext Transfer Protocol)

The **Hypertext Transfer Protocol** (HTTP) is an application-level protocol with the lightness and speed necessary for distributed, collaborative, hypermedia information systems. It is a generic, stateless, object-oriented protocol which can be used for many tasks, such as name servers and distributed object management systems, through extension of its request methods (commands). A feature of HTTP is the typing of data representation, allowing systems to be built independently of the data being transferred. HTTP has been in use by the World-Wide Web global information initiative since 1990.

Practical information systems require more functionality than simple retrieval, including search, front-end update, and annotation. HTTP allows an open-ended set of methods to be used to indicate the purpose of a request. It builds on the discipline of reference provided by the *Uniform Resource Identifier* (URI), as a *location* (URL) or *name* (URN), for indicating the resource on which a method is to be applied. Messages are passed to HTTP in a format similar to that used by Internet Mail and *Multipurpose Internet Mail Extensions* (MIME).

NOTE

HTTP (Hypertext Transfer Protocol) is the set of rules for transferring hypertext (*i.e.*, text, graphic, image, sound, video etc.) on WWW (World Wide Web)

10. Multitasking is a capability of a computer (in fact its CPU) to handle two or more tasks simultaneously.

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HTTP is also used as a generic protocol for communication between user agents and proxies/gateways to other Internet protocols, such as SMTP, NNTP, FTP, Gopher and WAIS, allowing basic hyper-media access to resources available from diverse applications and simplifying the implementation of user agents.

The HTTP protocol consists of two fairly distinct items : the set of requests from browsers to servers and the set of responses going back to the other way. Although HTTP was designed for use in the web, it has been intentionally made more general than necessary with an eye to future object-oriented applications.

The HTTP has various built-in request methods which allow users to read a web page, or to read a web page's header, or to store a webpage, or to append to a named resource, or to remove the web page or to connect two existing resources or to break an existing connection between two resources.

10.10.2 FTP (File Transfer Protocol)

One of the original services on the internet was designed to allow for transferring files from one system to another. It goes by the name *ftp* which stands for *file transfer protocol*. Files of any type can be transferred, although you may have to specify whether the file is an ASCII or binary file. They can be transferred to any system on the Internet provided that permissions are set accordingly.

FTP (File Transfer Protocol) is a standard for the exchange of files across Internet.

FTP offers these advantages :

(*i*) It is very useful to transfer files from one network in an organization to another.

(*ii*) It is an effective way to get a geographically dispersed group to co-operate on a project.

(*iii*) It is a potent and popular way to share information over the internet.

FTP isn't just the name of the protocol ; it is also the name of a program or command. Issue the command by typing *ftp* followed by the address of another site, and press enter.

FTP works as a client/server process. You give the command *ftp* using a remote address such as the following :

FTP newday.horizon.com

The ftp running on your system is client to an *FTP* process that acts as server on newday.horizon.com. You issue commands to the ftp process at newday, and it responds appropriately.

This protocol is mainly concerned with transfer of file.

Objectives of FTP are :

- to promote sharing of files (computer programs and/or data) ;
- to encourage indirect or implicit (via programs) use of remote computers ;
- to shield a user from variations in file storage systems among hosts ; and
- to transfer data reliably and efficiently. FTP, though usable directly by a user at a terminal, is designed mainly for use by programs.

10.10.3 TCP/IP (Transmission Control Protocol/Internet Protocol)

TCP/IP is a layered set of protocols. In order to understand what this means, it is useful to look at an example. A typical situation is sending mail. First, there is a protocol for mail. This defines a set of commands which one machine sends to another, *e.g.*, commands to specify who the

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sender of the message is, who it is being sent to, and then the text of the message. However this protocol assumes that there is a way to communicate reliably between the two computers. Mail, like other application protocols, simply defines a set of commands and messages to be sent. It is designed to be used together with TCP and IP. *TCP is responsible for making sure that the commands get through to the other end. It keeps track of what is sent, and retransmitts anything that did not get through.* If any message is too large for one datagram, *e.g.*, the text of the mail, TCP will split it up into several datagrams, and make sure that they all arrive correctly. Since these functions are needed for many applications, they are put together into a separate protocol, rather than being part of the specifications for sending mail. You can think of TCP as forming a library of routines that applications can use when they need reliable network communications with another computer. Similarly, TCP calls on the services of IP. Although the services that TCP supplies are needed by many applications, there are still some kinds of applications that don't need them. However there are some services that every application needs. So these services are put together into IP. As with TCP, you can think of IP as a library of routines that TCP calls on, but which is also available to applications that don't use TCP. This strategy of building several levels of protocol is called "layering". We think of the application programs such as mail, TCP, and IP, as being separate "layers", each of which calls on the services of the layer below it.

TCP/IP is the base com- munication protocol of the Internet. IP part of TCP/IP uses numeric IP addresses to join network segments and TCP part of TCP/IP provides reliable delivery of messages between networked computers.

Generally, TCP/IP applications use *four* layers :

(*i*) an application protocol (such as mail)

(*ii*) a protocol such as TCP that provides services need by many applications

(*iii*) IP, which provides the basic service of getting datagrams to their destination

(*iv*) the protocols needed to manage a specific physical medium, such as Ethernet or a point to point line.

DATAGRAM

A Datagram is a collection of the data that is sent as a single message.

10.10.4 SLIP/PPP

Slip (Serial Line Internet Protocol)

Serial Line IP (SLIP) was the first protocol for relaying IP packets over dial-up lines. It defines an encapsulation mechanism, but little else. There is no support for dynamic address assignment, link testing, or multiplexing different protocols over a single link. SLIP has been largely supplanted by PPP.

SLIP is for delivering IP packets over dial-up lines ; PPP is for transmitting IP packets over serial lines.

PPP (Point to Point Protocols)

PPP is the Internet Standard for transmission of IP packets over serial lines. The Point-to-Point Protocol (PPP), is currently the best solution for dial-up Internet connections, including ISDN. PPP is a layered protocol, starting with a Link Control Protocol (LCP) for link establishment, configuration and testing. Once the LCP is initialized, one or many of several Network Control

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Protocols (NCPs) can be used to transport traffic for a parti- cular protocol suite. The IP Control Protocol (IPCP), permits the trans- port of IP packets over a PPP link (*see* Fig. 10.19). PPP supports both synchronised and unsynchronised lines.

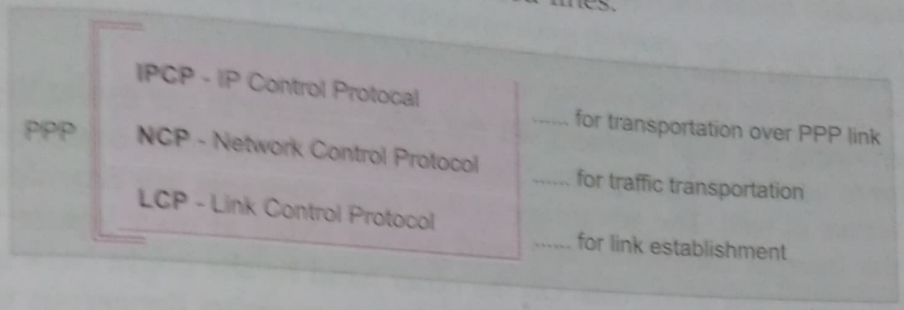

Figure 10.19 Layered PPP.

SLIP/PPP Overview

As we all are aware of the fact that a direct connection to the Internet represents the ultimate mode of access. But a direct connection (generally through leased lines) is too expensive for an individual user. The individual user rather shall opt for a dial-up connection, and this is where role of SLIP/PPP begins.

A compromise between a direct Internet connection and a dial-up connection is to use SLIP or PPP. Both SLIP and PPP are similar in many ways, hence we shall be referring to them as SLIP/PPP henceforth.

SLIP/PPP provides the ability to transport TCP/IP traffic ever serial line (*e.g.*, telephone lines) between two computers. Both of these computers are supposed to run some sort of TCP/IP based network software. This enables a home user to avail direct Internet access for her own PC via a simple modem and a telephone line, at a very low cost. The SLIP/PPP enables one to run one's favourite GUI based browser, ftp client etc. for one's own PC.

SLIP/PPP provides a form of direct Internet connection in the sense that :

- The home user's computer has a communications link to the Internet even if it is via a service provider (ISP).
- The home user's computer has the networking software that can speak TCP/IP with other computers on the Internet.
- The home user's computer has an identifying address (IP address) at which it can be contacted by other computers on Internet.

10.10.5 Protocols used in Email

Basically, a protocol refers to standard set of rules used at each end of a communication channel, in order to properly transmit information. In order to deal with your email you must use a mail client to access a mail server. The mail client and mail server can exchange information with each other using a variety of protocols. The protocols mainly used with email accessing are *IMAP, POP3, SMTP* and *HTTP*.

Let us briefly talk about these.

IMAP (*Internet Message Access Protocol*) is a standard protocol for accessing e-mail from local server. IMAP is a client/server protocol in which e-mail is received and held for the user by Internet server. As this requires only a small data transfer this works well even

IMAP

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over a slow connection such as a modem. Only if the user requests to read a specific email message, then it will be downloaded from the server. You can also create and manipulate folders or mailboxes on the server, delete messages etc.

POP3 The **POP** (*Post Office Protocol 3*) protocol provides a simple, standardized way for users to access mailboxes and download messages to their computers.

When using the POP protocol, all the eMail messages get downloaded from the mail server to user's local computer. The user can choose to leave copies of his/her eMails on the server as well. The advantage is that once messages are downloaded, the user can cut the Internet connection and read his/her eMail at own leisure without incurring further communication costs. On the other hand he/she might have transferred a lot of message (including spam or viruses), which may prove dangerous for data on PC.

SMTP The **SMTP** (*Simple Mail Transfer Protocol*) protocol is used when you send email to another email users(the recipient). The SMTP protocol is used by the Mail Transfer Agent (MTA) to deliver the sent eMail to the recipient's mail server. The SMTP protocol can only be used to send emails, not to receive them. Depending on the network / ISP settings, user may only be able to use the SMTP protocol under certain conditions

HTTP The **HTTP protocol** is not a protocol dedicated for email communications, but it can be used for accessing mailbox. Also called web based email, this protocol can be used to compose or retrieve emails from an email account. *Hotmail, Gmail, Ymail, Rediffmail* etc are good examples of using HTTP as an email protocol.

10.11 WIRELESS/MOBILE COMPUTING

This section is going to discuss about wireless and mobile computing technologies. But before discussing various wireless and mobile technologies, you must be clear about what wireless and mobile computing is and the difference between the two.

10.11.1 Wireless vs. Mobile Computing

Wireless refers to the method of transferring information between a *computing device*, such as a personal data assistant (PDA), and a *data source*, such as an agency database server, without a physical connection. Not all wireless communications technologies are mobile.

Mobile simply describes a computing device that is not restricted to a desktop. A mobile device may be a PDA, a "smart" cell phone or Web phone, a laptop computer, or any one of numerous other devices that allow the user to complete computing tasks without being tethered, or connected, to a network. Mobile computing does not necessarily require wireless communication. In fact, it may not require communication between devices at all.

Wireless communication is simply data communication without the use of landlines. This may involve cellular telephone, two-way radio, fixed wireless, laser, or satellite communications. Here the computing device is continuously connected to the base network.

Mobile, or "untethered," computing means that the computing device is not continuously connected to the base or

WIRELESS COMMUNICATION

Wireless communication is simply data communication without the use of landlines.

MOBILE COMPUTING

Mobile computing means that the computing device is not continuously connected to the base or central network.

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central network. Mobile devices include PDAs, laptop computers, and many of today's cell phones (aptly called "smart phones"). These products may communicate with a base location with or without a wireless connection.

Following list gives you an idea of different computing devices, which can be either wireless or mobile or both.

Wireless	vs. Mobile	Examples
×	×	Stationary computer
×	✓	Notebook in a hotel
✓	×	Wireless LANs in historic buildings
✓	✓	Personal Digital Assistant (PDA)
✓	✓	Smart phones, pagers

10.11.2 Wireless/Mobile Computing Technologies

Let us now talk about various technologies and interfaces used for wireless and mobile computing.

1. GSM

GSM is short for ***Global System for Mobile*** *communications*, which is one of the leading digital cellular systems. The GSM standard for digital cell phones was established in Europe in the mid 1980s. GSM has now become the international standard in Europe, Australia and much of Asia and Africa.

In covered areas, cell-phone users can buy one phone that will work anywhere where the standard is supported. To connect to the specific service providers in these different countries, GSM users simply switch **subscriber identification module** (SIM) cards. *SIM cards are small removable disks that slip in and out of GSM cell phones.* They store all the connection data and identification numbers you need to access a particular wireless service provider. Unfortunately, the 1900-MHz GSM phones used in the United States are not compatible with the international system.

NOTE

TDMA works by dividing a radio frequency into time slots and then allocating slots to multiple calls. In this way, a single frequency can support multiple, simultaneous data channels.

GSM uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency. TDMA is short for *Time Division Multiple Access*, a technology for delivering digital wireless service using time-division multiplexing (TDM). TDMA works by dividing a radio frequency into time slots and then allocating slots to multiple calls. In this way, a single frequency can support multiple, simultaneous data channels.

GSM digitizes and compresses voice data, then sends it down a channel with other streams of user data, each in its own time slot. GSM systems use **encryption** to make phone calls more secure. GSM operates in the 900-MHz and 1800-MHz bands in Europe and Asia, and in the 1900-MHz (sometimes referred to as 1.9-GHz) band in the United States. It is used in digital cellular and **PCS-based** systems. GSM is also the basis for **Integrated Digital Enhanced Network** (IDEN), a popular system introduced by Motorola and used by Nextel.

NOTE

GSM uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency.

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What is a SIM card ?

The SIM – Subscriber Identity Module – is a chip card, the size of a first class postage stamp. It is a key element in over 600 million *GSM* (*Global System for Mobile*) mobile phones – representing about 70 percent of the mobile handset market.

A SIM is actually a tiny computer chip that gives a cellular device its unique phone number. It has memory (for data and applications), a processor and the ability to interact with the user. Current SIMs typically have 16 to 64 kb of memory, which provides plenty of room for storing hundreds of personal phone numbers, text messages and other data.

2. CDMA

CDMA is short for ***Code-Division Multiple Access***, a digital cellular technology that uses *spread-spectrum* techniques. Unlike competing systems, such as GSM, that use *TDMA*, CDMA does not assign a specific frequency to each user. Instead, every channel uses the full available spectrum. Individual conversations are encoded with a pseudo-random digital sequence. CDMA is a form of *spread spectrum*, which simply means that data is sent in small pieces over a number of the discrete frequencies available for use at any time in the specified range. All of the users transmit in the same **wide-band** chunk of spectrum. Each user's signal is spread over the entire bandwidth by a **unique spreading code**. At the receiver end, that same unique code is used to recover the signal.

CDMA is a military technology first used during World War II by the English allies to foil German attempts at jamming transmissions. The allies decided to transmit over several frequencies, instead of one, making it difficult for the Germans to pick up the complete signal.

NOTE

CDMA (Code Division Multiple Access) uses a spread-spectrum technique where data is sent in small pieces over a number of discrete frequencies. Each user's signal is spread over the entire bandwidth by unique spreading code. At the receiver end, the same unique code is used to recover the signal.

3. WLL

Wireless in Local Loop (**WLL** or **WiLL**), is meant to serve subscribers at homes or offices. **Wireless local loop** is analogous with local telephone service, but much more capable. A WLL system serves a local area by deploying a multiplicity of multichannel *transmit/receive base stations* (**transceivers**) that are within line-of-site of the intended customers. Each customer is equipped with a *mini-station of low power*, into which the telephone (or PBX) is connected. The WLL unit consists of ***a radio transceiver*** and the ***WLL interface*** assembled in one metal box. Two cables and a telephone connector are the only outlets from the box; one cable connects to a directional antenna and a phone receptacle to connect to a common telephone set. A fax or modem could also be connected for fax or computer communication.

When calls are made from the telephone, it signals the *base station* for a connection, which is subsequently established through a *switch center*, exactly as in conventional telephony. An incoming call is identified at the *switch center* and routed to the *base station* assigned to serve the telephone being called. The wireless connection is then made, and the call is completed in a conventional manner.

In WLL services, the telephone provided is expected to be as good as wired phone. Its voice quality must be high – a subscriber carrying out long conversation must not be irritated with quality; one must be able to use speakerphones, cordless phones and parallel phones. The telephone must support fax and modem communications and should be connectable to a Public Call Office.

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The point-to-point signal transmissions occur through the air over a terrestrial microwave platform rather than through copper or fiber cables; therefore, fixed wireless does not require satellite feeds or local phone service. The advantages of fixed wireless include the ability to connect with users in remote areas without the need for laying new cables and the capacity for broad bandwidth that is not impeded by fiber or cable capacities.

NOTE

WLL is a system that connects subscribers to the public switched telephone network (PSTN) using radio signals as a substitute for other connecting media.

The WLL system can operate with GSM Handsets/Mobile Units, as well as with GSM compatible Subscriber Units. The system is transparent to the Central Office and subscribers, and interfaces with the most standard Central Office Switches and subscriber telephone equipment.

Advantages of WLL

(*i*) Lacking exterior plant, reliability is greatly enhanced; as well designed WLL facilities do not significantly suffer from weather damage, vandalism, and accidents.

(*ii*) WLL system offers better bandwidth than traditional telephone systems.

(*iii*) Most important, because the WLL system has much better bandwidth than traditional telephone systems, superior customer service features and quality can be provided.

(*iv*) WLL systems support high quality data transmission, signaling services, and all the most advanced customer service features.

4. GPRS

GPRS is the abbreviation for **General Packet Radio Service**. GPRS is used for wireless communication using a mobile device. With this service you can access the Internet, send emails and large data. You can also watch real time News, download games and watch movies.

GPRS

GPRS is a technology for radio transmission of small packets of data esp. between mobile devices and Internet.

How does GPRS work ?

You must be aware of how files are transferred from one location to another on your computer. They are broken down into Packets and sent across. Similarly GPRS also uses the same function to transfer data through a network. The information is split into smaller units or Packets and sent through the network and is reassembled at the receiving end. GPRS provides a high-speed data transfer, typically between 56 Kbits per second to 110 k bits per second. A user of the GPRS network is charged only on the amount of data is sent or received as opposed to the duration of the connection.

5. 1G, 2G, 3G, 4G and 5G Networks

The "G" in wireless networks refers to the "generation" of the underlying wireless network technology.

Technically generations are defined as follows :

1G networks (*NMT, C-Nets, AMPS, TACS*) are considered to be the first analog cellular systems, which started early 1980s. There were radio telephone systems even before that. 1G networks were conceived and designed purely for voice calls with almost no consideration of data services (with the possible exception of built-in modems in some headsets).

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2G networks (*GSM, CDMAOne, D-AMPS*) are the first digital cellular systems launched early 1990s, offering improved sound quality, better security and higher total capacity. GSM supports circuit-switched data (CSD), allowing users to place dial-up data calls digitally, so that the network's switching station receives actual ones and zeroes rather than the screech of an analog modem.

NOTE

3G (Third Generation) mobile communications technology is a broadband, packet-based transmission of *text, digitized voice, video,* and *multimedia* at data rates up to and possibly higher than *2 megabits per second (Mbps)*, offering a consistent set of services to mobile computer and phone users no matter where they are located in the world.

2.5G networks (*GPRS, CDMA2000 1x*) are the enhanced versions of 2G networks with theoretical data rates up to about 104 kbit/s. GPRS offered the first always-on data service.

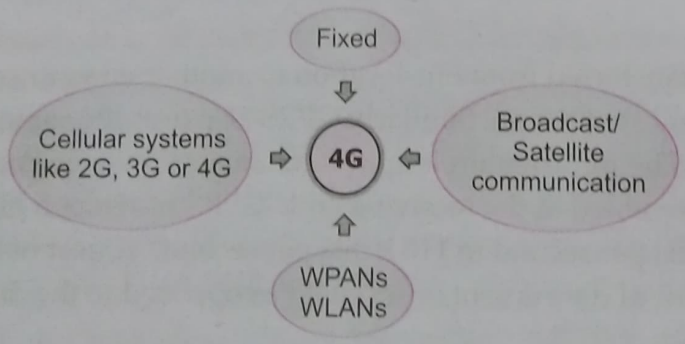
3G networks (*UMTS FDD and TDD, CDMA2000 1x EVDO, CDMA2000 3x, TD-SCDMA, Arib WCDMA, EDGE, IMT-2000 DECT*) are newer cellular networks that have data rates of 384kbit/s and more.

The UN's IMT-2000 standard requires stationary speeds of 2Mbps and mobile speeds of 384kbps for a "true" 3G.

4G networks. 4G is all about faster Internet speeds – it offers no improvement in making calls or sending texts but very fast web-experience compared to 3G. Fourth generation (4G) technology offers many advancements to the wireless market such as *downlink data rates well over 100 Mbps, low latency, very efficient spectrum use* and *low-cost implementations*.

4G is all about **convergence**; convergence of wired and wireless networks, wireless technologies including GSM, wireless LAN, and Bluetooth as well as computers, consumer electronics, communication technology and several others.

4G wireless technology is also referred to by "**MAGIC**" which stands for *Mobile multimedia, Any-where, Global mobility solutions over, Integrated wireless and Customized services*.



NOTE

4G is a Mobile multimedia, Network System width anytime anywhere Global mobility support, integrated wireless solution, and Customized Personal Service.

4G is an all IP-based integrated system will be capable to provide 100 Mbps for high mobility and 1 Gbps for low mobility, with end-to-end QoS and high security, and will offer *various services at any time as per user requirements, anywhere with seamless interoperability, at affordable cost.* The user services include *IP telephony, ultra-broadband Internet access, gaming services* and *High Definition Television (HDTV) streamed multimedia*. Underneath 4G will use technologies like *WiMAX* and *LTE* (Long Term Evolution) etc.

5G networks. 5G is the fifth generation of wireless communication technologies supporting cellular data networks. 5G networks promise to provide speeds of upto 100 gigabites per second. 5G is set to be 40 to 100 times faster than 4G networks.

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Table 10.3 Comparison of Wireless Communication Technologies

Technology	1G	2G/2.5G	3G	4G	5G
Development	1970/1984	1980/1999	1990/2002	2000/2010	2014/2015
Bandwidth	2 kbps	14-16 kbps	2 mbps	200 mbps	> 1 gpps
Technology	Analog cellular	Digital cellular	Broadband/ CDMA/IP technology	unified IP & seamless combo of LAN/WAN/ WLAN/PAN	4G + WWW
Services	Mobile technology (Voice only)	Digital voice/ Short messaging (SMS), Media	Integrated high quality audio, video & data	Data + Voice converged over IP	Better quality voice with super high speed data transmission
Switching	Circuit	Circuit/Circuit for access network & air interface	Packet network	Internet	Internet

6. Some More Mobile Communication Technologies

Mobile communication technologies are ever evolving. Some other mobile communication technologies are listed below :

EV-DO

Shorthand for CDMA2000 1xEV-DO (also known as IS-856), a CDMA based 3G technology developed by Qualcomm and supported by the 3GPP2 that builds on 1X and supports entirely packet based networks. Rev A, the most deployed version of the technology, is capable of peak rates of 3.1 Mbit/s in a 1.25 MHz channel.

HSPA

High Speed Packet Access is an amalgamation of High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA) that supports increased peak data rates of up to 10 Mbit/s in the downlink and 5.76 Mbit/s in the uplink. Evolved HSPA (also known as HSPA+) is a wireless broadband standard that provides data rates up to 84 Mbit/s in the downlink and 22 Mbit/s in the uplink (per 5 MHz carrier) with MIM) technologies and higher order modulation.

IMS

IP Multimedia Subsystem is an architectural framework for delivering Internet Protocol (IP) multimedia services, originally designed by the 3GPP as a part of the vision for evolving mobile networks beyond GSM.

LTE (Long Term Evolution)

A OFDMA based 3GPP standard, generally branded as 4G, that uses an all-IP flat network architecture and is capable of peak downlink speeds 100 Mbit/s and uplink speeds of 50 Mbit/s when deployed in a 20 MHz channel, and even higher rates if used with MIMO to deploy LTE in multiple channels.

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X LTE-Advanced

A 3GPP standard that builds off LTE, offering even greater channel flexibility and peak data rates of more than 1 Gbit/s.

WiMax (Worldwide Interoperability for Microwave Access)

WiMax refers to set of implementations of the IEEE's 802.16 wireless network standards supported by the WiMax Forum, which certifies vendor equipment to ensure interoperability. WiMax requires an all-IP, network architecture and makes uses of OFDMA, and generally uses unpaired.

WiMax 2

The common name for 802.16m, which is truly 4G WiMax technology capable of mobile data speeds up to 120 Mbit/s in a single 20 MHz channel. 802.16m will succeed 802.16e, with which it is backwards compatible.

7. Mobile Processors

As per *Mobile World Congress 2017*, there will be about Five billion mobile phone users in 2017 in India. The popularity of mobile phones of today is because one small machine is capable of serving your various needs like communications, *text creation, sending receiving messages, calculator, alarm clock, audio video recording, camera, music player* etc.

All this and even more is delivered to you in a small compact machine. All this is made possible by one essential and often-overlooked element that's largely responsible for the speed, efficiency, and *battery life* of your smartphone—the **processor**.

Let's take a look at various parts of the processor that work together to enable seamless actions.

- **CPU, or Central Processing Unit.** It receives commands, makes instant calculations, and sends signals throughout your device.
- **GPU, or Graphics Processing Unit.** The GPU assists the CPU by handling the visuals, even for games and other graphically-rich applications.
- **Camera ISP (Image Signal Processor).** It provides instant image capture, high-resolution support, image stabilization, and other image enhancements.
- **Audio and Video.** It is a dedicated processing unit for handling audio and video.
- **Radio (RF Transceiver) & 3G/4G Modem.** The RF Transceiver receives and transmits voice connections and the modem enables your phone to send and receive digital signals over high-speed cellular wireless network or Wi-Fi connection.

Smartphones or the mobile phones you use today claim about their performance only because of the capabilities and power of their processors.

Some mobile processors of today's age are :

Qualcomm Snapdragon *Snapdragon 835, Snapdragon 820* etc. ;

Samsung EXYNOS 8890, 7570, 7420 etc. ;

Huawei KIRIN 960, 955, 950 etc. ;

Nvidia TEGRA X1, K1 etc. ;

MediaTek Helio P10, P20, X20, X30 etc. ;

Apple A8, A9, A10 etc.

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8. SMS

Short Message Service (SMS) is the transmission of short text messages to and from a mobile phone, fax machine and/or IP address. Messages must be no longer than some fixed number of alpha-numeric characters and contain no images or graphics.

Once a message is sent, it is received by a *Short Message Service Center* (SMSC), which must then get it to the appropriate mobile device.

To do this, the SMSC sends a SMS Request to the *home location register* (HLR) to find the roaming customer. Once the HLR receives the request, it will respond to the SMSC with the subscriber's status : (1) inactive or active (2) where subscriber is roaming.

NOTE

Short Message Service (SMS) is the transmission of short text messages to and from a mobile phone, fax machine and/or IP address.

9. Chat

Chatting is the most fantastic thing on Internet. Chatting is like a text-phone. In a telephonic conversations, you say something, people hear it and respond, you hear their responses on the spot and can reply instantly. In the same manner, in chatting, you type a message on your screen, which is immediately received by the recipient ; then the recipient can type a message in response to your message, which is received by you instantly.

CHATTING

Online textual talk, in real time, is called Chatting.

10. Video Conferencing

The next dimension in Internet communication is the videophone. People who have a multimedia PC with a camera and video compression handware, access to Internet over an ordinary telephone line, and videophone software can see each other while talking, which is what is called *video conferencing*.

VIDEO CONFERENCING

A two-way videophone conversation among multiple participants is called Video Conferencing.

11. Protocols for Chat and Video Conferencing

With the advent of Internet, communication formats such as chat and video- conferencing etc have gained popularity. In this section, we shall talk about some common chat and video conferencing protocols.

- Most common chat protocol is **IRC** (Internet Relay Chat)
- Most common video-conferencing protocols are: **H.323** and **SIP** (Session Initiation Protocol)

Chat protocol IRC

The IRC (Internet Relay Chat) protocol is a simple, text-based conferencing protocol, involving a number of users spread across a number of interconnected servers. These users may chat with other individual users, or may chat with groups of users on "channels"—what other chat systems refer to as "rooms" or "chat rooms".

A typical setup in *Internet Relay Chat (IRC)* network involves a single process (the server) forming a central point for clients (or other servers) to connect to, performing the required message delivery/multiplexing and other functions. The server forms the backbone of IRC,

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providing a point to which clients may connect to talk to each other, and a point for other servers to connect to, forming an IRC network. The only network configuration allowed for IRC servers is that of a spanning tree where each server acts as a central node for the rest of the net it sees.

Video-conferencing protocol H.323

H.323 is a standard that specifies the components, protocols and procedures that provide multimedia communication services - real-time audio, video, and data communications - over packet-based networks (including the Internet). H.323 is part of a family of ITU-T (International Telecommunications Union) recommen- dations called H.32x that provides multimedia communication services over a variety of networks. These standards define how components that are built in compliance with H.323 set up calls, exchange compressed audio and video, participate in multiunit conferences, and operate with non-H.323 endpoints.

H.323 provides various services and, therefore, can be applied in a wide variety of areas - consumer, business, and entertainment applications. It can be applied in a variety of mechanisms :

- audio only (IP telephony);
- audio and video (video telephony);
- audio and data;
- and audio, video and data.
- H.323 can also be applied to multipoint-multimedia communications.

Two popular video- conferencing protocols are :

- H.323
- SIP

Video-conferencing protocol SIP

SIP, short for **Session Initiation Protocol** is an IP telephony signaling protocol used to establish, modify and terminate VOIP telephone calls. SIP works with both IPv4 and IPv6. For Internet telephony sessions, SIP works as follows :

Callers and callees are identified by SIP addresses. When making a SIP call, a caller first locates the appropriate server and then sends a SIP request. The most common SIP operation is the invitation. Instead of directly reaching the intended callee, a SIP request may be redirected or may trigger a chain of new SIP requests by proxies. Users can register their location(s) with SIP servers. SIP addresses (URL) can be embedded in Web pages and therefore can be integrated as part of powerful implementations such as Click to talk.

SIP can establish, modify, and terminate multimedia sessions such as Internet telephony calls (VoIP – Voice over IP). SIP can also invite participants to already existing sessions, such as multicast conferences. Media can be added to (and removed from) an existing session. SIP transparently supports name mapping and redirection services, which supports personal mobility.

SIP has taken the VoIP world by storm. The protocol resembles the HTTP protocol, is text based, and very open and flexible. It has therefore largely replaced the H.323 standard.

12. Voice over Internet Protocol, VoIP

VoIP is a technology that enables voice communications over the Internet through the compression of voice into data packets that can be efficiently transmitted over data networks

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and then converted back into voice at the other end. Data networks, such as the Internet or local area networks (LANs), have always utilized packet-switched technology to transmit information between two communicating terminals (for example, a PC downloading a page from a web server, or one computer sending an e-mail message to another computer).

The most common protocol used for communicating on these packet-switched networks is Internet protocol, or IP. VoIP allows for the transmission of voice along with other data over these same packet-switched networks and provides an alternative to traditional telephone networks, which use a fixed electrical path to carry voice signals through a series of switches to a destination.

13. Connecting Wirelessly to Internet

These days you can also connect to Internet wirelessly. Two most common ways to connect to Internet wirelessly are :

(i) Wi-Fi

Wi-Fi refers to *Wireless Fidelity*, which lets you connect to the Internet without a direct line from your PC to the ISP. For Wi-Fi to work, you need :

- A broadband Internet connection.
- A wireless router, which relays your Internet connection from the "wall" (the ISP) to the PC.
- A laptop or desktop with a wireless internet card or external wireless adapter.

Transmitting computer data without wires makes your data especially susceptible to hackers, computer users who can intercept your connection and steal your data. If you decide to use Wi-Fi at home, be sure that the network you set up is security-enabled.

Wi-Fi Hotspots. A hotspot is a venue that offers Wi-Fi access. The public can use a laptop, WiFi phone, or other suitable portable device to access the Internet through a WiFi Hotspot. Hotspots are public locations (such as libraries, hotels, airports, and local bookstores and restaurants etc.) with free or fee-based wireless Internet access. There are Wi-Fi hotspots in thousands of locations around the world. Figure 10.20(*a*) shows a WiFi Network.

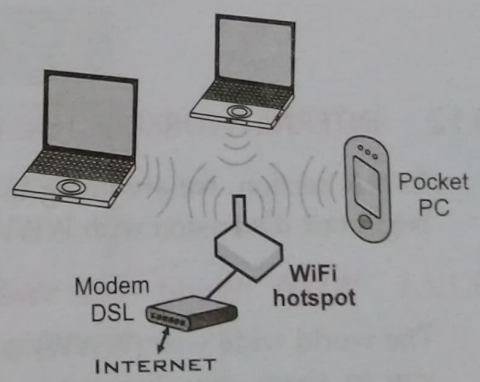

Figure 10.20 (*a*) A Wi-Fi Network

Check Point 10.4

1. Define Mobile Communication and Wireless Communication.
2. Define GSM, CDMA, WLL.
3. Compare 1G, 2G and 3G networks.
4. Define the following :
   (*i*) 3G (*ii*) EDGE (*iii*) SMS (*iv*) TDMA.
5. Name some chat and video conferencing protocols.
6. What is VoIP ?
7. Discuss the two technologies to connect to Internet wirelessly.

(ii) WiMax

WiMAX is a wireless digital communications system. WiMAX can provide broadband wireless access (BWA) up to 30 miles (50 km) for fixed stations, and 3-10 miles (5-15 km) for mobile stations. In contrast, the WiFi wireless local area network standard is limited in most cases to only 100-300 feet (30-100 m).

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WiMax requires a tower called *WiMax Base Station* [see Fig. 10.20(*b*)], similar to a cell phone tower, which is connected to the Internet using a standard wired high-speed connection. But as opposed to a traditional Internet Service Provider (ISP), which divides that bandwidth among

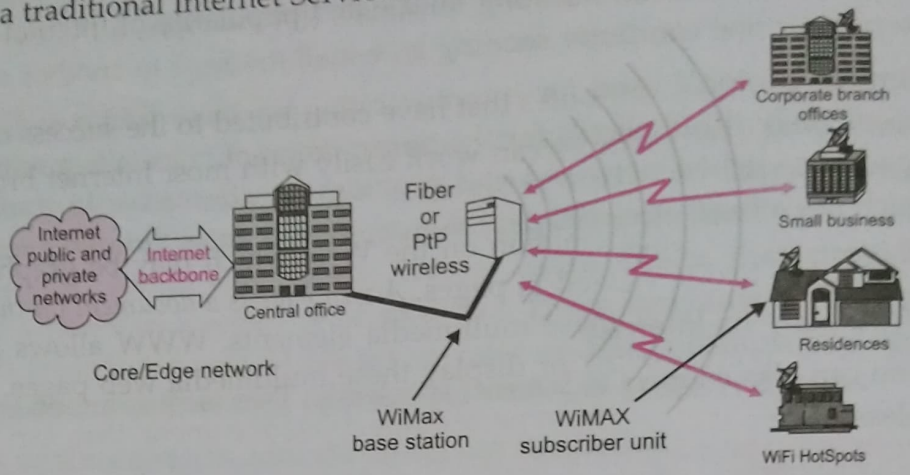

Figure 10.20 (*b*) WiMax Connection.

customers via wire, it uses a microwave link to establish a connection. In other words, WiMax does not depend on cables to connect each endpoint, the Internet connectivity to an end-user is provided through microwave link between the tower and the user-endpoint, known as WiMax Subscriber unit.

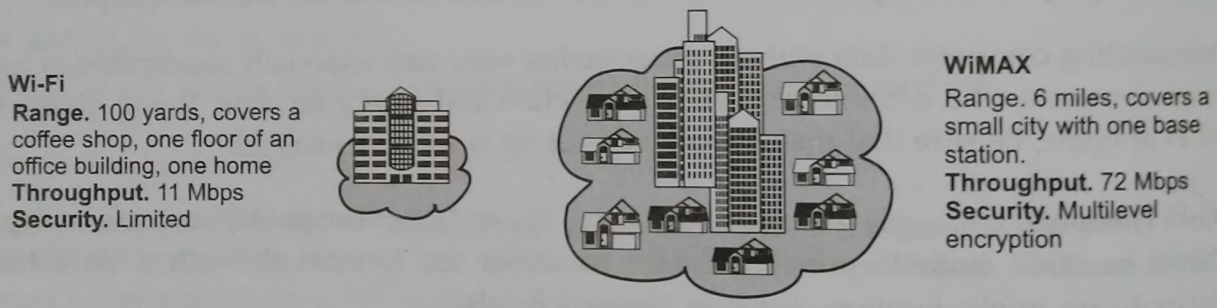

Figure 10.20 (*c*) Wi-Fi vs. WiMax

10.12 INTERNETWORKING TERMS AND CONCEPTS

In this section, we are going to discuss various internetworking terms and concepts. Let us begin our discussion with WWW.

10.12.1 WWW (World Wide Web)

The world wide web (WWW) is a set of protocols that allows you to access any document on the Net through a naming system based on URLs[1]. WWW also specifies a way—the hypertext Transfer protocol (HTTP) – to request and send a document over the internet. With these standard protocols of WWW in place, one can set up a server and construct hypertext documents with links in them that point to the documents on the server.

NOTE

Some people mistake WWW for Internet. But in real terms, WWW is a small part of Internet. We can say that Internet is a highway that offers lot many services, features etc. And WWW is a truck that uses this highway.

1. URL means Uniform Resource Locator. It is a pointer to information on the WWW. It can include pointers to other types of resources such as ftp servers and gopher servers in addition to WWW servers.

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Before WWW, Internet was mainly used for obtaining textual information. But post-WWW, the Internet popularity grew tremendously because of graphic-intensive nature of WWW. Therefore, we may attribute the explosion in use and popularity of Internet to WWW only.

WWW Attributes

Let us have a look at various attributes that have contributed to the success of WWW.

(i) **User-friendly**. WWW resources can work easily with most Internet browsers, which are very user-friendly.

(ii) **Multimedia Documents.** Information on the Web, which may be graphics, audio, video, animations and text is viewed in **pages.** *A web page is a document on the Internet* that can contain text plus any of these multimedia elements. WWW allows and supports the Internet users to create, link or display these multimedia web pages.

(iii) **Hypertext and Hyperlinks.** A hypertext file is a document that can incorporate text, graphic images, audio and video tracks, and most importantly, *dynamic links* to related files or documents, even on net. These *dynamic links* are called ***hyper links***.

The WWW supports fully these hypertext files and hyperlinks. Thus net surfing seems very easy to the users.

(iv) **Interactive.** WWW, with its pages, supports and enables interactivity between users and servers through one or more of the following ways :

- hyperlinks
- input boxes
  e.g., radio buttons, check-boxes, text-boxes etc.

Fig. 10.21 shows such an inter- active web page on WWW.

(v) **Frames.** WWW also supports frames. **Frames** is the display of more than one independently controllable section on single web page. Fig. 10.21 shows you a web page containing frames.

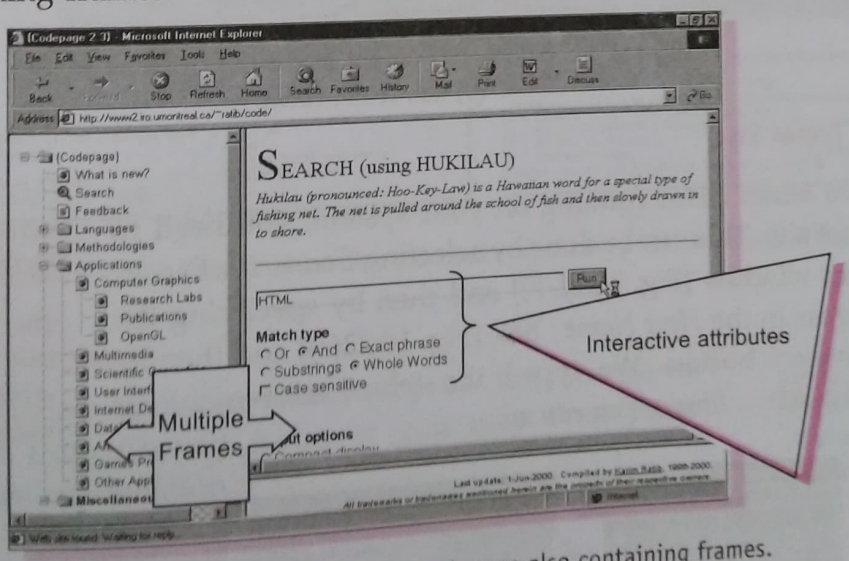

Figure 10.21 An interactive web page also containing frames.

10.12.2 Telnet

Telnet is an older Internet utility that lets you log on to remote computer systems. Basically, a Telnet program gives you a character-based terminal window on another system. You get a login prompt on that system. If you've permitted access, you can work on that system, just as you would if you were sitting next to it.

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Traditionally, Telnet has been used by people who have logins on remote systems and wanted to do serious work there.

But Telnet has some additional uses that are more relevant to people who are exploring the Internet. Most notably, you can use Telnet to connect to thousands of catalogs at libraries around the world. This capability is wonderful for anyone doing serious research, knowing being able to find out which books in your particular discipline are available at a number of specialty libraries in remote locations—all while you plug away at your desk.

To find out about available Telnet resources of all kinds, you may go to

http:// www.lights.com/hytelnet/

In the following subsection, we'll run an example Telnet session, to make you understand the working and use of Telnet session.

TELNET

Telnet is an Internet utility that lets you log onto remote computer systems.

A Sample Telnet Session

To run a telnet session, you first have to run the Telnet client and then connect to the desired Telnet site.

All this is illustrated in following steps :

(*i*) Run Telnet Client

To do this, firstly, click at *Start* → *Run* command and then type *Telnet* or *c:\windows\telnet* in the Run dialog. [Fig. 10.22(*a*)]

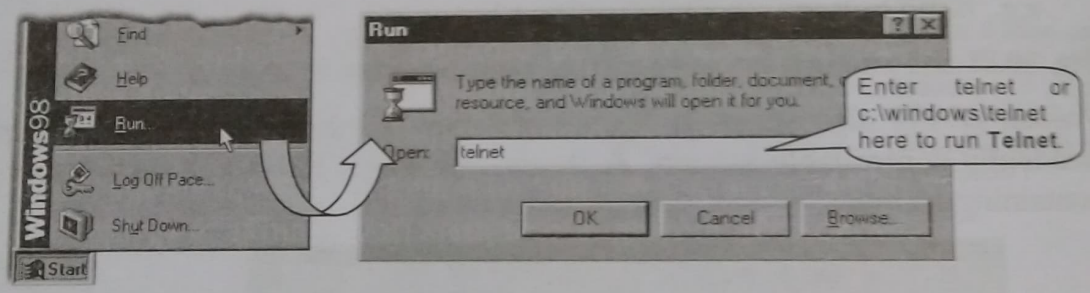

Figure 10.22 (*a*) Run Telnet client.

(*ii*) Connect to Telnet Site

Once you have telnet client running on your system, you need to connect to telnet site. This can be done by selecting *Connect*→ *Remote System* in telnet window [Fig. 10.22(*b*)] and then by specifying the telnet site address in the *Host Name* : box [Fig. 10.22(*c*)] and then by clicking at *Connect* button. We typed the telnet address of an Australian university : *library.anu.edu.au*.

NOTE

The default port of telnet and default terminal of *vt100* will do in most cases.

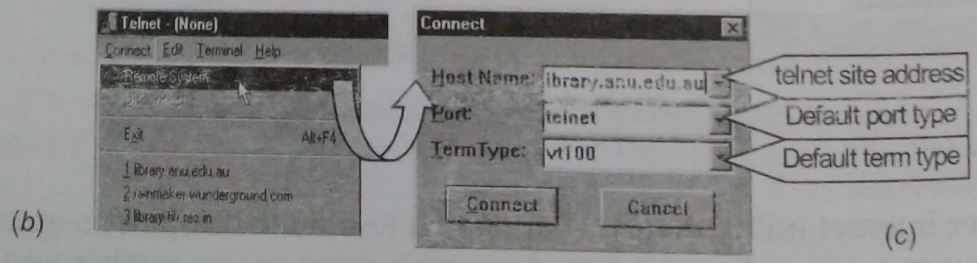

Figure 10.22 (*b*) Connect → Remote System in Telent window. (*c*) Connect dialog.

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(iii) Start browsing

Now you'll see the default menu of the telnet site [Fig. 10.23(*a*)]. Directions of using the site are available there. For example, to search a book by specifying its subject, we typed the letter *S*. And then we typed the word *computer* for the subject search [Fig. 10.23(*b*)].

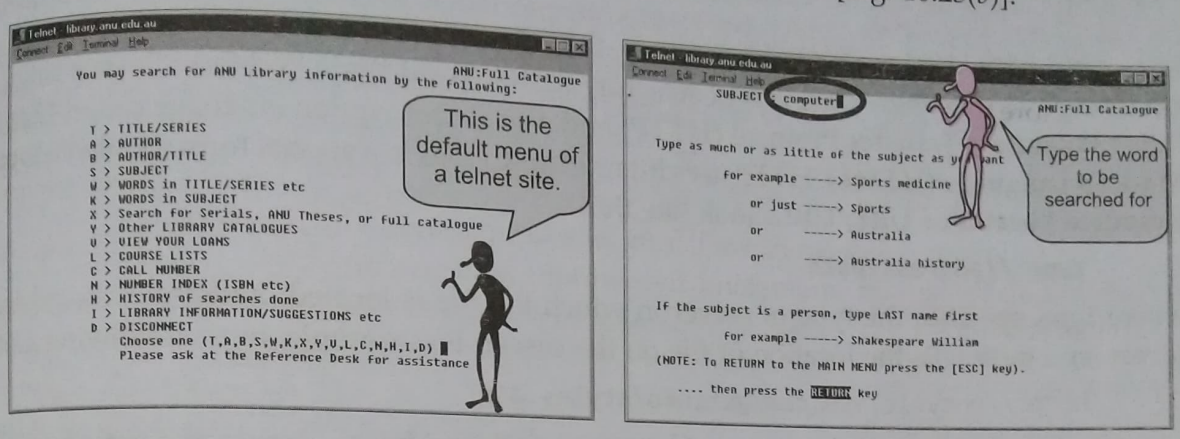

Figure 10.23 (*a*) Default menu of library.anu.edu.au. (*b*) Specifying the word to be searched.

(iv)

After, it displays the details of the search [Fig. 10.23(*c*)] you can view further details by the options provided [Fig. 10.29(*d*)]. For example, in the screen shown in Fig. 10.23(*c*), we typed digit 3 to view the details of book numbered 3, shown in Fig. 10.23(*d*).

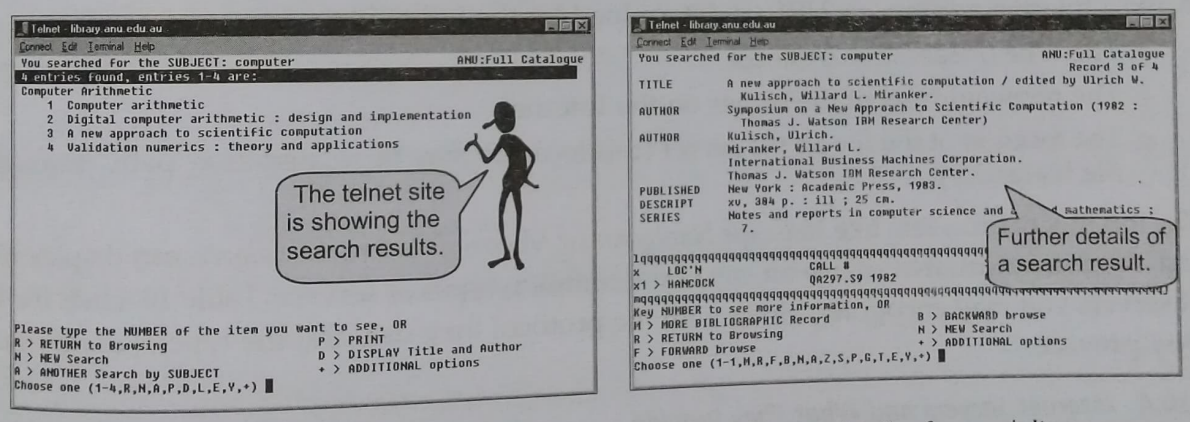

Figure 10.23 (*c*) Details of search conducted. (*d*) Viewing further details of a search item.

(v) Finally Disconnect

To disconnect, you can either choose the *Disconnect* command from *Connect* menu or you may even press Alt + F4 key combination.

10.12.3 Web Browser and Web Server

The World Wide Web (WWW) is based upon clients and servers. A WWW client is called **Web Browser** or simply a **browser** and a WWW server is called a **Web Server** or just a **server.** *Internet Explorer* and *Netscape Navigator* are two most popular web browsers.

WEB BROWSER

A Web Browser is a WWW client that navigates through the World Wide Web and displays web pages.

WEB SERVER

A Web Server is a WWW server that responds to the requests made by web browsers.

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10.12.4 Web Sites, Web Addresses and Web Pages

A location on a net server is called a web site. Each web site has a unique address called URL (Uniform Resource Locator) *e.g.*, the web site of microsoft has an address or URL called **http://www.microsoft.com.**

10.12.5 URL and Domain Names

Let us explore it further. The Internet structure of the World Wide Web is built on a set of rules called **Hypertext Transfer Protocol (HTTP)** and a page description language called **Hypertext Markup Language (HTML)**. HTTP uses Internet addresses in a special format called a **Uniform Resource Locator** or **URL**, URLs look like this :

```
type://address/path
```

where ***type***: specifies the type of server in which the file is located, ***address*** is the address of server, and ***path*** tells the location of file on the server. For example, in the following URL

```
http://encycle.msn.com/getinfo/styles.asp
```

http: specifies the ***type*** of server, ***encycle.msn.com*** is the ***address*** of server and ***getinfo/style.asp*** is the ***path*** of the file *styles.asp*. The other examples of URLs are

```
ftp://ftp.prenhall.com, http://www.yahoo.com, news://alt.tennis etc.
```

Syntax Elements of URLs

By now you have come to know that a URL (Uniform Resource Locator) is an address of a file on Internet. Let us discuss the components or syntax elements of URLs.

A file's Internet address, or URL, is determined by the following :

- The type of server or protocol
- The name/address of the server on the Internet
- The location of the file on the server (this location may be related as a "path" through the file hierarchy)

The intelligent browsers like *Netscape Navigator* or *Microsoft Internet Explorer*, can display files in just about any format available on any of the common types of servers. Table 10.4 lists the types of servers you may encounter, along with the protocol they use, and the type(s) of information they provide.

Table 10.4 *Internet Servers and What They Provide*

Server	Protocol	Information It Provides
ftp	File Transfer Protocol	Text and binary files that are organized in a hierarchical structure, much like a family tree.
gopher	Transfer Control Protocol/Internet Protocol (TCP/IP)	Text and binary files that are organized in a menu structure.
http	Hypertext Transfer Protocol	Hypertext/hypermedia files (*i.e.*, multimedia documents that contain links to images, sounds, or other multi- media documents on the World Wide Web).
mail	Post Office Protocol (POP) Version 3 and Simple Mail Transfer Protocol (SMTP)	Messages sent via electronic mail.
news	Network News Transfer Protocol (NNTP)	Newsgroups that are organized in a hierarchical structure.

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In any typical URL *e.g.*, **http://www.khoj.com**, the "http" identifies both the protocol and server. According to standard URL syntax, a colon (:) and two forward slashes (//) follow the protocol/server.

The next component of the address is the name of the server, in this case, www.khoj.com. Server names have multiple components. Commonly a Web server's name will begin "www" for World Wide Web. The ".com" suffix (called a *domain* indicator) indicates that Khoj is a commercial entity, as opposed to a nonprofit organization (".org"), a school or university (".edu"), a branch of the government (".gov"), etc.

URL

A URL (Uniform Resource Locator) specifies the distinct address for each resource on the Internet. An Internet address which is character based is called a **Domain Name**.

The naming scheme by which servers are identified is also known as the *domain name system*. Table 10.5 lists some most common domains. Another method of addressing servers is based on numbers *e.g.* 203.127.54.9. Such addresses are called *IP addresses*. (We are not getting into details of IP addressing method, as it is beyond the scope of this book).

NOTE

The characters based naming system by which servers are identified is also known as ***domain name system*** (DNS).

Table 10.5 *Some Most Common Domains*

S.No.	Domain ID	Affiliation	Remarks
1.	com	Commercial	for commercial firms
2.	edu	Education	for educational firms
3.	gov	Government	for government organizations / bodies
4.	mil	Military	for Military
5.	net	Network resources	for ISPs/networks
6.	org	Usually non-profit organizations	for NGOs and other no-profit
7.	co	Company	for listed companies
8.	biz	business	for business
9.	tv	television	for television companies and channels

In addition to it, a two letter abbreviation indicating the country name may be used *e.g.*,

http://www.microsoft.co.in

here the last **in** suggests that it is based in India (.in). Similarly, the URL **http://www.clearnet.nz** suggests that it is based in New Zealand (.nz). Some country abbreviations are being listed below :

au	Australia	ca	Canada
dk	Denmark	fr	France
in	India	jp	Japan
nz	New Zealand	uk	United Kingdom

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Web Page

The documents residing on web sites are called **web pages**. The **web pages** use HTTP.

There are many associated terms which should be discussed for better understanding.

Let us discuss them :

1. **HOME PAGE.** It is the top-level web page of a web site. When a web-site is opened, its *home page* is displayed.
2. **WEB PORTAL.** It is a web site, which hosts other web sites. In other words, a web portal has hyperlinks to many other web sites. By clicking upon these links, the corresponding web sites can be opened. **www.yahoo.com** is an example of a web portal. Other examples are **www.indiatimes.com**, **www.khoj.com**, etc.

A web portal also offers a broad array of resources and services such as *e-mail*, forums (users with similar interests sharing ideas and information), *search-engine*, *on-line shopping malls* etc.

WEB PAGE

A location on a net server is called a **Web Site**. A document that uses **HTTP** is called a Web Page.

10.12.6 Web Hosting

As you have read in the previous topic that accessing information on the web requires data communication between a *web-browser client* and a *web-server application*. Web hosting is linked to this very thing. **Web Hosting** is a means of hosting *web-server application* on a computer system through which electronic content on the Internet is readily available to any *web-browser client*.

The computer system providing the web-hosting is known as **web-server** or the **web host**.

Basically, the web hosts allow their customers to place web documents, such as *html pages*, *graphics*, and other *multimedia files* etc. onto a special type of computer called a web server, which maintains constant, high speed connections to the backbone of Internet.

WEB HOSTING

Web Hosting is a means of hosting *web-server application* on a computer system through which electronic content on the Internet is readily available to any *web-browser client*.

One can choose from various types of web hosting services such as free or virtual or shared or dedicated hosting.

Let us talk about these types of web-hosting, one by one.

1. **Free Hosting.** This type of hosting is available with many prominent sites that offer to host some web pages for no cost. Examples of such sites are : *geocities*, *tripod*, *homestead* etc.

Free is for fun. If you want to experiment with a site or put up a small, personal site for the fun of it, a free package will suffice.

2. **Virtual or Shared Hosting.** This type of hosting is provided under one's own domain name, www.yourname.com. With a hosting plan with the web hosting company, one can present oneself as a fully independent identity to his/her web audience.

Virtual hosting is where one's web site domain is hosted on the web server of hosting company along with other web sites. One can access and update to the site and its files are carefully secured. Through a logon-id and password, one has 24-hour access to maintain one's site.

Go "shared" if you are serious about doing some business or have a professional website that is much better off "standing on its own." Or if you simply prefer your own domain name and space.

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3. **Dedicated Hosting.** In this type of hosting, the company wishing to go online, rents an entire web server from a hosting company. This is suitable for companies hosting larger web sites, maintaining others' sites or managing a big online mall etc.

Dedicated is for large, high-traffic sites, or for those with special needs such as e-commerce or security. They are also good for those folks for whom money is no object.

4. **Co-location Hosting.** For those who do not fit the dedicated-server mold, hosting companies offer a *similar, but less-restrictive* hosting, known as co-location hosting. In this type of hosting, the company actually owns the server on which its site is hosted. That is, the company owning the site rather than the web hosting company, is respon- sible for all server administration. The web-hosting-company is only responsible for providing rack-space for server and meeting its physical needs. This generally includes a high speed connection to the Internet, a regulated power supply, and a limited amount of hands-on-techical-support, such as *data backup* or *hardware upgrades*.

Co-location hosting is similar to that of dedicated hosting except for the fact that the server is now provided by the user-company itself and its physical needs are met by the hosting company.

Co-location hosting is suitable for those with complex needs and for those who require the ability to make changes as per its changing requirement as and when.

10.12.7 Web 2.0

The arrival of Web 2.0 has added many new features to the web applications; it has revolutionized the information sharing, user-oriented design, interoperability on the Internet. This has provided information sharing in a way that was never dreamed about few years ego.

Web 2.0 refers to added features and applications that make the web more interactive, support easy online- information exchange and interoperability. Some noticeable features of Web 2.0 are blogs, wikis, video-sharing websites, social networking websites, RSS etc.

Web 2.0 provides a much independent solution to interact or commute thoughts with each other through the various online social media's. There are many Web 2.0 sites which have made the online information exchange very users interactive like: blogs, wikis, video-sharing websites, social networking websites, web applications etc.

The Internet based tools like RSS, social bookmarking, press release, online marketing, blog's, forums etc made an everlasting impression on people's lives as it has crossed the hurdle of socio-economic barriers. Web 2.0 tools are available free and are widely used by people; some of the most noticeable are :

- Facebook
- Myspace
- Digg
- Del.icio.us
- Flickr
- WordPress
- Twitter
- YouTube
- Blogger

All of the above provide an interactive platform where reviews, opinions, likes etc can be shared among the online users group. It has increased the rate of participation of users on online websites and hence given a wide horizon to the online community. Web 2.0 has definitely provided a better functionality and allows the visitor to communicate with the website in a much better prospective.

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10.12.8 HTML

The World Wide Web is an exciting new medium, bringing information, images, advertising and what not to every desktop. Everything that you see on the *Web* is documents written in a special language called *HTML* or *Hypertext Markup Language*. This language tells the browsers like *Mosaic* or *Netscape* or *Internet Explorer* how to display text, pictures and links on the screen.

HTML is a document-layout and hyperlink-specification language *i.e.*, a language used to design the layout of a document and to specify the hyperlinks. HTML tells the browser how to display the contents of a hypertext document *i.e.*, a documents including text, images and other support media. The language also tells how to make a document interactive through special hyperlinks. Though HTML is a language that supports multimedia and new page layout features yet it has its limitations.

HTML is not a word processing tool ; it is not a desktop publishing solution or even a programming language. It is just a *page-layout and hyperlink specification language.*

HTML provides many layout commands, called **tags** that let you control the presentation of information on a web pages. For example, there are tags for various types of headings, lines, image alignment, paragraph alignment, hyperlinking etc.

10.12.9 XML (eXtensible Markup Language)

XML is a markup language for documents containing structured information.

Structured information contains both content (words, pictures, etc.) and some indication of what role that content plays (for example, content in a section heading has a different meaning from content in a footnote, which means something different than content in a figure caption or content in a database table, etc.). Almost all documents have some structure.

A markup language is a mechanism to identify structures in a document. The XML specification defines a standard way to add markup to documents.

So XML is Just Like HTML ?

No. In HTML, both the tag semantics and the tag set are fixed. On the other hand, XML specifies neither semantics nor a tag set. In fact XML is really a meta-language for describing markup languages. In other words, XML provides a facility to define tags and the structural relationships between them. Since there's no predefined tag set, there can't be any preconceived semantics. All of the semantics of an XML document will either be defined by the applications that process them or by stylesheets.

10.12.10 DHTML (Dynamic HTML)

DHTML refers to *Web* content that changes each time it is viewed. For example, the same URL could result in a different page depending on any number of parameters, such as :

- Geographic location of the reader
- Time of day
- Previous pages viewed by the reader
- Profile of the reader

DHTML refers to new *HTML* extensions that will enable a *Web page* to react to user input without sending requests to the *Web server*.

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"Dynamic HTML" is typically used to describe the combination of HTML, style sheets and scripts that allows documents to be animated. Dynamic HTML allows a web page to change after it's loaded into the browser – there doesn't have to be any communication with the web server for an update. You can think of it as 'animated' HTML. For example, a piece of text can change from one size or color to another, or a graphic can move from one location to another, in response to some kind of user action, such as clicking a button.

10.12.11 Web Scripting

The process of creating and embedding **scripts** in a web page is known as **web-scripting**. A **script** or a *computer-script* is a list of commands that are embedded in a web-page normally and are interpreted and executed by a certain program or scripting engine. *Scripts* may be written for a variety of purposes such as for automating processes on a local-computer or to generate web-pages on the web.

The programming languages in which scripts are written are called scripting languages. There are many scripting languages available today. Most common ones are VBScript, JavaScript, ASP, PHP, PERL, JSP etc.

SCRIPT

A Script is a list of commands embedded in a web-page. Scripts are inter- preted and executed by a certain program or script engine.

Types of Scripts

Scripts are broadly of following *two* types :

1. Client-Side Scripts

Client-side scripting enables *interaction within a web page*. The client-side scripts are **downloaded** at the client-end and then interpreted and executed by the *browser*.

The client-side scripting is *browser-dependent*. That is, the client-side browser must be scripting enabled in order to run scripts.

Client-side scripting is used when the client-side interaction is used. Some sample uses of client-side scripting may be :

- to get data from user's screen or browser.
- online games.
- customising the display of page in browser without reloading the page *e.g.*, rollover a hyperlink highlights that link without reloading the page.

Some popular client-side scripting languages are VBScript, JavaScript, Hypertext Preprocessor (PHP).

NOTE

Client-side scripting supports interaction within a webpage.

Check Point 10.5

1. What is remote login ? What is Telnet ?
2. What is HTML ? Where it is used ?
3. What is URL ? What is WWW ?
4. Define webbrowser and webserver.
5. What is web hosting ?
6. What is web scripting ?
7. Name some web scripting languages.

2. Server-Side Scripts

Server-side scripting enables the completion or carrying out a task at the server-end and then sending the result to the client-end.

In server-side script, the server does all the work, so it doesn't matter which browser is being used at client-end.

Server-side scripting is used when the information is sent to a server to be processed at the server-end.

Path Wala

Some sample uses of server-side scripting may be :

- Password protection.
- Browser customization (sending information as per the requirements of client-end browser.)
- Form Processing.
- Building and displaying pages created from a data base.
- Dynamically editing changing or adding content to a web page.

Some popular server-side scripting languages are :

PHP (Hypertext Preprocessor), Perl, ASP (Active Server Pages), JSP (Java Server Pages) etc.

NOTE

Server-side scripting supports execution at server-end.

Comparing Client-Side and Server-Side Scripting

After discussing the basics of the two types of scripts, in this section, we are going to compare different features and uses of these script types.

S.No.	Client Side Scripting	Server Side Scripting
1.	Script code is downloaded and executed at client end.	The script is executed at the server-end and the result is sent to the client-end.
2.	Response to interaction is more immediate once the program code has been down- loaded.	Complex processes are more efficient as the program and associated resources are not down-loaded to the browser.
3.	Services are secure as they do not have access to files and databases.	Have access to files and data bases but have security considerations when sending sensitive information.
4.	Browser dependent	Does not depend on browsers
5.	Affected by the processing speed of user's computer	Affected by the processing speed of the host server.

10.13 NETWORK SECURITY CONCEPTS

The networking offers endless possibilities and opportunities to every user of it, along with convenience. But this convenience and endless benefits are not free from risks as there are many a risks to network security.

While ensuring network security, the concerns are to make sure that only legal or authorized users and programs gain access to information resources like databases. Also, certain control mechanisms are setup to ensure that properly authenticated users get access only to those resources that they are entitled to use. Under this type of security, mechanisms like *authorization, authentication, encrypted smart cards, biometrics* and *firewalls* etc. are implemented.

The problems encountered under network security can be summarised as follows :

(i) *Physical Security holes.* When individuals gain unauthorized physical access to a computer and temper with files. Hackers do it by guessing passwords of various users and then gaining access to the network systems.

(ii) *Software Security holes.* When badly written programs or 'privileged' software are compromised into doing things that they should not be doing.

(iii) *Inconsistent Usage holes.* When a system administrator assembles a combination of hard-ware and software such that the system is seriously flawed from a security point of view.

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Protection Methods

To counter or reduce the security threats received under this category, many protection methods are used. These protection methods are being discussed briefly in the coming lines.

1. Authorization

Authorization determines whether the service provider has granted access to the web service to the requestor. Basically, authorization confirms the service requestor's credentials. It determines if the service requestor is entitled to perform the operation, which can range from invoking the web service to executing a certain part of its functionality.

Authorization is performed by asking the user a legal login-id. If the user is able to provide a legal login-id, he/she is considered an authorized user.

2. Authentication

Authentication ensures that each entity involved in using a web service – the requestor, the provider, and the broker (if there is one) – is what it actually claims to be. Authentication involves accepting credentials from the entity and validating them against an authority.

Authentication is also termed as *password-protection* as the authorized user is asked to provide a valid password, and if he/she is able to do this, he/she is considered to be an authentic user.

3. Encrypted Smart Cards

Passwords in a remote log-in session generally pass over the network in unencrypted form, any hacker (or cracker) can simply record it and can use it later maliciously to corrupt data/files or to harm anyone etc. To counter such threats, newer approaches are suggested such as encrypted smart cards.

An encrypted smart card is a hand-held smart card that can generate a token that a computer system can recognise. Everytime a new and different token is generated, which even-though cracked or hacked, can not be used later.

4. Biometric Systems

The biometric systems form the most secure level of authorization. The biometric systems involve some unique aspect of a person's body such as finger-prints, retinal patterns etc. to establish his/her identity.

5. Firewall

A system designed to prevent unauthorized access to or from a private *network* is called ***Firewall***. Firewalls can be implemented in both *hardware* and *software*, or a combination of both. Firewalls are frequently used to prevent unauthorized *Internet* users from accessing private networks connected to the Internet, especially *intranets*. All messages entering or leaving the intranet pass through the firewall, which examines each message and blocks those that do not meet the specified *security* criteria.

FIREWALL

The system designed to prevent unauthorized access to or from a private network is called Firewall.

There are several types of firewall techniques :

- **Packet filter.** Looks as each *packet* entering or leaving the network and accepts or rejects it based on user-defined rules. Packet filtering is fairly effective and transparent to users, but it is difficult to configure. In addition, it is susceptile to *IP spoofing*.

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- **Application gateway.** Applies security mechanisms to specific applications, such as *FTP* and *Telnet* servers. This is very effective, but can impose a performance degradation.
- **Proxy server.** Intercepts all messages entering and leaving the network. The proxy server effectively hides the true network addresses.
- **Circuit-level gateway.** Applies security mechanisms when a connection is established. Once the connection has been made, packets can flow between the hosts without further checking.

In practice, many firewalls use two or more of these techniques in concert.

A firewall is considered a first line of defense in protecting private information. For greater security, *data* can be *encrypted*.

10.13.1 Related Terms

Let us now talk about some terms related to it *i.e.*, some terms related to network security.

Cookies

A cookie is a message given to a Web browser by a Web server. The browser stores the message in a text file. The message is then sent back to the server each time the browser requests a page from the server.

The main purpose of cookies is to identify users and possibly prepare customized Web pages for them. When you enter a Web site using cookies, you may be asked to fill out a form providing such information as your name and interests. This information is packaged into a cookie and sent to your Web browser, which stores it for later use. The next time you go to the same Web site, your browser will send the cookie to the Web server. The server can use this information to present you with custom Web pages. So, for example, instead of seeing just a generic welcome page you might see a welcome page with your name on it.

The name *cookie* derives from UNIX objects called *magic cookies*. These are tokens that are attached to a user or program and change depending on the areas entered by the user or program.

COOKIES

Cookies are messages that a Web server transmits to a Web browser so that the Web server can keep track of the user's activity on a specific Web site.

Cookies do not act maliciously on computer systems. They are merely text files that can be deleted at any time – they are not plug ins nor are they programs. Cookies cannot be used to spread viruses and they cannot access your hard drive. This does not mean that cookies are not relevant to a user's privacy and anonymity on the Internet. Cookies cannot read your hard drive to find out information about you; however, any personal information that you give to a Web site, including credit card information, will most likely be stored in a cookie unless you have turned off the cookie feature in your browser. In only this way are cookies a threat to privacy. The cookie will only contain information that you freely provide to a Web site.

Cookies have *six* parameters that can be passed to them :

- The *name* of the cookie.
- The *value* of the cookie.
- The *expiration date* of the cookie - this determines how long the cookie will remain active in your browser.
- The *path the cookie is valid for* - this sets the URL path the cookie is valid in. Web pages outside of that path cannot use the cookie.

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- The *domain the cookie is valid for* - this takes the path parameter one step further. This makes the cookie accessible to pages on any of the servers when a site uses multiple servers in a domain.
- The *need for a secure connection* - this indicates that the cookie can only be used under a secure server condition, such as a site using SSL.

Both Netscape and Microsoft Internet Explorer (IE) can be set to reject cookies if the user prefers to use the Internet without enabling cookies to be stored. In Netscape, follow the **Edit/Preferences/Advanced** menu and in IE, follow the **Tools/Internet Options/Security** menu to set cookie preferences.

Hackers and Crackers

Hacker is a slang term for a computer enthusiast, *i.e.*, a person who enjoys learning programming languages and computer systems and can often be considered an expert on the subject(s). Among professional programmers, depending on how it used, the term can be either complimentary or derogatory, although it is developing an increasingly derogatory connotation. The pejorative sense of hacker is becoming more prominent largely because the popular press has co-opted the term to refer to individuals who gain unauthorized access to computer systems for the purpose of stealing and corrupting data. Hackers, themselves, maintain that the proper term for such individuals is **cracker**. Although hackers still argue that there's a big difference between what they do and what crackers do, the mass media has failed to understand the distinction, so the two terms – *hack* and *crack* – are often used interchangeably.

HACKERS & CRACKERS

The **Crackers** are the malicious programmers who break into secure systems whereas **Hackers** are more interested in gaining knowledge about computer systems and possibly using this knowledge for playful pranks.

CyberLaw

Cyberlaw is a generic term which refers to all the legal and regulatory aspects of Internet and the World Wide Web. Anything concerned with or related to or emanating from any legal aspects or issues concerning any activity of netizens and others, in Cyberspace comes within the ambit of Cyberlaw. The growth of Electronic Commerce has propelled the need for vibrant and effective regulatory mechanisms which would further strengthen the legal infrastructure, so crucial to the success of Electronic Commerce. All these regulatory mechanisms and legal infrastructures come within the domain of Cyberlaw.

CYBERLAW

Cyberlaw is a generic term, which refers to all the legal and regulatory aspects of Inter- net and the World Wide Web.

Cyberlaw is important because it touches almost all aspects of transactions and activities on and concerning the Internet, the World Wide Web and Cyberspace.

India's IT Act and IT (Amendment) Act, 2008

In India the cyber laws are enforced through **Information Technology Act, 2000** (*IT Act 2000*) which was notified on 17 October 2000. It is based on the United Nation's Commission for International Trade related laws (UNCITRAL) model law.

IT ACT 2000's prime purpose was **to provide legal recognition to electronic commerce** and to facilitate filing of electronic records with the Government, *i.e.*, to provide the legal infrastructure for e-commerce in India.

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The Act was later amended in December 2008 through the **IT (Amendment) Act, 2008**. It provided additional focus on Information Security. It has added several new sections on offences including Cyber Terrorism and Data Protection. **The Information Technology Amendment Act, 2008** (IT Act 2008) came into force from October 27, 2009 onwards. Major amendments of IT ACT (2008) included :

Digital Signatures	Authentication of electronic records by digital signatures gets legal recognition.
Electronic governance	E-Documents get legal recognition. Documents required as per law by any arm of the government may be supplied in electronic form.
Offences and Penalties	The maximum penalty for any damage to computers or computer systems is a fine up to ₹1 crore.
Amendments to other laws	Other related acts such as the Indian Penal Code, 1860, the Indian Evidence Act, 1872, the Bankers' Books Evidence Act, 1891, the Reserve Bank of India Act, 1934 were to be amended to align them with the IT Act.

Cyber Crimes

The Cambridge dictionary defines Cyber Crimes as Crimes committed with the use of computers or relating to computers, especially through the Internet. Universally, Cyber Crime is understood as *"an unlawful act where in the computer is either a tool or a target or both"*.

Cyber Crimes are different from conventional crimes as in cyber crimes; the cyber crime is committed in an electronic medium.

Classification of Cyber Crimes. The Information Technology Act deals with the following cyber crimes along with others :

1. **Tampering with computer source documents.** A person who knowingly or inten- tionally, conceals (hides or keeps secret), destroys (demolishes or reduces), alters (change in characteristics) or causes another to conceal, destroy, and alter any computer source code used for a computer, computer program, computer system or computer network, when the computer source code is required to be kept or maintained by law is punishable. For instance, hiding the C.D.ROM in which the source code files are stored, making a C File into a CPP File or removing the read only attributes of a file.

2. **Hacking.** Hacking is usually understood to be the unauthorized access of a computer system and networks. Whoever with the intent to cause or knowing that he is likely to cause wrongful loss or damage to the public or any person destroys or deletes or alters any information residing in a computer resource or diminishes its value or utility or affects it injuriously by means is said to commit hacking.

3. **Publishing of information, which is obscene in electronic form.** A person who publishes or transmits or causes to be published in the electronic form, any material which is lascivious, or if its effect is such as to tend to deprave and corrupt persons who are likely to read, see or hear the matter contained or embodied in it, is liable to punishment. The important ingredients of such an offence are publishing (make generally known or issue copies for sale to public), or transmitting (transfer or be a medium for), or causing to be published (to produced the effect of publishing), pornographic material in the electronic form.

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4. **Child Pornography.** Child Pornography is a part of cyber pornography but it is such a grave offence that it is individually also recognized as a cyber crime.

5. **Accessing protected system.** Any unauthorized person who secures access or attempts to secure access to a protected system is liable to be punished with imprisonment and may also be liable to fine.

6. **Breach of confidentiality and privacy.** Any person who, secures access to any electronic record, book, register, correspondence, information, document or other material without the consent of the person concerned or discloses such electronic record, book, register, correspondence, information, document or other material to any other person shall be liable to be punished under the Information Technology Act.

10.13.2 IPR Issues

The term *Intellectual Property (IP)* reflects the idea that its subject matter is the product of the mind or the intellect. These could be in the form of Patents; Trademarks; Geographical Indications; Industrial Designs; Layout-Designs (Topographies) of Integrated Circuits; Plant Variety Protection and Copyright.

IP, protected through law, like any other form of property can be a matter of trade, that is, it can be owned, bequeathed, sold or bought. The major features that distinguish it from other forms are their intangibility and non-exhaustion by consumption.

Intellectual property rights are legal rights, which result from intellectual activity in the industrial, scientific, literary and artistic fields. These rights give statutory expression to the moral and economic rights of creators in their creations. Intellectual property rights safeguard creators and other producers of intellectual goods and services by granting them certain time-limited rights to control the use made of those productions. These rights also promote creativity and the dissemination and application of its results and encourage fair-trading, which contributes to economic and social development.

INTELLECTUAL PROPERTY

The **Intellectual Property** may be defined as a product of the intellect that has commercial value, including copyrighted property such as literary or artistic works, and ideational property.

10.14 VIRUSES

Computer virus is a malicious program that requires a host and is designed to make a system sick, just like a real virus. Viruses can spread from computer to computer, and they can replicate themselves. Some viruses are categorized as harmless pranks, while others are far more malicious. Broadly *three* types of viruses are :

1. File infectors – attach themselves to a program file.
2. Boot sector viruses – install themselves on the beginning tracks of a hard drive.
3. Macro viruses – infect data files.

Most viruses are spread by **e-mail attachment** and warn them to be suspicious of any files attached to unsolicited messages. The following are characteristics of a computer virus :

- It is able to replicate.
- It requires a host program as a carrier.
- It is activated by external action
- Its replication ability is limited to the (virtual) system.

COMPUTER VIRUS

Computer Virus is a malicious program that requires a host and is designed to make a system sick, just like a real virus.

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10.14.1 How Computer Viruses Spread ?

Computer viruses move from computer to computer by attaching themselves to files or boot records of disks and diskettes. These days it is not uncommon to find them in e-mail attachments and other programs that can be downloaded from the Internet.

A virus is a relatively passive agent that can travel from one file to another on the same computer if the infected file is executed, from computer memory to a file on disk, on a disk that is carried from one computer to another (some companies prohibit floppy drives, thereby preventing users from copying information onto their computers), on e-mail attachment executable files, and over a modem or network connection.

10.14.2 Damage that Viruses Cause

Viruses' main objective is to make your system unstable and cause harm to data. Mainly these cause damage in many ways :

- can destroy file allocation tables (FAT) and lead to the corruption of an entire file system, resulting in the need to fully reinstall and reload the system.
- can create bad sectors on the disk, destroying parts of programs and files.
- can decrease the space on hard disks by duplicating files.
- can format specific tracks on the disks or format the entire disk.
- can destroy specific executable files and alter data in data files, causing a loss of integrity in the data.
- can cause the system to hang so that it does not respond to any keyboard or mouse movements.

10.14.3 Trojan Horses

A Trojan horse is code hidden in a program such as a game or spreadsheet that looks safe to run but has hidden side effects. When the program is run, it seems to function as the user expects, but in actuality it is destroying, damaging, or altering information in the background. It is a program on its own and does not require a host program in which to embed itself. An example of a Trojan horse would be a Christmas executable that, when executed, pops up with an animated figure of Santa Claus and a caption saying "Merry Christmas." In the background, extra code could be deleting files or performing other malicious actions.

TROJAN HORSE

A **Trojan Horse** is code hidden in a program such as a game or spreadsheet that looks safe to run but has hidden side effects.

How Trojan Horses Spread

Trojan horses generally are spread through e-mail and exchange of disks and information between computers. Worms could also spread Trojan horses.

Damage Caused by Trojan Horses

The damage that Trojan horses cause is much the same as what a virus causes. Most of the time the users are unaware of the damage it is causing because of the Trojan horse's masking effect.

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10.14.4 Worms

A worm is a program designed to replicate. The program may perform any variety of additional tasks as well.

The following are characteristics of a worm :

- It is able to replicate.
- It is self-contained and does not require a host.
- It is activated by creating process (it needs a multitasking system).
- If it is a network worm, it can replicate across communication links.

WORMS

A **Worm** is a program designed to replicate.

Worms are programs that run independently and travel from computer to computer across network connections. Worms may have portions of themselves running on many different computers. Worms do not change other programs, although they may carry other code that does.

How Worms Spread

Worms are autonomous agents capable of propagating themselves without the use of another program or intervention or action by a user. Worms are found primarily on computers that are capable of multitasking and are connected by a network.

Damage that Worms Can Cause

Most worms disrupt services and create system management problems. Some worms scan for passwords and other loopholes and then send the information back to the attacker. In some cases worms can install Trojan horses or viruses that cause damage to the systems.

10.14.5 Spam

Spam refers to electronic junk mail or junk newsgroup postings. Some people define spam even more generally as any unsolicited e-mail. Merriam-Webster dictionary defines spam as *unsolicited usually commercial e-mail sent to a large number of addresses.*

SPAM

Spam refers to electronic junk mail or junk newsgroup postings.

Avoiding Spam

- One way to help avoid Spam or junk mail is to create a filter that finds and does something to e-mail that you suspect is *Spam.*
- Another tip is not to register yourself with true id to sign up for things on the Internet. These places often share that e-mail address with other companies that then send you spam.

10.14.6 Virus Prevention

Virus prevention is not a difficult task. All you need to be is extra careful and ensure to follow the following guidelines to lead virus free computing life.

- Never use a "foreign" disk or CD without scanning it for viruses.
- Always scan files downloaded from the internet or other sources.
- Never boot your PC from a floppy unless you are certain that it is virus free.
- Write protect your disks.

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- Use licensed software.
- Password protect your PC to prevent unattended modification.
- Make regular backups.
- Install and use antivirus software.
- Keep antivirus software up to date.

10.15 E-COMMERCE PAYMENT TRANSACTIONS USING ONLINE BANKING

Online banking allows a user to execute financial transactions via the Internet. Online banking is also known as "internet banking" or "web banking". An online bank offers customers just about every service traditionally available through a local branch, including deposits, which is done online or through the mail, and online bill payment.

Advantages

- Convenience is a major advantage of online banking
- In effect, consumers can perform banking transactions 24 hours-a-day, seven-days a week.
- Online banking is fast and efficient.
- Funds can be transferred between accounts almost instantly, especially if the two accounts are held at the same banking institution.

Disadvantages of Online Banking

- For a novice online banking customer, using systems for the first time may present challenges that prevent transactions from being processed.
- Although online banking security is continually improving, such accounts are still vulnerable when it comes to hacking.
- Consumers are advised to use their data plans, rather than public Wi-Fi networks when using online banking, to prevent unauthorized access.
- Additionally, online banking is dependent on a reliable internet connection. Connectivity issues from time-to-time may make it difficult to determine if banking transactions have been successfully processed.
- On occasion, consumers may prefer face-to-face interactions for more complex banking issues.

10.15.1 Mobile Banking

When you perform or use the banking services via a mobile, it is called **mobile banking**. Difference between online banking and mobile banking is that Mobile banking is done via a *mobile banking app* while the online baking is done via *secure website* of the bank. Some popular mobile apps used today are :

- **State Bank Freedom (State Bank of India App).** This is the official *State Bank of India* mobile banking application.
- **iMobile Android App (ICICI Bank App).** This is the official *ICICI Bank* mobile banking application.

Check Point 10.6

1. What is hacking ?
2. What are cookies ?
3. What is cracking ? How is it different from hacking ?
4. What is Cyber Crime ?
5. When was IT Act enforced in India ?
6. What is Spam ?

Path Wala

- **M-Connect (BOB App).** This is the official *Bank of Baroda* mobile banking application.
- **Citibank IN (Citibank App).** You can manage your Citibank Accounts and Credit Cards with official Citi Mobile application.
- **NGpay Application (HDFC BANK).** NGpay is also the official mobile banking application for Axis Bank and HDFC Bank.

10.15.2 e-Wallet

E-wallet is a similar electronic service used for payments. E-wallet as the name suggests is your own wallet available to you electronically where you can use your own money (in electronic form) for payments. Some most popular e-wallets of today are : *Paytm, Freecharge, Mobikwik, Citrus Pay, Airtel Money, Oxigen Wallet, OlaMoney, HDFC PayZapp, Chillr, Pockets By ICICI Bank, JioMoney, SBI Buddy, mRupee, ItzCash* etc.

Govt of India announced a new digital payments app named **BHIM – Bharat Interface for Money** – after *Babasaheb Dr Bhimrao Ambedkar*. BHIM is a digital payments solution app based on the *Unified Payments Interface (UPI)* from the *National Payments Corporation of India (NPCI)*, the umbrella organisation for all retail payments systems in India.

LET US REVISE

- *A network is a collection of interlinked computers by means of a communication system.*
- *The networks facilitate resource sharing, increased reliability, reduced costs, and increased and fast communication.*
- *Today's Internet has evolved from ARPANET (Advanced Research Projects NETwork) of U.S. Department of Defense along with some other networks such as NSFnet and other private networks.*
- *Internet is a worldwide network of computer networks.*
- *InterSpace is said to be the future of Internet.*
- *InterSpace is a client/server software program that allows multiple users to communicate online with real-time audio, video and text chat in dynamic 3D environments.*
- *Switching techniques are used for transmitting data across networks.*
- *Various switching techniques are : **circuit switching** (where complete physical connection is setup prior to communication), **message switching** (which follows store and forward principle for complete messages), and **packet switching** (which follows store and forward principle for packets – a message is divided into fixed sized packets).*
- *A network can have any of these transmission media or connecting media : twisted pair cable, coaxial cable, optical fibre, microwave, radiowave, satellite etc.*
- *On the basis of geographical spread, networks can be classified into LAN (Local Area Network), WAN (Wide Area Network), and PAN (Personal Area Network).*
- *Small computer networks that are confined to a localised area e.g., an office, a building etc., are called LANs.*
- *MANs are the networks spread over a city.*
- *A WAN is a group of computers that are separated by large distances and tied together. It can even be a group of LANs that are spread across several locations and connected together to look like a big LAN.*
- *The pattern of interconnection of nodes in a network is called topology.*
- *Most popular topologies are star, bus, ring, and tree.*
- *A modem is a computer peripheral that allows you to connect and communicate with other computers via telephone lines.*
- *RJ-45 (Registered Jack-45) is an eight-wire connector, which is commonly used to connect computers on LANs – especially Ethernets.*

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- Ethernet is a LAN architecture developed by Xerox Corp along with DEC and Intel. It uses either a bus or star topology and supports data transfer rates of upto 10 Mbps.
- Computers part of Ethernet are connected through a special card called Ethernet card.
- A hub is a hardware device used to connect several computers together. Hubs can be either active hubs or passive hubs.
- A switch is a device that is used to segment networks into different subnetworks called subnets or LAN segments.
- A backbone network is a network that is used as a backbone to connect LANs together to form a WAN.
- A repeater is a device that amplifies a signal being transmitted on the network.
- A bridge is a device that links two networks together.
- A router is a device that works like a bridge but can handle different protocols.
- A gateway is a device that connects dissimilar networks.
- A protocol is a set of standardized rules for data packets, techniques for detecting and correcting errors and so on.
- Some most common protocols are : HTTP (Hyper Text Transfer Protocol), FTP (File Transfer Protocol), TCP/IP (Transmission Control Protocol / Internet Protocol).
- Wireless communication is simply data communication without the use of landlines.
- Mobile computing means that the computing device is not continuously connected to the base or central network.
- GSM (Global System for Mobile communications) uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency.
- TDMA (Time Division Multiple Access) technology divides a radio frequency into time slots and then allocates allots to multiple calls.
- WLL (Wireless in Local Loop) is a system that connects subscribers to the public switched telephone network (PSTN) using radio signal as a substitute for other connecting media.
- SMS (Short Message Service) is the transmission of short text message to and from a mobile phone, fax machine and/or IP address.
- Email (Electronic Mail) is sending and receiving messages by computer.
- Online textual talk, in real time, is called chatting.
- A two-way videophone conversation among multiple participants is called video-conferencing.
- Remote login (Telnet) is the process of accessing a network from a remote place without actually being at the actual place of working.
- The World Wide Web (WWW) is a set of protocols that allows you to access any document on the net (short for internet) through a naming system based on URL's (Uniform Resource Locators).
- A Web Browswer is a WWW client that navigates through the World Wide Web and displays web pages. A Web Server is a WWW server that responds to the requests made by web browsers.
- A URL (Uniform Resource Locator) specifies the distinct address for each resource on the Internet. An Internet address which is character based is called a Domain Name.
- A location on a net server is called a Web Site. A document that uses HTTP is called a Web Page.
- The system designed to prevent unauthorized access to or from a private network is called Firewall.
- Cookies are messages that a Web server transmits to a Web browser so that the Web server can keep track of the user's activity on a specific Web site.
- The crackers are malicious programmers who break into secure systems whereas hackers are more interested in gaining knowledge about computer systems and possibly using this knowledge for playful pranks.
- Viruses are malicious program that damage data and files and cause harm to computer system.
- Viruses can be trojan horses, worms and other infective programs.
- Spams are unsolicited mails.
- Online banking allows a user to execute financial transactions via the Internet.
- Difference between online banking and mobile banking is that Mobile banking is done via a mobile banking app while the online baking is done via secure website of the bank.
- E-wallet is a similar electronic service used for payments.

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Objective Type Questions

OTQs

Multiple Choice Questions

1. Two devices are in network if
   (a) a process in one device is able to exchange information with a process in another device
   (b) a process is running on both devices
   (c) the processes running of different devices are of same type
   (d) none of the mentioned

2. What is a stand alone computer ?
   (a) A computer that is not connected to a network
   (b) A computer that is being used as a server
   (c) A computer that does not have any peripherals attached to it
   (d) A computer that is used by only one person

3. Central Computer which is powerful than other computers in the network is called as _____ .
   (a) Client (b) Server (c) Hub (d) Switch

4. Network in which every computer is capable of playing the role of a client, or a server or both at same time is called
   (a) peer-to-peer network (b) local area network
   (c) dedicated server network (d) wide area network

5. In peer-to-peer network, each computer in a network is referred as
   (a) server (b) client (c) peer (d) sender

6. Which transmission media is capable of having a much higher bandwidth (data capacity) ?
   (a) Coaxial (b) Twisted pair cable
   (c) Untwisted cable (d) Fibre optic

7. Which type of transmission media is the least expensive to manufacture?
   (a) Coaxial (b) Twisted pair cable
   (c) CAT cable (d) Fibre optic

8. Which of these components is internal to a computer and is required to connect the computer to a network ?
   (a) Wireless Access Point (b) Network Interface card
   (c) Switch (d) Hub

9. A device that forwards data packet from one network to another is called a
   (a) Bridge (b) Router (c) Hub (d) Gateway

10. Which of the following is the fastest media of data transfer ?
    (a) Co-axial Cable (b) Untwisted Wire
    (c) Telephone Lines (d) Fibre Optic

11. Hub is a
    (a) Broadcast device (b) Unicast device (c) Multicast device (d) None of the above

Path Wala

12. Switch is a
    (a) Broadcast device (b) Unicast device
    (c) Multicast device (d) None of the above
13. The device that can operate in place of a hub is a :
    (a) Switch (b) Bridge (c) Router (d) Gateway
14. A repeater takes a weak and corrupted signal and _____ it.
    (a) Amplifies (b) Regenerates
    (c) Resembles (d) Reroutes
15. What factors should be considered when selecting the appropriate cable for connecting a PC to a network ? (*Choose two*)
    (a) type of system bus (b) motherboard model
    (c) distance of cable run (d) speed of transmission
    (e) computer manufacturer
16. What are two advantages of using UTP cable in a networking environment ? (*Choose two*)
    (a) is stiffer than STP
    (b) is less expensive than fiber
    (c) is easier to install than coaxial
    (d) provides longer distances than coaxial provides
    (e) is less susceptible to outside noise sources than fiber is
17. Which cable connectors are used to connect a cable from a router's console port to a PC?
    (a) RJ-11 (b) RJ-12 (c) RJ-45 (d) none
18. What are two advantages of using fiber-optic cabling instead of UTP ? (*Choose two.*)
    (a) lower cost (b) easier to install
    (c) allows longer distances (d) less effected by external signals
    (e) easier to terminate the cable ends
19. Which network topology requires a central controller or hub ?
    (a) Star (b) Bus (c) Mesh (d) Tree
20. Which topology requires a multipoint connection on a single cable?
    (a) Star (b) Bus (c) Mesh (d) Tree
21. Which of the following topologies contains a backbone cable running through the whole length of the network?
    (a) Star (b) Bus (c) Mesh (d) Tree
22. Which of the following devices can be used at the centre of a star topology?
    (a) Router (b) Repeater (c) Modem (d) Hub
23. If a computer connected to a star topology fails, the entire network will _____
    (a) also fail (b) work unaffectedly
    (c) only server will work (d) none of these
24. A combination of bus and star topologies is called a _____ topology.
    (a) Combination (b) Hybrid (c) Mesh (d) Tree
25. Internet is an example of _____ topology.
    (a) Star (b) Bus (c) Mesh (d) Bus

Path Wala

26. Data is converted in a form so as to travel over telephone lines using this device.
(a) Modem (b) Hub (c) Switch (d) Router

27. Network device that regenerates and retransmits the whole signal is _____.
(a) Modem (b) Hub (c) Repeater (d) Bridge

28. Network device which connects networks of similar types (same protocols).
(a) Hub (b) Router (c) Bridge (d) Gateway

29. Network device which connects dissimilar networks (different protocols).
(a) Hub (b) Router (c) Bridge (d) Gateway

30. Networks devices that sends the data over optimizing paths through connected hops is
(a) Hub (b) Router (c) Bridge (d) Gateway

Fill in the Blanks

1. A computer network that spans a relatively large geographical area is called _____ .
2. WAN stands for _____ .
3. Wired networks' communication media is called _____ media.
4. Wireless networks' communication media is called _____ media.
5. _____ is a protocol which allows users to download E Mail messages from mail server to a local computer.
6. _____ is a protocol that allows to send/upload email message from local computer to an email server.
7. A network of networks is known as _____ .
8. In a network, a machine is identified by unique address called _____ .
9. The physical address assigned by NIC manufacturer is called _____ address.
10. A MAC address consumes _____ bytes or _____ bits.
11. A network with a dedicated server is called a _____ network.
12. A computer, part of a computer network is called a _____.
13. A network having a span within a building is called a _____.
14. A network having a span of city, is called a _____.
15. The _____ is a central connection point where all network cables are concentrated.
16. The _____ is a network device that can connect the network segments based on the same protocol.
17. The _____ is a network device that navigates the data packets over large networks through the most efficient route.
18. The _____ is a network device that connects dissimilar networks.
19. The _____ is a networking device that regenerates or recreates a weak signal into its original strength and form.
20. The _____ topology has a central line and all nodes are connected to it.
21. The _____ topology has a central controller.
22. The tree topology is said to be a combination of _____and _____ topologies.
23. In _____ topology, there exists multiple paths between any two nodes of the network.
24. The _____ is a small network created by linking many personal devices.

Path Wala

True/False Questions

1. A LAN is connected to large geographical area.
2. A client is the computer that asks for the action in a network.
3. A computer is identified by 64 bit IP address.
4. Every object on the Internet has a unique URL.
5. A stand alone computer may also be referred to as host.
6. Big networks can be of peer-to-peer types.
7. MAC address is a 48 bit address.
8. A switch can work is place of a hub.
9. A gateway is like a modem.
10. LAN is the biggest network geographically.
11. LAN is the smallest network geographically.
12. PAN is the smallest network geographically.
13. The Internet is an example of WAN.
14. The bus topology is the simplest topology.
15. The star topology ensures that the network will work even when a node fails.
16. An amplifier and a repeater do the same thing.
17. A hub broadcasts the received signal to all its connected devices.
18. A switch is an intelligent hub.
19. Repeater and router precisely do the same thing.
20. A hub can be replaced with a switch.
21. A router can be replaced with a bridge.

NOTE : Answers for OTQs are given at the end of the book.

Solved Problems

1. *What is a network ? Why is it needed ?* **Or**

   Mention one advantage of networking. **(Outside Delhi 2007)**

   Solution. A network is an interconnected collection of autonomous computers that can share and exchange information. Major reasons that emphasize on the need of networks are :

   (i) *Resource Sharing*. Through a network, data, software and hardware resources can be shared irrespective of the physical location of the resources and the user.

   (ii) *Reliability*. A file can have its copies on two or more computers of the network, so if one of them is unavailable, the other copies could be used. That makes a network more reliable.

   (iii) *Reduced Costs*. Since resources can be shared, it greatly reduces the costs.

   (iv) *Fast communication*. With networks, it is possible to exchange information at very fast speeds.

2. *What are major types of networks and explain ?*

   Solution. ⇨ Server-based network

   ⇨ Peer-to-peer network

Path Wala

Server-based networks provide centralized control of network resources and rely on server computers to provide security and network administration.

Peer-to-peer network, computers can act as both servers sharing resources and as clients using the resources.

3. *What are the types of Transmission media ?*

Solution. Signals are usually transmitted over some transmission media that are broadly classified in to *two* categories.

(*a*) *Guided Media*. These are those that provide a conduit from one device to another that include twisted-pair, coaxial cable and fiber-optic cable. A signal traveling along any of these media is directed and is contained by the physical limits of the medium. Twisted-pair and coaxial cable use metallic that accept and transport signals in the form of electrical current. Optical fiber is a glass or plastic cable that accepts and transports signals in the form of light.

(*b*) *Unguided Media*. This is the wireless media that transport electromagnetic waves without using a physical conductor. Signals are broadcast either through air. This is done through radio communication, satellite communication and cellular telephony.

4. *What is a communication channel ? What choices do you have while choosing a communication channel for a network ?*

Solution. Communication channels mean the connecting cables that link various workstations. There are *three* basic types of cables :

(*i*) *Twisted-Pair Cables*. These cables consist of two insulated copper wires twisted around each other. These are also used for short and medium range telephone communication.

(*ii*) *Coaxial Cables*. A coaxial cable consists of one or more small cables in protective covering. These are more expensive than twisted pair cables but perform better.

(*iii*) *Fiber-optic Cables*. These cables are made of plastic or glass and are about as thick as human hair. These cables are highly durable and offer excellent performance but are expensive.

Above given media are guided media. Unsigned communication media are microwaves, radiowaves and sattellites.

5. *What is NIC ?*

Solution. NIC stands for Network Interface Card. It is also known as Network Adapter. It is in the form of add-in card and is installed in a computer so that the computer can be connected to a network.

Each NIC has a MAC address which helps in identifying the computer on a network.

6. *What is MAC address ?*

Solution. The address for a device as it is identified at the Media Access Control (MAC) layer in the network architecture. MAC address is usually stored in ROM on the network adapter card and is unique.

7. *What is the difference between bit rate and baud rate.*

Solution. Bit rate is the number of bits transmitted during one second whereas baud rate refers to the number of signal units per second that are required to represent those bits.

baud rate = bit rate/N where N is no-of-bits represented by each signal shift.

8. *What is Bandwidth ?*

Solution. Every line has an upper limit and a lower limit on the frequency of signals it can carry. This limited range is called the bandwidth.

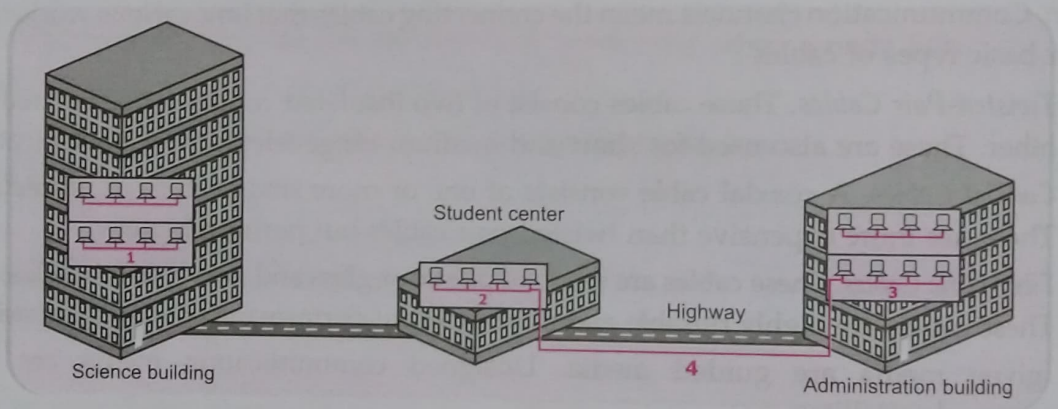
Path Wala

9. *What are the different types of networking / internetworking devices?*

Solution. Different types of networking/internetworking devices are :

- *Repeater.* Also called a regenerator, it is an electronic device that operates only at physical layer. It receives the signal in the network before it becomes weak, regenerates the original bit pattern and puts the refreshed copy back in to the link.
- *Bridges.* These operate both in the physical and data link layers of LANs of same type. They divide a larger network in to smaller segments. They contain logic that allow them to keep the traffic for each segment separate and thus are repeaters that relay a frame only the side of the segment containing the intended recipent and control congestion.
- *Routers.* They relay packets among multiple interconnected networks (*i.e.*, LANs of different type). They operate in the physical, data link and network layers. They contain software that enable them to determine which of the several possible paths is the best for a particular transmission.
- *Gateways.* They relay packets among networks that have different protocols (*e.g.*, between a LAN and a WAN). They accept a packet formatted for one protocol and convert it to a packet formatted for another protocol before forwarding it. They operate in all seven layers of the OSI model.

10. *Govt. of Delhi has computer networks inside each of its buildings. It has now interconnected the networks of Administration building and of Student center building. The networks so formed are marked below as numbers. Mention which types of networks is each of these ?*



Solution.

Network number	Type of network
1, 2, 3	LAN
4	WAN (it is connecting only networks 2 and 3)

11. *What is the difference between Hub, Switch, and Router?*

Solution.

Hub	Switch	Router
Hub is the least expensive, least intelligent and least complicated of the three. It broadcasts all data to every port which may cause serious security and reliability concern.	Switches work similarly like Hubs but in a more efficient manner. It creates connections dynamically and provides information only to the requesting port.	The router is smartest and most complicated out of these three. It comes in all shapes and sizes. Routers are similar like little computers dedicated for routing network traffic.
In a Network, Hub is a common connection point for devices connected to the network. Hub contains multiple ports and is used to connect segments of LAN.	Switch is a device in a network which forwards packets in a network.	Routers are located at gateway and forwards data packets.

Path Wala

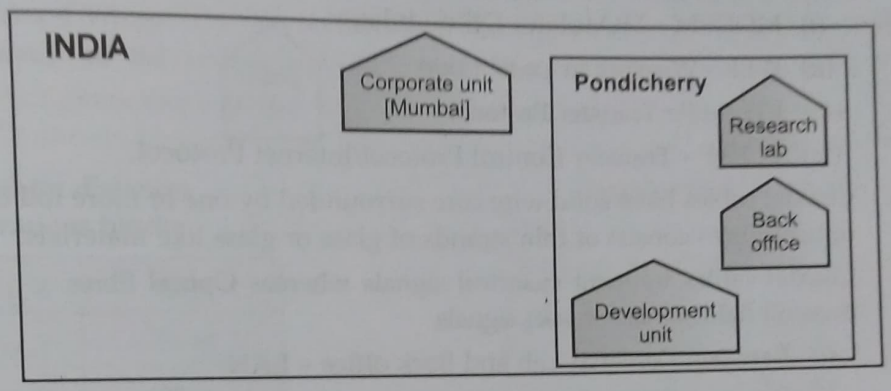
12. (a) *What is a Hub ?*

(b) *Expand the following terms with respect to Networking :*

(i) MODEM (ii) WLL (iii) FTP (iv) TCP/IP

(c) *How is Coaxial cable different from Optical Fibre ?*

(d) *"Bias Methodologies" is planning to expand their network in India, starting with three cities in India to build infrastructure for research and development of their chemical products. The company has planned to setup their main office in Pondicherry – at three different locations and have named their offices as "Back Office", "Research Lab" and "Development Unit". The company has one more Research office namely "Corporate Office" in "Mumbai". A rough layout of the same is as follows :*



Approximate distance between these offices is as follows :

From	To	Distance
Research Lab	Back Office	110 Mtr
Research Lab	Development Unit	16 KM
Research Lab	Corporate Unit	1800 KM
Back Office	Development Unit	13 KM

In continuation of the above, the company experts have planned to install the following number of computers in each of their offices :

Research Lab	158
Back Office	79
Development Unit	90
Corporate Unit	51

(i) *Suggest the kind of network required (out of LAN, MAN, WAN) for connecting each of the following office units :*

- Research Lab and Back Office
- Research Lab and Development Unit

(ii) *Which one of the following devices will you suggest for connecting all the computers with in each of their office units ?*

- Switch/Hub
- Modem
- Telephone

Path Wala

(iii) *Which of the following communication media, you will suggest to be procured by the company for connecting their local office units in Pondicherry for very effective (High Speed) communication ?*

- Telephone Cable
- Optical Fibre
- Ethernet Cable

(iv) *Suggest a cable/wiring layout for connecting the company's local office units located in Pondicherry. Also, suggest an effective method/technology for connecting the company's office unit located in Mumbai.* (Delhi 2008)

Solution.

(a) A *hub* is a hardware device used to connect several computers together.

(b) (i) MODEM - MOdulator DEModulator

(ii) WLL - Wireless in Local Loop

(iii) FTP - File Transfer Protocol

(iv) TCP/IP - Transfer Control Protocol/Internet Protocol.

(c) Coaxial cables have solid wire core surrounded by one or more foil or wire shields whereas optical fibres consist of thin strands of glass or glass like materials.

Coaxial cables transmit electrical signals whereas Optical fibres transmit light signals or laser signals.

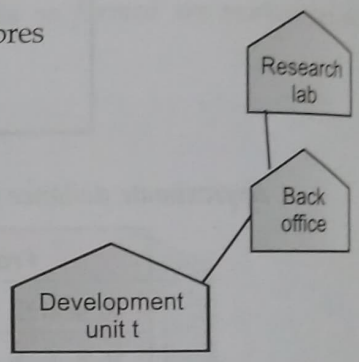
(d) (i) Between Research Lab and Back office – LAN

Between Research Lab and Development unit – MAN

(ii) Switch/hub (iii) Optical fibre

(iv) Suggested layout is shown in adjacent figure.

Technology for connecting to Mumbai office – *Sattellite.*



13. *Software Development Company has set up its new center at Raipur for its office and web based activities. It has 4 blocks of buildings named Block A, Block B, Block C, Block D.* [CBSE Sample Paper 2019-20]

Number of Computers

Block A	25
Block B	50
Block C	125
Block D	10

Shortest distances between various Blocks in meters

Block A to Block B	60 m
Block B to Block C	40 m
Block C to Block A	30 m
Block D to Block C	50 m

(i) *Suggest the most suitable place (i.e., block) to house the server of this company with a suitable reason*

(ii) *Suggest the type of network to connect all the blocks with suitable reason.*

(iii) *The company is planning to link all the blocks through a secure and high speed wired medium. Suggest a way to connect all the blocks.*

(iv) *Suggest the most suitable wired medium for efficiently connecting each computer installed in every block out of the following network cables :*

- Coaxial Cable
- Ethernet Cable
- Single Pair Telephone Cable.

Solution. (i) Block C, It has maximum number of computers.

(ii) LAN (iii) Star topology (iv) Ethernet cable

Path Wala

4. (a) *What is the difference between Message Switching technique and Packet Switching technique ?*

Or

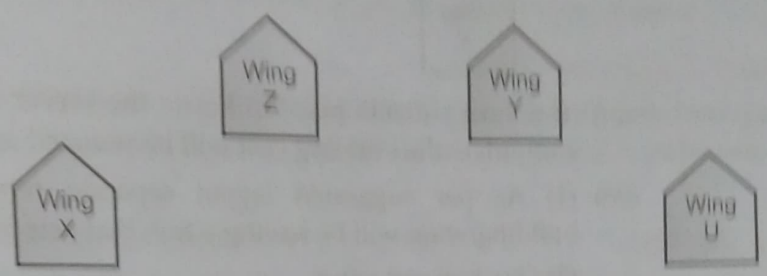
Differentiate between packet switching and message switching technique in network communication.

(CBSE D 2016C)

(b) *Expand the following terminologies :* (i) TCP/IP (ii) XML (iii) CDMA (iv) WLL (Delhi 2011)

(c) *Write two applications of Cyber Law.*

(d) *The Great Brain Organisation has set up its new Branch at Srinagar for its office and web based activities. It has 4 Wings of buildings as shown in the diagram :*



Center to center distances between various blocks

Wing X to Wing Z	50 m
Wing Z to Wing Y	70 m
Wing Y to Wing X	125 m
Wing Y to Wing U	80 m
Wing X to Wing U	175 m
Wing Z to Wing U	90 m

Number of Computers

Wing X	50
Wing Z	30
Wing Y	150
Wing U	15

(i) *Suggest the most suitable cable layout of connections between the Wings, and topology.*

(ii) *Suggest the most suitable place (i.e., Wing) to house the server of this organisation with a suitable reason, with justification.*

(iii) *Suggest the placement of the following devices with justification :* (1) *Repeater* (2) *Hub/Switch*

(iv) *The organization is planning to link its head office situated in Delhi with the offices at Srinagar. Suggest an economic way to connect it ; the company is ready to compromise on the speed of connectivity. Justify your answer.* (Delhi 2005)

Solution.

(a) **Message Switching.** In this form of switching no physical copper path is established in advance between sender and receiver. Instead when the sender has a block of data to be sent, it is stored in first switching office, then forwarded later, one jump at a time.

Packet Switching. With message switching there is no limit on block size, in contrast packet switching places a tight upper limit on block size.

(b) (i) Transmission Control Protocol/Internet Protocol

(ii) eXentensible Markup Language

(iii) Code-Division Multiple Access

(iv) Wireless in Local Loop.

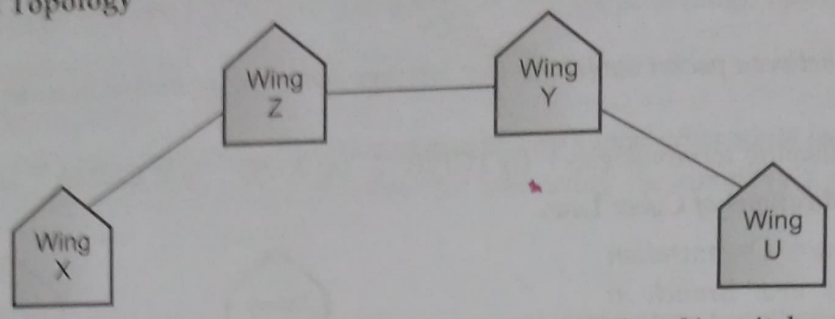
(c) Two applications of cyber law are :

(i) Digital transactions

(ii) Activities on Internet.

Path Wala

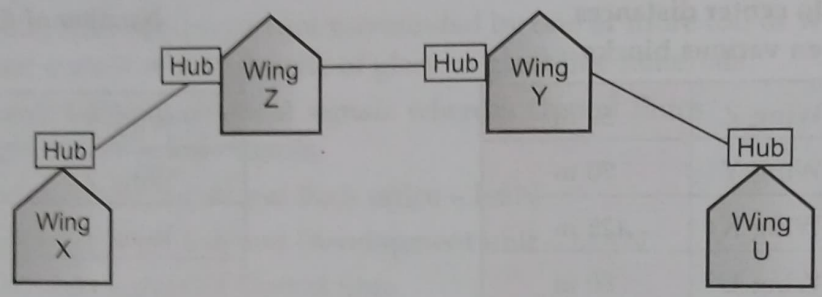
(*d*) (*i*) **Bus Topology**



(*ii*) The most suitable place to house the server is **Wing Y** as it has the most number of computers thus cabling cost will be reduced and most traffic will be local.

(*iii*) (1) As per suggested layout separate repeaters need not be installed as each building/wing will be having a hub that acts as a repeater.

(2) One hub per wing.



(*iv*) An economic way of connecting is Dial-up or broadband as it can connect two computers at an economic rate though it provides lesser speed than other expensive methods.

15. *What are the different types of networks ? What is the geographical scope of LAN, MAN and WAN ?*

Solution. Networks vary widely in their size, complexity and geographical spread. On the basis of geographical spread, networks can be classified into three categories :

(*i*) *Local Area Networks* (*LANs*). These are computer networks confined to a localised area such as an office or a factory.

(*ii*) *Metropolitan Area Networks* (*MANs*). These are the networks that link computer facilities within a city.

(*iii*) *Wide Area Networks* (*WANs*). These are the networks spread over large distances, say across countries or even continents. It can even include a group of LANs connected together.

16. *What are the important topologies for networks ?*

Solution. Important network topologies are :

- **BUS topology.** In this each computer is directly connected to primary network cable in a single line.

  Advantage. Inexpensive, easy to install, simple to understand, easy to extend.

- **STAR topology.** In this all computers are connected using a central hub.

  Advantage. Can be inexpensive, easy to install and reconfigure and easy to trouble shoot physical problems.

- **RING topology.** In this all computers are connected in loop.

  Advantage. All computers have equal access to network media, installation can be simple, and signal does not degrade as much as in other topologies because each computer regenerates it.

Path Wala

17. *Explain in brief the capabilities and services supported by LAN.*

Solution. Small computer networks that are confined to a localised area (*e.g.*, an office, a building or a factory) are known as *Local Area Networks* (LANs). The key purpose of a LAN is to serve its users in resource sharing. The hardware as well as software resources are shared through LANs. For instance, LAN users can share data, information, programs, printer, hard-disks, modems etc. One node has a printer connected to it and other nodes on the LAN can communicate with it in order to print files and hence allowing expensive peripherals to be shared among number of users.

18. *What is the purpose of using router ?* (CBSE Outside Delhi 1999)

Solution. A router can work like a bridge and can also handle different protocols. A router can locate the destination required by sending the traffic to another router, if the destination is unknown to itself.

19. (*a*) *Give two examples of PAN and LAN type of networks.* (CBSE Delhi 2016)

(*b*) *Differentiate between PAN and LAN types of networks.* (CBSE Outside Delhi 2016)

Solution.

(*a*) **PAN :** *Examples*

(*i*) Network formed by connecting smartphones of family members to laptop via bluetooth.

(*ii*) Network formed by connecting devices like printer, laptop, smartphone, digital recorder etc.

LAN : *Examples*

(*i*) Network formed by computers in an office.

(*ii*) Network formed by computers in a bank.

(*b*) PAN expands to *Personal Area Network.*

LAN expands to *Local Area Network.*

A PAN is a computer network organized around an individual person where a small network is formed by connecting various devices of the individual *e.g.*, a laptop, a printer, a smartphone, digital recorder etc.

LAN interconnects some stand-alone computers within a confined physical area upto a kilometer, *e.g.*, a LAN inside a university or a LAN inside a hospital etc.

20. *What are two types of modems ?*

Solution. Modems come in *two* varieties :

1. ***Internal modems*** are the modems that are fixed within the computer.
2. ***External modems*** are the modems that are connected externally to a computer as other peripherals are connected.

21. *Write two advantages of 4G over 3G Mobile Telecommunication Technologies in terms of speed and services.* (CBSE Delhi 2016)

Solution. Speed. 4G offers peak download speeds of more them 10 Mbps while 3G offers peak download speeds around 3.1 Mbps.

Services. Using QoS, Quality of service technology, 4G can prioritize services to offer flawless performance, *e.g.*, VoIP is prioritized over other data to offer flawless calling experience.

22. *What do you mean by network topology ? What are the most popular topologies ?* (CBSE Question Bank)

Solution. Topology refers to the way in which the workstations attached to the network are interconnected. The most popular topologies are :

- Bus or Linear
- Ring
- Star
- Tree

Path Wala

1. *Bus or Linear Topology.* In this topology, all devices on network are connected to a single continuous cable called a bus. Transmission from any station travels the length of the bus in both directions and can be received by all other stations. The destination device, on identifying the address on data packet copies the data onto its disk. When the data packet reaches at either end the terminator on that end absorbs the signal, removing from the bus.

   This topology can be used for smaller networks.

2. *Ring Topology.* A LAN using the ring topology is connected in the closed loop. The data packets transmitted, circulate along the ring. The destination station copies the packet content on recognizing its address on the packet. After a packet travels a full circle, it is removed at the source station.

3. *Star Topology.* In this topology each workstation is directly linked to a central node. Devices can be easily plugged or unplugged to the central node, as need dictates. Any communication between the stations must pass through the central node.

4. *Tree Topology.* In this topology the network is shaped as an inverted tree with the central root branching and sub-branching to the extremities of the network. Transmission in this topology takes place in the same way as in bus topology.

23. *What is a modem ? What is its function ?*

Solution. A modem is a computer peripheral that connects a workstation to other work-stations via telephone lines and facilitates communications. It is short form for Modulation / Demodulation.

Modem converts digital signals to A/F (Audio Frequency) tones which are in the frequency range that the telephone lines can transmit and also it can convert transmitted tones back to digital information.

24. (*a*) *Differentiate between Internet and Intranet.* (Delhi 2006)

(*b*) *Expand the following terms :* (*i*) *CDMA* (*ii*) URL (*iii*) HTTP (*iv*) WAN

(*c*) *Write one advantage of STAR topology as compared to BUS topology.*

(*d*) *UNIVERSITY OF CORRESPONDENCE in Allahabad is setting up the network between its different wings. There are 4 wings named as Science (S), Journalism (J), ARTS (A) and Home Science (H).*

Distance between various wings

Wing A to Wing S	100 m
Wing A to Wing J	200 m
Wing A to Wing H	400 m
Wing S to Wing J	300 m
Wing S to Wing H	100 m
Wing J to Wing H	450 m

Number of Computers

Wing A	150
Wing S	10
Wing J	5
Wing H	50

(*i*) *Suggest a suitable Topology for networking the computer of all wings.*

(*ii*) *Name the wing where the Server to be installed. Justify your answer.*

(*iii*) *Suggest the placement of Hub/Switch in the network.*

(*iv*) *Mention in economic technology to provide internet accessibility to all wings.*

Solution.

(*a*) The Internet is a worldwide network of computer networks around the globe. Internet uses a set of protocols called TCP / IP. Internet is not owned by anybody.

On the other hand Intranet is network, which is privately owned. Intranet also uses same set of protocols as Internet.

Path Wala

(b) (i) **CDMA** – Code-Division Multiple Access (ii) **URL** – Uniform Resource Locator
(iii) **HTTP** – Hyper Text Transfer Protocol (iv) **WAN** – Wide Area Network

(c) Fault Diagnosis is relatively easy in STAR topology as compared to BUS topology

(d) (i) Star Topology can be used to network the computer of all wings.
(ii) The Sever should be installed in Wing A, as Wing A has maximum number of computer and installing the server in this wing will help to reduce the network traffic.
(iii) Hub/Switch will be required in all the Wings
(iv) The economic way to provide internet accessibility to all wings is to use the proxy server at wing A and connect to the internet through a dial-up network.

25. (a) *Name two transmission media for networking.* (Outside Delhi 2006)
(b) *Expand the following terms :* (i) XML (ii) GSM (iii) SMS (iv) MAN
(c) *Differentiate between Hackers and Crackers ?*
(d) *INDIAN PUBLIC SCHOOL in Darjeeling is setting up the network between its different wings. There are 4 wings named as SENIOR(S), JUNIOR(J), ADMIN(A) and HOSTEL(H).*

Distance between various wings

Wing A to Wing S	100 m
Wing A to Wing J	200 m
Wing A to Wing H	400 m
Wing S to Wing J	300 m
Wing S to Wing H	100 m
Wing J to Wing H	450 m

Number of Computers

Wing A	10
Wing S	200
Wing J	100
Wing H	50

(i) *Suggest a suitable Topology for networking the computer of all wings.*
(ii) *Name the wing where the server is to be installed. Justify your answer*
(iii) *Suggest the placement of Hub/Switch in the network.*
(iv) *Mention an economic technology to provide internet accessibility to all wings.*

Solution.

(a) (i) Coaxial Cable (ii) Microwave

(b) (i) **XML** – Extensible Markup Language
(ii) **GSM** – Global System for Mobile
(iii) **SMS** – Short Message Service
(iv) **MAN** – Metropolitan Area Network

(c) Programmers who gain knowledge about computer system for playful pranks are known as Hackers where as Crackers are malicious programmers who break into secure systems.

(d) (i) Star Topology can be used to network the computer of all wings.
(ii) The Sever should be installed in Wing S, as Wing S has maximum number of com- puter and installing the server in this wing will help to reduce the network traffic.
(iii) Hub/ Switch will be required in all the Wings
(iv) The economic way to provide internet accessibility to all wings is to use the proxy server at wing S and connect to the internet through a dial-up network.

Path Wala

26. *Differentiate between XML and HTML.* (Outside Delhi 2011)

Solution. In HTML (HyperText Markup Language), both tag semantics and the tag set are fixed whereas, XML (eXtensible Markup Language) is a meta-language for describing markup languages. XML provides facility to define tags and the structural relationships between them. All the semantics of an XML document will either be defined by the applications that process them or by stylesheets.

27. *Jai is an IT expert and a freelancer. He recently used his skills to access the Administrator password for the network server of Megatech Corporation Ltd. and provided confidential data of the organisation to its Director, informing him about the vulnerability of their network security. Out of the following options (i) to (iv), which one most appropriately defines Jai ?* (CBSE D 2017)

Justify the reason for your chosen option :

(i) Hacker (ii) Cracker (iii) Operator (iv) Network Admin

Solution. **Hacker.** A computer hacker breaks into computer system for gaining knowledge about possible vulnerabilities and finding possible solutions.

28. *Define the following : (i) Data channel (ii) Baud (iii) bps (iv) Bps (v) Bandwidth.*

Solution. (*i*) A data channel is the medium used to carry information or data from one point to another.

(*ii*) Baud is the unit of measurement for the information carrying capacity of a communication channel. It is synonymous with bps (bits per second).

(*iii*) bps – bits per second. It refers to a thousand bits transmitted per second.

(*iv*) Bps – Bytes per second. It refers to a thousand bytes transmitted per second.

(*v*) Bandwidth – It refers to the difference between the highest and lowest frequencies of a transmission channel. This term is also sometimes used to refer to the amount of information travelling through a single channel at any one point of time.

29. *What are repeaters and routers ?* (CBSE Question Bank 1998)

Solution. **REPEATER.** A *repeater* is a device that amplifies a signal being transmitted on the network. It is used in long network lines, which exceed the maximum rated distance for a single run.

Over distance, the cables connecting a network lose the signal transmitted. If the signal degrades too much, it fails to reach the destination. Or if it does arrive, the degradation of the message makes it useless. *Repeaters* can be installed along the way to ensure that data packets reach their destination. *Repeaters* are of two kinds — *amplifier* and *signal repeater*.

The *first* merely amplifies all incoming signals over the network. However, it amplifies both the signal and any concurrent noise. The *second* type collects the inbound packet and then retransmits the packet as if it were starting from the source station.

ROUTER. A device that works like a bridge but can handle different protocols, is known as a *router*. For example, a router can link Ethernet (ethernet is a very popular and widely accepted method of linking local stations to one another (*i.e.*, a LAN) for sharing data, program and equipment resources.) to a mainframe.

If the destination is unknown to a router it sends the traffic (bound to unknown destination) to another router (using logical addresses) which knows the destination.

A router differs from a bridge in a way that former uses logical addresses and the latter uses physical addresses.

30. *A teacher provides "http://www.XtSchool.com/default.aspx" to his/her student to identify the URL and domain name.* (CBSE Sample Paper 2017-18)

Solution. **URL :** http://www.XtSchool.com/default.aspx

Domain name : XtSchool.com

Path Wala

31. *How is TELNET service of internet useful ?*

Solution. Telnet, the most widely used remote logic program in the world, is used to extract the raw power of Internet. Using telnet a student in Delhi can access a server at America. A major chunk of scientists on the internet are accessing and utilizing the power of super computers by telneting.

32. *What are cookies ?*

Or

(Outside Delhi 2011)

What is the significance of cookies stored on a computer ?

(CBSE Sample Paper 2017-18)

Solution. Cookies are messages that a web server transmits to a web browser so that the web server can keep track of users activity on a specific web site.

33. *Give the advantages of E-mail and World Wide Web services provided by INTERNET.*

Solution. **Advantages of E-MAIL**

(i) Low cost. Electronic mail is an extremely cost-effective way to move information around, especially when it must be moved quickly. A three page letter to U.S.A. can cost Rs. 200 through courier, or about Rs. 100 to fax. The same letter can be sent by e-mail for the cost of one local call.

(ii) Speed. Electronic mail can be delivered almost as fast as the wire can carry it.

(iii) Waste reduction. E-mail goes a long way toward reducing the clutter of paper in the modern office, not to mention saving many trees.

(iv) Ease of use. It is easy to send an e-mail. You don't have to retype it three times, find an envelope, go to the corner to buy a stamp, and then find a mail box.

(v) Record maintenance. Because all messages are files, you can automatically maintain a record of communications with someone else.

(vi) Patience. E-mail waits until you read it. It doesn't have the jangling urgency of a phone call.

34. *What are protocols ? Give some examples of different types of protocols used.*

Solution. A **protocol** means the rules that are applicable for a network or we can say that the common set of rules used for communication in a network. Different types of protocols are :

(i) HTTP : Hyper Text Transfer Protocol

(ii) FTP : File Transfer Protocol.

(iii) SLIP : Serial Line Internet Protocol.

(iv) PPP : Point to Point Protocol.

(v) TCP/IP : Transmission Control Protocol/Internet Protocol.

(vi) NTP : Network Time Protocol.

(vii) SMTP : Simple Mail Transfer Protocol.

(viii) POP : Post Office Protocol.

(ix) IMAP : Internet Mail Access Protocol.

(Delhi 2011)

35. *What is VoIP ?*

Solution. VoIP (Voice over IP) refers to a way to carry telephone calls over an IP data network. It offers a set of facilities to manage the delivery of voice information over Internet in digital form.

36. (a) *Give one advantage and one disadvantage of optical fibre cable and coaxial cable used in communication.*

(b) *Differentiate between Tree and Bus topologies of network.*

(c) *What do email and FTP mean ?*

(d) *What is the difference between a repeater and a bridge ?*

(CBSE 2000)

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Solution.

(a) **Optical Fibre Cable**

Advantage. It is free from electrical noise and interference.

Disadvantage. It is an expensive communication medium.

Coaxial Cable

Advantage. It provides a cheap means of transporting multi-channel television signals around metropolitan areas.

(b) **Tree topology** is a network with the shape of an inverted tree with the central root branching and sub-branching to the extremities of the network as shown in Fig. 14.10. There is a single link between two nodes in this topology.

Bus topology. In this topology, all devices on network are connected to a single continuous cable called a bus. This topology can be used for smaller networks.

(c) **Email.** E-mail (Electronic Mail) is sending and receiving messages by computers.

FTP. FTP expands to **File Transfer Protocol,** which ensures the proper transfer of files from one network in an organization to another.

(d) **Repeater.** A repeater is a device that amplifies a signal being transmitted on the network.

Bridge. A bridge links two networks of same protocol using their physical addresses.

37. (a) *Give the full form of NFS and FTP.* (Delhi 2002)

(b) *What do you understand by firewall ?*

(c) *Differentiate between downloading and uploading.*

Solution.

(a) NFS – Network File System ;

FTP – File Transfer Protocol.

(b) The system designed to prevent unauthorized access to or from a private network is called firewall.

(c) *Downloading* refers to transfer of files from (FTP) server on the user's computer and *uploading* refers to transfer of files from user's computer onto (FTP) server.

38. *Differentiate between GSM and CDMA.*

Solution. GSM (*Global System for Mobile*) communications is a technique that uses narrowband TDMA, which allows eight simultaneous calls on the same radio frequency. TDMA is short for *Time Division Multiple Access*. TDMA technology uses time-division multiplexing (TDM) and divides a radio frequency into time slots and then allocates these slots to multiple calls thereby supporting multiple, simultaneous data channels.

CDMA (Code-Division Multiple Access) on the other hand, unlike GSM, does not assign a specific frequency to each user. CDMA uses spread-spectrum technique where every channel uses full available spectrum. With CDMA, data is sent in small pieces over a number of discrete frequencies available for use at any time in the specified range. All users transmit in the same wide-band chunk of spectrum. Each user's signal is spread over the entire bandwidth by a unique spreading code, which is again used at the receiver end to recover the transmitted signal.

39. *Write a short note on WLL.*

Solution. A WLL (Wireless in Local Loop) system serves a local area by deploying a multiplicity of multichannel transmit/receive base stations (transceivers) that are within line-of-site of the intended

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customers. Each customer is equipped with a mini-station of low power, into which the telephone (or PBX) is connected. When calls are made from the telephone, it signals the base station for a connection, which is subsequently established through a switch center, exactly as in conventional telephony. An incoming call is identified at the switch center and routed to the base station assigned to serve the telephone being called. The wireless connection is then made, and the call is completed in a conventional manner. The infrastructure design of a WLL system typically uses an advanced transmission technology such as CDMA, which permits support of large subscriber bases through orderly expansion of the base station clusters.

40. *Who are hackers ? Who are crackers ?*

Solution. The **Crackers** are the malicious programmers who break into secure systems whereas **Hackers** are more interested in gaining knowledge about computer systems and possibly using this knowledge for playful pranks.

41. *Which of the following will come under Cyber Crime ?* (Delhi 2011)

(*i*) *Theft of a brand new sealed pack Laptop*

(*ii*) *Access to a bank account for getting unauthorized Money Transaction*

(*iii*) *Modification in a company data with unauthorized access*

(*iv*) *Photocopying a printed report*

Solution. (*ii*) Access to a bank account for getting unauthorized Money Transaction

42. *Write two characteristics of Web 2.0.* (CBSE Delhi 2016)

Solution. Web 2.0 refers to added features and applications to WWW that make the web more interactive, support easy online-information exchange and interoperability. Some noticeable features of Web 2.0 are blogs, wikis, video-sharing websites, social networking websites, RSS etc.

43. *Out of the following, identify client side script(s) and server side script(s) :* (Outside Delhi 2011 ; D 2016)

(*i*) Javascript (*ii*) ASP (*iii*) VBScript (*iv*) JSP

Solution. Client side scripts are Javascript, and vbscript, server side scripts are ASP, and JSP.

44. *What do you mean by data encryption ? For what purpose it is used for ?* (CBSE Sample Paper 2017-18)

Solution. Data encryption is a technique used for data security in which original message is converted or encoded using an algorithm into a form not understood by anyone except the person who has the key to decode it.

45. (*a*) *Write one characteristic each for 2G and 3G Mobile Technologies.*

(*b*) *What is the difference between Video Conferencing and Chat ?*

(*c*) *Expand the following :*

- GPRS
- CDMA

(*d*) *Which type of network (out of LAN, PAN and MAN) is formed, when you connect two mobiles using Bluetooth to transfer a picture file ?*

(*e*) *Write names of any two popular Open Source Software, which are used as operating system.* (Delhi 2014)

(*f*) *Write any two important characteristics of Cloud Computing.*

Solution.

(*a*) **2G.** First digital cellular system with data speeds upto 64 kbps.

3G. With speeds between 384 kbps to 2 Mbps, the 3G technologies allowed more data transmission, voice and video calling file transmission etc.

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(*b*) **Vido conferencing.** A video-conference refers to a live connection between people in separate locations for the purpose of visual communication.

Chat. The Internet Chat or just the chat generally refers to the instant broadcast of textual messages over the Internet between the sender and receiver.

(*c*) **GPRS.** General Packet Radio Service

CDMA. Code Division Multiple Access

(*d*) PAN is formed.

(*e*) Linux, FreeDOS

(*f*) (*i*) On demand self services (*ii*) Wide range of network access capabilities.

46. (*a*) *What out of the following, will you use to have an audio-visual chat with an expert sitting in a far-away place to fix-up a technical issue ?*

(*i*) VoIP (*ii*) email (*iii*) FTP

(*b*) *Name one server side scripting language and one client side scripting language.*

(*c*) *Which out of the following comes under Cyber Crime ?*

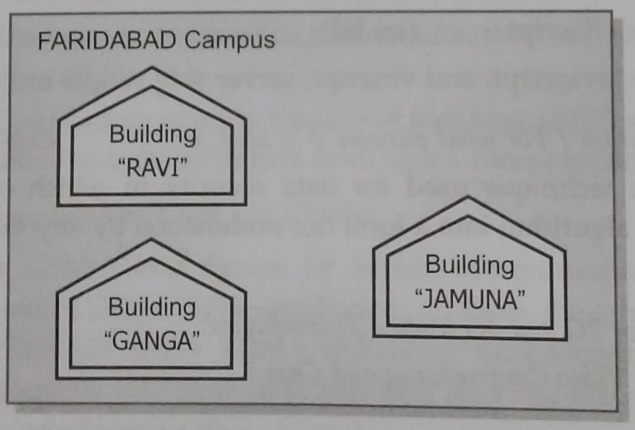
(*i*) *Operating someone's Internet banking account, without his knowledge.*

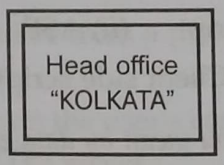
(*ii*) *Stealing a keyboard from someone's computer.*

(*iii*) *Working on someone's computer with his/her permission.*

(*d*) *Write one advantage of Bus Topology of network. Also, illustrate how 4 computers can be connected with each other using star topology of network.*

(*e*) *Workalot Consultants are setting up a secured network for their office campus at Gurgaon for their day-to-day office and web-based activities. They are planning to have connectivity between 3 buildings and the head office situated in Mumbai. Answer the questions (i) to (iv) after going through the building positions in the campus and other details, which are given below.*





Distances between various buildings

Building "GREEN" to Building "RED"	110 m
Building "GREEN" to Building "BLUE"	45 m
Building "BLUE" to Building "RED"	65 m
Gurgaon Campus to Head Office	1760 KM

Number of Computers

Building "GREEN"	32
Building "RED"	150
Building "BLUE"	45
Head Office	10

(*i*) *Suggest the most suitable place (i.e., building) to house the server of this organization. Also give a reason to justify your suggested location.*

(*ii*) *Suggest a cable layout of connections between the buildings inside the campus.*

Path Wala

(iii) *Suggest the placement of the following devices with justification :* 1. Switch 2. Repeater

(iv) *The organization is planning to provide a high speed link with its head office situated in MUMBAI using a wired connection. Which of the following cables will be most suitable for this job ?*

1. Optical Fibre 2. Co-axial Cable 3. Ethernet Cable

(f) *Give one suitable example of each URL and Domain Name.*

(g) *Name two Proprietary software alongwith their applications.* (Outside Delhi 2012)

Solution.

(a) (i) VoIP

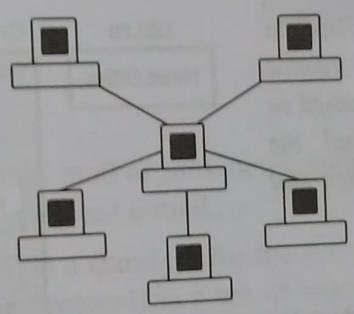
(b) Server Side Scripting – JSP

Client Side Scripting – Javascript

(c) Stealing a keyboard from someone's computer

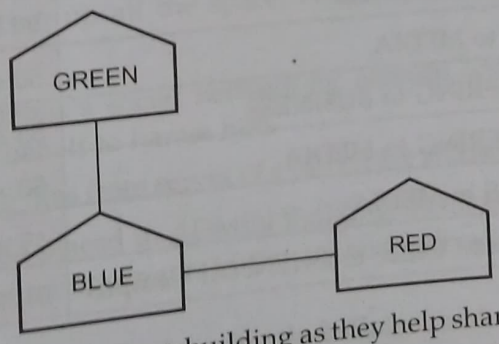
(d) *Advantage of Bus Topology*

- Easy to extend



(e) (i) In building RED as it houses maximum number of computer. ; hence most traffic will be local traffic if server is placed here.

(ii)



(iii) Switches are needed in every building as they help share bandwidth in every building. Repeaters may be skipped as per above layout, (because distance is less than 100 m) however if building Green and building Red are directly connected, we can place a repeater there as the distance between these two buildings is more than 100 m.

(iv) Fiber Optic

(f) *URL example* – www.cbse.nic.in/welcome.htm

Domain name – cbse.nic.in (in above URL)

(g) *MS-Office* – Office application suite

MS-Windows – Operating System

Path Wala

47. (a) *Illustrate the layout for connecting 5 computers in a Bus and a Star topology of Networks.*

(b) *What is a spam mail ?*

(c) *Differentiate between ftp and http.*

(d) *Out of the following, which is the fastest (i) wired and (ii) wireless medium of communication : Infrared, Coaxial Cable, Ethernet Cable, Microwave, Optical Fiber ?*

(e) *What is Worm ? How is it removed ?*

(f) *Out of the following, which all come under cyber crime ?*

(i) *Stealing away a brand new computer from a showroom.*

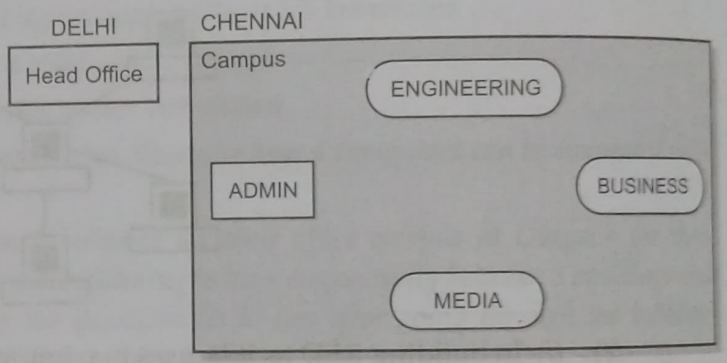
(ii) *Getting in someone's social networking account without his consent and posting pictures on his behalf to harass him.*

(iii) *Secretly copying files from server of a call center and selling it to the order organization.*

(iv) *Viewing sites on a internet browser.*

(g) *Perfect Edu Services Ltd. is an educational organization. It is planning to setup its India campus at Chennai with its head office at Delhi. The Chennai campus has 4 main buildings – ADMIN, ENGINEERING, BUSINESS and MEDIA.*

You as a network expert have to suggest the best network related solutions for their problems raised in (i) to (iv), keeping in mind the distances between the buildings and other given parameters.



Shortest distances between various buildings :

ADMIN to ENGINEERING	55 m
ADMIN to BUSINESS	90 m
ADMIN to MEDIA	50 m
ENGINEERING to BUSINESS	55 m
ENGINEERING to MEDIA	50 m
BUSINESS to MEDIA	45 m
DELHI Head Office to CHENNAI Campus	2175 km

Number of Computers installed at various buildings are as follows :

ADMIN	110
ENGINEERING	75
BUSINESS	40
MEDIA	12
DELHI Head Office	20

(i) *Suggest the most appropriate location of the server inside the CHENNAI campus (out of the 4 buildings), to get the best connectivity for maximum no. of computers. Justify your answer.*

Path Wala

(ii) *Suggest and draw the cable layout to efficiently connect various buildings within the CHENNAI campus for connecting the computers.*

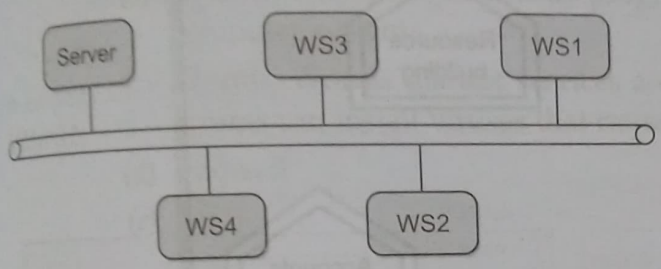
(iii) *Which hardware device will you suggest to be procured by the company to be installed to protect and control the internet uses within the campus ?*

(iv) *Which of the following will you suggest to establish the online face-to-face communication between the people in the Admin Office of CHENNAI campus and DELHI Head Office ?*

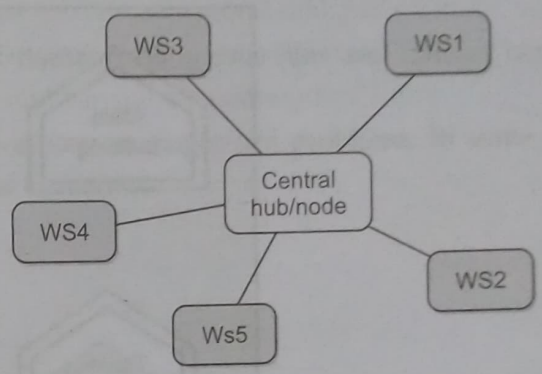
(a) Cable TV (b) Email (c) Video Conferencing (d) Text Chat (Delhi 2015)

Solution.

(a) **Bus topology**



Star topology



(b) Spam refers to electronic junk mail or junk newsgroup postings. Some people define spam even more generally an unsolicited e-mail.

(c) FTP (File Transfer Protocol) is a standard for the exchange of files across internet. Whereas HTTP (Hypertext Transfer Protocol) is a set of rules for transferring hypertext (*i.e.*, text, graphic, image, sound, video etc.) on WWW.

(d) (i) Wired – Optical fibre (ii) Wireless – Microwave.

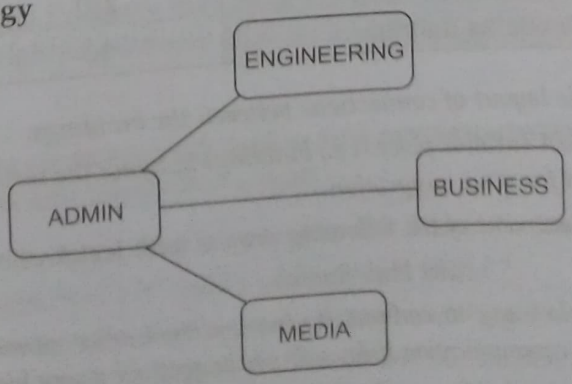
(e) A worm is a program designed to replicate. It is a self contained and does not require host and can harm by eating up all the space. Worms can be removed by using appropriate antivirus software.

(f) (ii) Getting in someone's social networking account without his consent and posting pictures on his behalf to harass him.

(iii) Secretly copying files from server of a call center and selling it to the other organization.

(g) (i) Server should be placed in ADMIN Building, as maximum number of computers are there and therefore maximum traffic can be localized.

(ii) **Star topology**



(iii) Firewall (iv) Video conferencing

Path Wala

(Outside Delhi 2016)

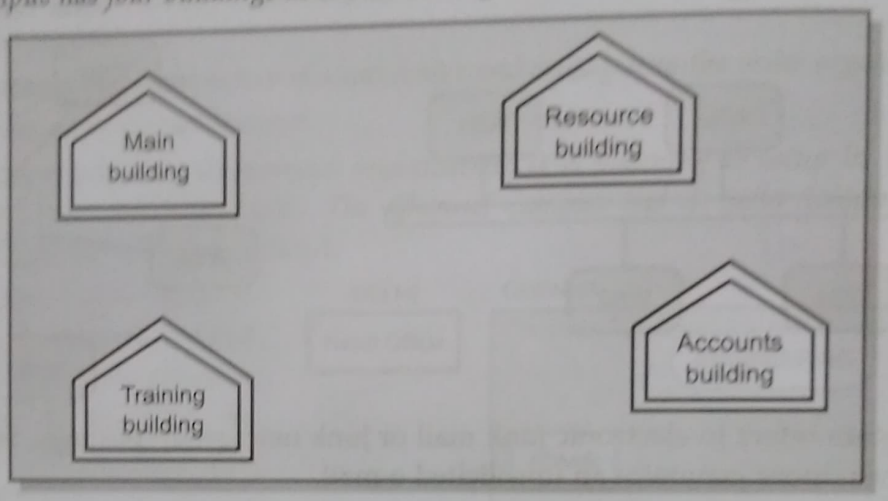
48. (a) What was the role of ARPANET in the Computer Network ?

(b) Which of the following is not a unit of data transfer rate ? (i) mbps (ii) kbps (iii) sbps (iv) gbps

(c) What is the difference between Virus and Worms in the computers ?

(d) What term do we use for a software/hardware device, which is used to block unauthorized access while permitting authorized communications ? This term is also used for a device or set of devices configured to permit, deny, encrypt, decrypt, or proxy all (in and out) computer traffic between different security domains based upon a set of rules and other criteria.

(e) "Vidya for All" is an educational NGO. It is setting up its new campus at Jaipur for its web-based activities. The campus has four buildings as shown in diagram below :



Center to center distances between various buildings as per architectural drawings (in meters) is as follows :

Main Building to Resource Building	120 m
Main Building to Training Building	40 m
Main Building to Accounts Building	135 m
Resource Building to Training Building	125 m
Resource Building to Accounts Building	45 m
Training Building to Accounts Building	110 m

Expected number of Computers in each building is as follows :

Main Building	15
Resource Building	25
Training Building	250
Accounts Building	10

(e1) Suggest a cable layout of connections between the buildings.

(e2) Suggest the most suitable place (i.e., building) to house the server of this NGO. Also, provide a suitable reason for your suggestion.

(e3) Suggest the placement of the following devices with justification :
(i) Repeater (ii) Hub/Switch

(e4) The NGO is planning to connect its International office situated in Delhi. Which out of the following wired communication links, will you suggest for a very high speed connectivity ?
(i) Telephone Analog line (ii) Optical Fiber (iii) Ethernet Cable

Path Wala

(f) *Write the full forms of the following :* (f1) FTP (f2) FSF

(g) *Name any two common Web browsers.*

Solution.

(a) The first computer network was jointly designed by the Advanced Research Projects Agency (ARPA) and Department of Defense (DoD) of United States in 1969 and was called ARPANET. It was an experimental project, which connected a few computers from some of the reputed universities of USA and DoD. ARPANENT allowed access to computer resource sharing projects. This ARPANET was handed over to Defense Communication Agency (DCA) for further development

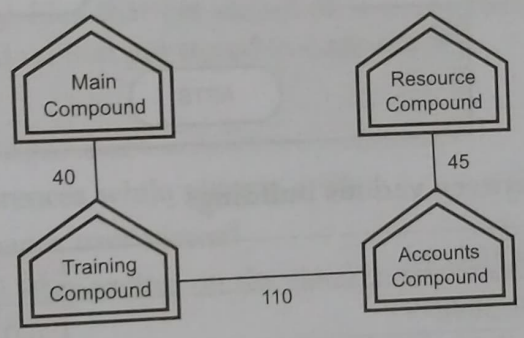
(b) (iii) sbps

(c) VIRUS. Virus is a malicious program that damages data and files and causes harm to computer system.

Worms. Worms disrupt services and create system management problems. In some cases worms can install viruses that cause damage to system.

(d) Firewall

(e) (e1)



(e2) *Training Building* as it hosts the most computers.

(e3) (i) Repeater – between Training & Accounts buildings as they have 110 m of distance.

(ii) Hub/Switch – In Training building as it will be hosting server.

(e4) Optical Fiber

(f) (f1) FTP – File Transfer Protocol (f2) FSF – Free Software Foundation

(g) Mozilla FireFox, Google Chrome

49. *What is Intellectual Property ?*

Solution. The Intellectual Property may be defined as a product of the intellect that has commercial value, including copyrighted property such as literary or artistic works, and ideational property.

50. *What is Spam ?*

Solution. Spam refers to electronic junk mail or junk newsgroups postings. Some people define spam even more generally as any unsolicited e-mail.

51. (a) *Illustrate the layout for connecting 5 computers in a Bus and a Star topology of Networks.*

(b) *What kind of data gets stored in cookies and how is it useful ?*

(c) *Differentiate between packet switching over message switching ?*

(d) *Out of the following, which is the fastest (i) wired and (ii) wireless medium of communication ?*

Infrared, Coaxial Cable, Ethernet Cable, Microwave, Optical Fiber

Path Wala

(e) *What is Trojan Horse ?*

(f) *Out of the following, which all comes under cyber crime ?*

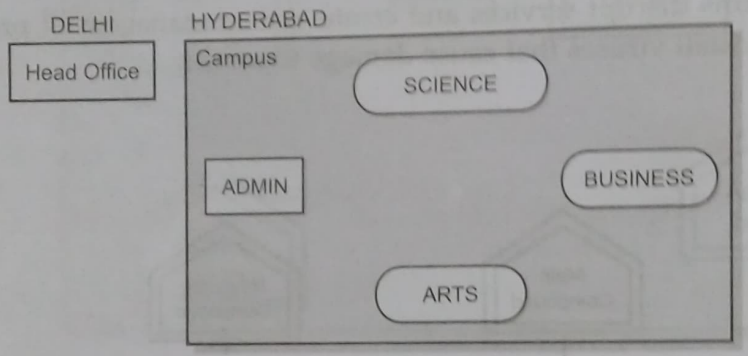
(i) *Stealing away a brand new hard disk from a showroom.*

(ii) *Getting in someone's social networking account without his consent and posting pictures on his behalf.*

(iii) *Secretly copying data from server of an organization and selling it to the other organization.*

(iv) *Looking at online activities of a friends blog.*

(g) *Xcelencia Edu Services Ltd. is an educational organisation. It is planning to set up its India campus at Hyderabad with its head office at Delhi. The Hyderabad campus has 4 main buildings – ADMIN, SCIENCE, BUSINESS and ARTS. You as a network expert has to suggest the best network related solutions for their problems raised in (i) to (iv), keeping in mind the distances between the buildings and other given parameters.*



Shortest distances between various buildings :

ADMIN to SCIENCE	65 m
ADMIN to BUSINESS	100 m
ADMIN to ARTS	60 m
SCIENCE to BUSINESS	75 m
SCIENCE to ARTS	60 m
BUSINESS to ARTS	50 m
DELHI Head Office to HYDERABAD Campus	1600 km

Number of computers installed at various buildings are as follows :

ADMIN	100
SCIENCE	85
BUSINESS	40
ARTS	12
DELHI Head Office	20

(i) *Suggest the most appropriate location of the server inside the HYDERABAD campus (out of the 4 buildings), to get the best connectivity for maximum number of computers. Justify your answer.*

(ii) *Suggest and draw the cable layout to efficiently connect various buildings within the HYDERABAD campus for connecting the computers.*

Path Wala

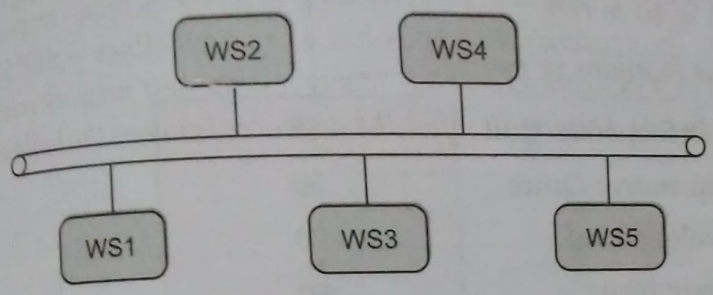
(iii) *Which hardware device will you suggest to be procured by the company to be installed to protect and control the internet uses within the campus ?*

(iv) *Which of the following will you suggest to establish the online face-to-face communication between the people in the Admin Office of HYDERABAD campus and DELHI Head Office ?*

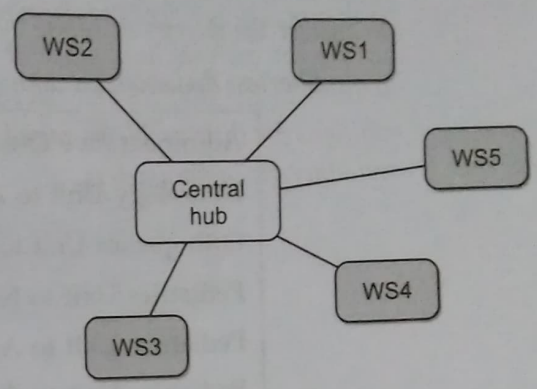
(a) E-mail, (b) Text Chat (c) Video Conferencing (d) Cable TV (Outside Delhi 2015)

Solution.

(a) **Bus topology**



Star topology



(b) Cookies are small text files that get stored on a user's hard drive when the user visits a website. The kind of data that get stored in cookies are :

- Cookie's name
- Cookie's content *e.g.,*
  - user's preferences while visiting a site
  - history of pages user viewed
  - login details (depending on the user's browser-settings)

(c) Refer to Ans. 14(*a*).

(d) (*i*) Wired fastest medium – Optical fibre. (*ii*) Wireless fastest medium – Microwave.

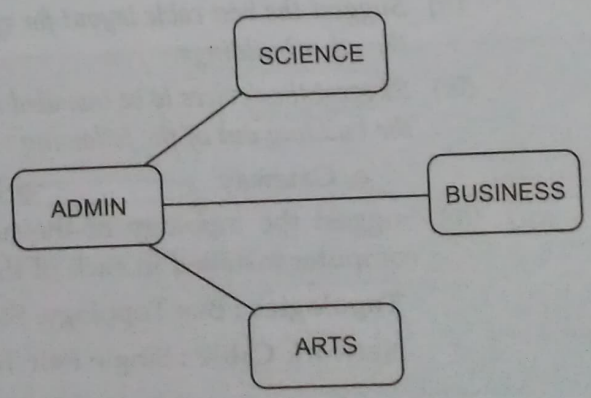
(e) A Trojan Horse is a code hidden in a program such as a game or spreadsheet that looks helpful and safe to run but has hidden side effects.

(f) (*ii*) Getting in someone's social networking account without his consent and posting on his behalf.

(*iii*) Secretly copying data from server of an organization and selling it to the other organisation.

(g) (*i*) Server should be placed in ADMIN Building of HYDERABAD campus as it contains maximum number of computers and hence maximum network traffic will be localized this way.

(*ii*) **Star topology for efficient connection** (see adjacent figure)



(*iii*) Firewall

(*iv*) (*iii*) Video conferencing

Path Wala

52. (a) *Classify each of the following Web Scripting as Client Side Scripting and Server Side Scripting :*

(i) Java Scripting (ii) ASP (iii) VB Scripting (iv) JSP

(b) *Case Study Based Question :*

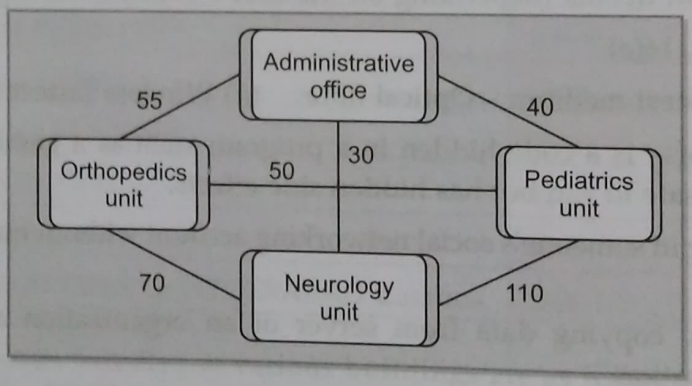
Ayurveda Training Educational Institute is setting up its centre in Hyderabad with four specialised departments for Orthopedics, Neurology and Pediatrics along with an administrative office in separate buildings. The physical distances between these department buildings and the number of computers to be installed in these departments and administrative office are given as follows. You, as a network expert, have to answer the queries as raised by them in (i) to (iv).

Shortest distances between various locations in metres :

Administrative Office to Orthopedics Unit	55
Neurology Unit to Administrative Office	30
Orthopedics Unit to Neurology Unit	70
Pediatrics Unit to Neurology Unit	50
Pediatrics Unit to Administrative Office	40
Pediatrics Unit to Orthopedics Unit	110

Number of Computers installed at various locations are as follows :

Pediatrics Unit	40
Administrative Office	140
Neurology	50
Orthopedics Unit	80



(i) *Suggest the most suitable location to install the main server of this institution to get efficient connectivity.*

(ii) *Suggest the best cable layout for effective network connectivity of the building having server with all the other buildings.*

(iii) *Suggest the devices to be installed in each of these buildings for connecting computers installed within the building out of the following :*

- Gateway
- Modem
- Switch

(iv) Suggest the topology of the network and network cable for efficiently connecting each computer installed in each of the buildings out of the following :

Topologies : Bus Topology, Star Topology

Network Cable : Single Pair Telephone Cable, Coaxial Cable, Ethernet Cable.

(CBSE Delhi 2018)

Path Wala

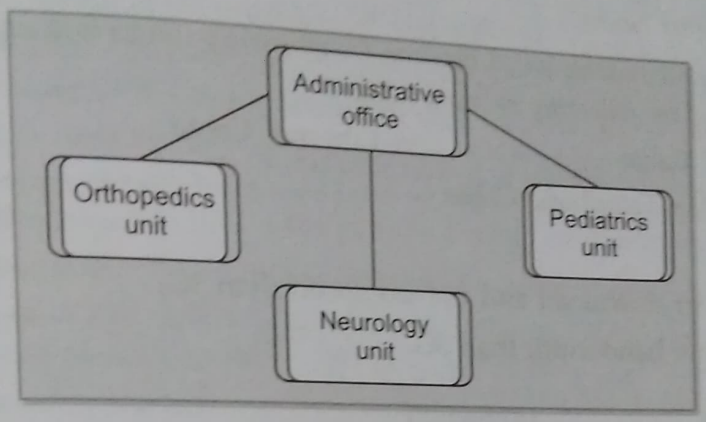
Solution.

(a) **Client side scripting :** Java scripting, VB scripting

Server side scripting : ASP, JSP

(b) (i) Administration office.

(ii)



(iii) Switch

(iv) **Topology :** Star topology

Network cable : Coaxial cable or Ethernet cable

53. (a) *Give two differences between 3G and 4G telecommunication technologies.*

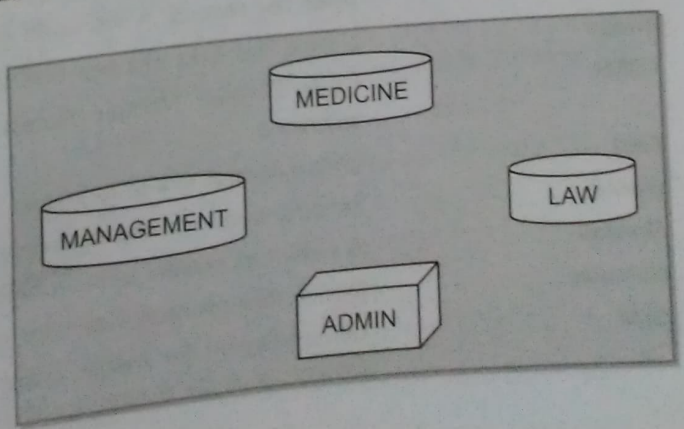
(b) Jonathan *and Jonathan Training Institute is planning to set up its centre in Amritsar with four specialised blocks for Medicine, Management, Law course alongwith an Admission block in separate buildings. The physical distances between these blocks and the number of computers to be installed in these blocks are given below. You as a network expert have to answer the queries as raised by their board of directors as given in (i) to (iv).*

Shortest distances between various locations in metres :

Administrative Block to Management Block	60
Administrative Block to Medicine Block	40
Administrative Block to Law Block	60
Management Block to Medicine Block	50
Management Block to Law Block	110
Law Block to Medicine Block	40

Number of Computers installed at various locations are as follows :

Administrative Block	150
Management Block	70
Medicine Block	20
Law Block	50



(i) *Suggest the most suitable location to install the main server of this institution*

Path Wala

(ii) *Suggest the devices to be installed in each of these buildings for connecting computers installed within the building out of the following :*

- Modem
- Switch
- Gateway
- Router

(iii) *Suggest by drawing the best cable layout for effective network connectivity of the blocks having server with all the other blocks.*

(iv) *Suggest the most suitable wired medium for efficiently connecting each computer installed in every building out of the following network cables :*

- Co-axial Cable
- Ethernet Cable
- Single Pair Telephone Cable

(CBSE Delhi 2019)

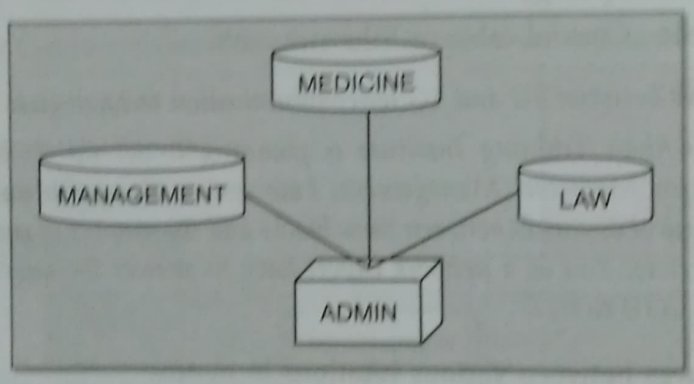
Solution.

(a) (i) 4G offers higher download and upload speed than 3G.

(ii) 4G offers higher bandwidth than 3G.

(b) (i) Admin block (ii) Switch

(iii)



(iv) Coaxial or Ethernet cable

GLOSSARY

Bandwidth	The capacity of a medium to transmit a signal.
Baud	Unit of measurement for the information carrying capacity of a communication channel.
bps	bits per second. A thousand bits transmitted per second.
Bps	Bytes per second. A thousand bytes transmitted per second.
Bridge	Device that links two networks together.
CDMA	Code Division Multiple Access, a digital cellular technology that uses spread- spectrum technique.
Chat	Online textual talk in real time.
E-MAIL	Sending and receiving messages by computer.
Firewall	A system to prevent unauthorised access to/from a network.
Gateway	Device that connects dissimilar networks.
GSM	Global System for Mobile communications. A technique that uses narrowband TDMA (Time Division Multiple Access) to allow eight simultaneous calls on same radio frequency.

Path Wala

Hub	Hardware device used to connect several computers together.
Internetworking	Connection of two or more networks.
Intellectual Property	A product of intellect having commercial value.
IPR	Intellectual Property Rights.
Modem	A computer peripheral that allows you to connect and communicate with other workstations via telephone lines.
Network	An interconnected collection of autonomous computers.
Protocol	The set of rules that govern the way a service is provided.
Repeater	Device that amplifies a signal being transmitted on a network.
Router	Device that works like a bridge but can handle different protocols.
SMS	Short Message Service. Transmission of short text messages to and from a mobile phone, fax machine and/or IP address.
Spam	Unsolicited mail.
Spread-spectrum	A technique in which data is sent in small pieces over a number of discrete frequencies available for use. Each user's signal is spread over the entire bandwidth.
Switch	Device used to segment networks into different subnetworks called subnets.
TCP/IP	(Transmission Control Protocol/Internet Protocol) The native protocol of the Internet.
Topology	The pattern of interconnection of nodes in a network.
Transceiver	Transmitter/Receiver.
Virus	Malicious program that causes harm to computer system, files and /or data.
WWW (World Wide Web)	Set of protocols that allow you to access any document on the net.
WLL	Wireless in Local Loop. A system (analogous with local telephone service) that provides telephony by deploying a multiplicity of multichannel transceivers.

Assignment

Short Answer Questions

1. What is a network ? What are its goals and applications ?
2. Briefly explain how Internet evolved.
3. Write a short note on ARPAnet.
4. How does Internet work ?
5. Write a short note on InterSpace.
6. How is circuit switching different from message switching ? (CBSE Sample Paper)
7. How does transmission take place across networks ?
8. What are communication channels ? Discuss various communication channels available for networks.
9. Write some advantages and disadvantages of the following :
   (*i*) optical fibres (*ii*) coaxial cables (*iii*) twisted pair cables (*iv*) radio waves
   (*v*) micro waves (*vi*) satellites.
10. What is bandwidth ? How is it measured ?
11. What do you understand by data transfer rates ?
12. Discuss and compare various types of networks.

Path Wala

13. Explain various mostly used topologies.
14. Discuss the factors that govern the selection of a topology for a network.
15. Compare and contrast
    (*i*) Star and Bus topologies (*ii*) Star and Tree topologies (*iii*) Bus and Ring topologies.
16. What is the role of modem in electronic communications ?
17. What are hubs ? What are its types ?
18. What is the role of a switch in a network ?
19. Briefly discuss the role of following devices in the context of networking.
    (*i*) repeater (*ii*) router (*iii*) bridge (*iv*) gateway.
20. What is a communication protocol ? What is its role in a network ?
21. Write short notes on : (*i*) HTTP (*ii*) TCP/IP (*iii*) FTP.
22. What is wireless computing ? How is it different from mobile computing ?
23. Write short notes on the following :
    (*i*) GSM (*ii*) CDMA (*iii*) WLL (*iv*) 3G (*v*) SMS (*vi*) EDGE (*vii*) UMTS.
24. Discuss the advantages and disadvantages of E-mail.
25. Compare and contrast (*i*) e-mail and voice mail (*ii*) e-mail and chatting.
26. What is video conferencing ? How is it related to networking ?
27. What is web browser ? What is a web server ? How are these two related ?
28. Write short notes on URLs and domain names.
29. What is web hosting ? What are its various categories ?
30. Explain briefly the following : (*i*) HTML (*ii*) XML (*iii*) DHTML.
31. What do you understand by network security ? Why is it considered very important ?
32. What is a firewall ? Briefly explain different firewall techniques.
33. What is hacking ? What is cracking ? How are these two terms inter-related.
34. Define the following :
    (*a*) Virsus (*b*) Worms (*c*) Trojan Horse (*d*) Spam
    (*e*) Cyber Crime (*f*) India IT Act 2000 (*g*) IPR
35. What is the general process of designing networks ?
36. While designing networks, what factors related to the network environment would you consider ?
37. While designing networks, what factors related to performance, would you consider ?
38. When would you prefer (*i*) hubs over repeaters (*ii*) bridges over hubs (*iii*) switch over other network devices ?
39. When would you opt for a router in a network ?
40. What is the difference between client-side scripting and server-side scripting ?
41. How are viruses harmful ? How can you prevent them ?
42. Out of the following, identify client side script(s) and server side script(s) :
    (*a*) ASP (*b*) Javascript (*c*) VBScript (*d*) JSP (Delhi 2011)

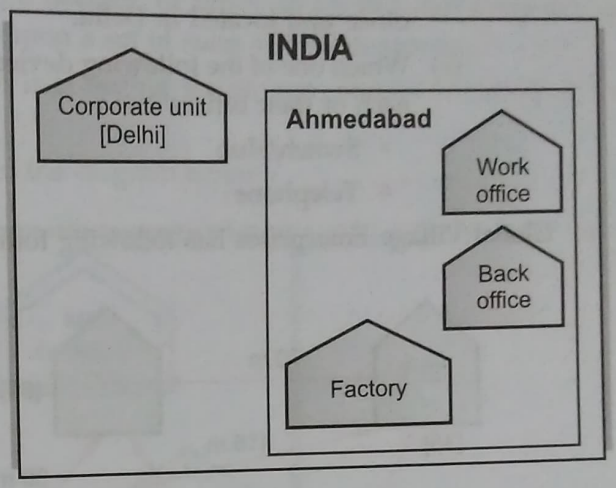
Long Answer Questions

1. Internet is a network of networks. How did it come into existence ? How does it function ?
2. Discuss various types of networks. Can you imagine the relationship of a LAN with a WAN ? What is it ? Discuss.

Path Wala

3. Briefly discuss wireless and mobile computing, and various techniques used for wireless and mobile computing.
4. Define network security. What is its need ? How can it be achieved ?
5. (*a*) What is a Repeater ? (Delhi 2008C)
   (*b*) Expand the following terms with respect to Networking :
   (*i*) FTP (*ii*) CDMA (*iii*) HTML (*iv*) SMS
   (*c*) How is an Email different from a Chat ?
   (*d*) "New York Avenue" is planning to expand their network in India, starting with two cities in India to provide infrastructure for distribution of their canned products. The company has planned to set up their main offices in Ahmedabad, at three different locations and have named their offices as "Work Office", "Factory" and "Back Office".

   The company has its Corporate Unit in Delhi. A rough layout of the same is as follows :



Approximate distance between these offices is as follows :

From	To	Distance
Work Office	Back Office	110 Mtr
Work Office	Factory	14 KM
Work Office	Corporate Office	1280 KM
Back Office	Factory	13 KM

In continuation of the above, the company experts have planned to install the following number of computers in each of their offices :

Work Office	200
Back Office	115
Factory	67
Corporate	75

(*i*) Suggest the kind of network required (out of LAN, MAN, WAN) for connecting each of the following offices :
- Work Office and Factory
- Work Office and Back Office

(*ii*) Which one of the following devices will you suggest for connecting all the computers within each of their office units ?
- Switch/Hub
- Modem
- Telephone

Path Wala

(*iii*) Which of the following communication media, you will suggest to be procured by the company for connecting their local offices in Ahmedabad for very effective (High Speed) communication ?

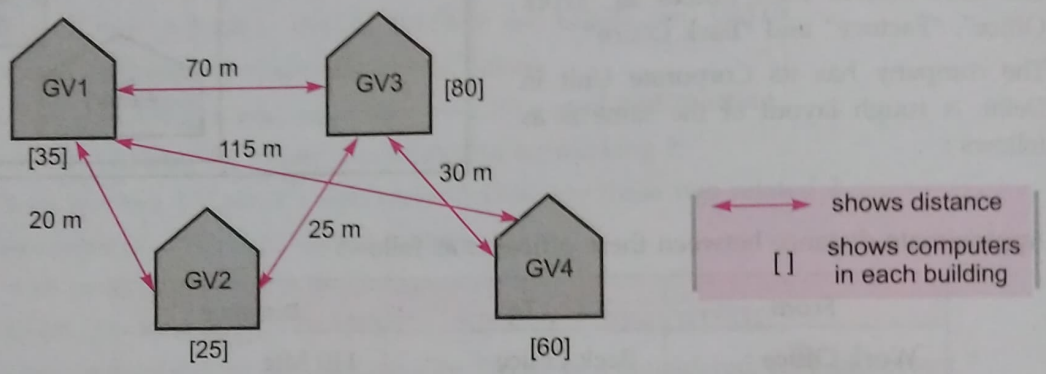
- Telephone Cable
- Optical Fibre
- Ethernet Cable

(*iv*) Suggest a cable/wiring layout for connecting the company's local office units located in Ahmedabad. Also, suggest an effective method/technology for connecting the company's office unit located in Delhi.

(*v*) Which one of the following devices will you suggest for connecting all the computers within each of their offices ?

- Switch/Hub
- Modem
- Telephone

6. Global Village Enterprises has following four buildings in Hyderabad city :



Computers in each building are networked but buildings are not networked so far. The company has now decided to connect buildings also.

(*a*) Suggest a cable layout for these buildings.

(*b*) In each of the buildings, the management wants that each LAN segment gets a dedicated bandwidth *i.e.*, bandwidth must not be shared. How can this be achieved ?

(*c*) The company also wants to make available shared Internet access for each of the buildings. How can this be achieved ?

(*d*) The company wants to link its headoffice in GV1 building to its another office in Japan.

(*i*) Which type of transmission medium is appropriate for such a link ?

(*ii*) What type of network would this connection result into ?

7. (*a*) Write two advantages and two dis- advantages for STAR topology. (Delhi 2004)

(*b*) Write one difference between Telnet and FTP.

(*c*) Explain the following terms in short :

(*i*) DHTML (*ii*) ISP

(*d*) Define Packet Switching.

8. (*a*) Write two advantages and two disadvantages for STAR topology. (Outside Delhi 2004)

(*b*) Write one difference between coaxial and optical cable.

(*c*) Explain the following terms in short :

(*i*) FTP (*ii*) URL

(*d*) Define Packet Switching.

Path Wala

9. (a) What was the role of ARPANET in Computer Network ? (Delhi 2010)

(b) Which of the following is not a unit for data transfer rate ?

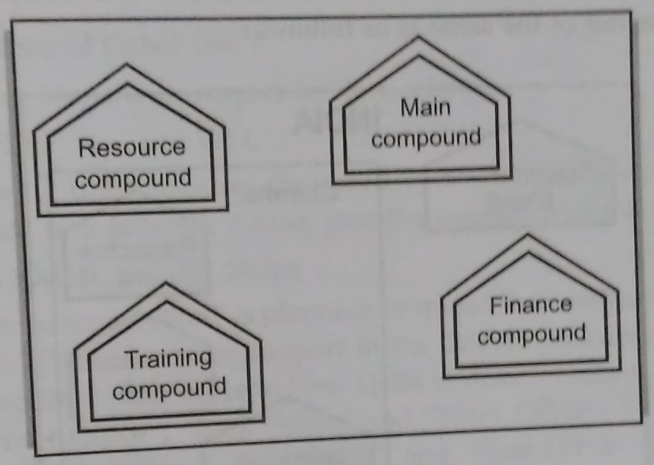
(i) bps (ii) abps (iii) gbps (iv) kbps

(c) What is the difference between Trojan Horse and Virus in terms of computers ?

(d) What term we use for a software/hardware device, which is used to block, unauthorized access while permitting authorized communi-ca tions. This term is also used for a device or set of devices configured to permit, deny, encrypt, decrypt, or proxy all (in and out) computer traffic between different security domains based upon a set of rules and other criteria..

(e) "Learn Together" is an educational NGO. It is setting up its new campus at Jabalpur for its webbased activities.

The campus has 4 compounds as shown in the diagram below :



Center to center distances between various Compounds as per architectural drawings (in Metre) is as follows :

Main Compound to Resource Compound	110 m
Main Compound to Training Compound	115 m
Main Compound to Finance Compound	35 m
Resource Compound to Training Compound	25 m
Resource Compound to Finance Compound	135 m
Training Compound to Finance Compound	100 m

Expected Number of Computers in each Compound is as follows :

Main Compound	5
Resource Compound	15
Training Compound	150
Accounts Compound	20

(e1) Suggest a cable layout of connections between the compounds.

(e2) Suggest the most suitable place (*i.e.*, compound) to house the server for this NGO. Also provide a suitable reason for your suggestion.

(e3) Suggest the placement of the following devices with justification :

(i) Repeater (ii) Hub/Switch

Path Wala

(e4) The NGO is planning to connect its International office situated in Mumbai, which out of the following wired communication link, you will suggest for a very high speed connectivity ?:

(*i*) Telephone Analog Line (*ii*) Optical Fiber (*iii*) Ethernet Cable

(*f*) Write one advantage of each for Open Source Software and Proprietary Software.

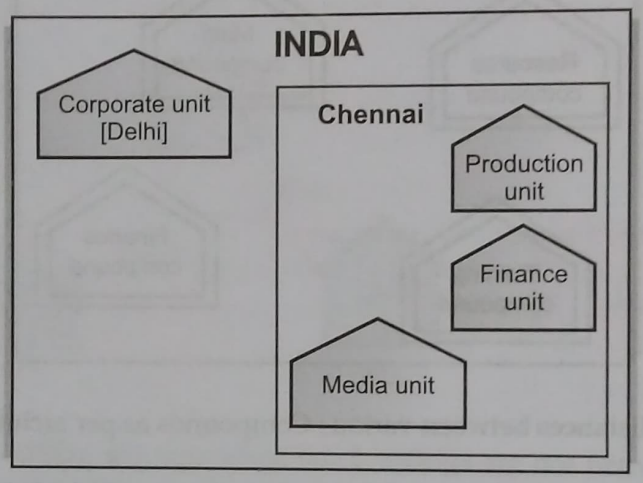
10. (*a*) What is a Modem ?

(*b*) Expand the following terms with respect to Networking :

(*i*) PPP (*ii*) GSM (*iii*) XML (*iv*) HTTP

(*c*) How is a Hacker different from a Cracker ?

(*d*) "China Middleton Fashion" is planning to expand their network in India, starting with two cities in India to provide infrastructure for distribution of their product. The company has planned to setup their main office in Chennai at three different locations and have named their offices as "Production Unit", "Finance Unit" and "Media Unit". The company has its corporate unit in Delhi. A rough layout of the same is as follows :



Approximate distance between these Units is as follows :

From	To	Distance
Production Unit	Finance Unit	70 Mtr
Production Unit	Media Unit	15 KM
Production Unit	Corporate Unit	2112 KM
Finance Unit	Media Unit	15 KM

In continuation of the above, the company experts have planned to install the following number of computers in each of their offices :

Production Unit	150
Finance Unit	35
Media Unit	10
Corporate Unit	30

(*i*) Suggest the kind of network required (out of LAN, MAN, WAN) for connecting each of the following office units :

- Production Unit and Media Unit
- Production Unit and Finance Unit

Path Wala

(ii) Which one of the following devices will you suggest for connecting all the computers within each of their office units ?

- Switch/Hub
- Modem
- Telephone

(iii) Which of the following communication media, you will suggest to be procured by the company for connecting their local office units in Chennai for very effective (High Speed) communication ?

- Telephone Cable
- Optical Fibre
- Ethernet Cable

(iv) Suggest a cable/wiring layout for connecting the company's local office units located in Chennai. Also, suggest an effective method/technology for connecting the company's office unit located in Delhi.

(Outside Delhi 2008)

11. (a) What is the significance of Cyber law ?

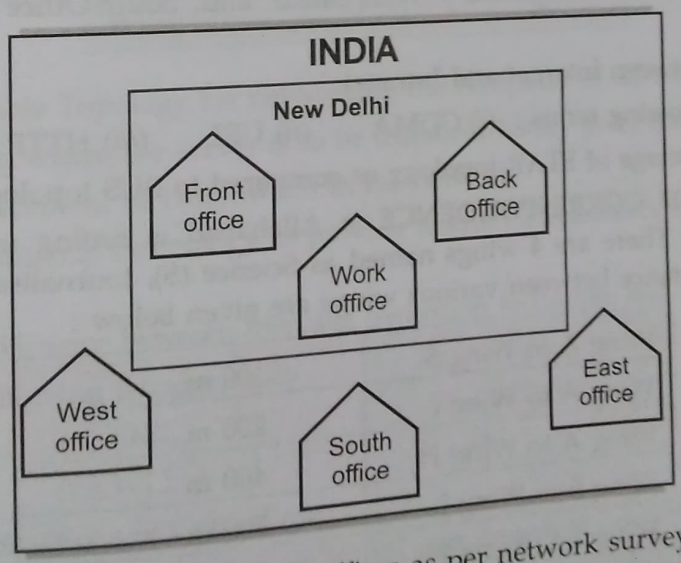
(b) Expand the following terms with respect to Networking :

(i) CDMA (ii) FTP (iii) WLL (iv) HTML

(c) Which of the following unit measures the speed with which data can be transmitted from one node to another node of a network ? Also, give the expansion of the suggested unit

(i) Mbps (ii) KMph (iii) MGps

(d) "Bhartiya Connectivity Association" is planning to spread their offices in four major cities in India to provide regional IT infrastructure support in the field of Education & Culture. The company has planned to setup their head office in New Delhi in three locations and have named their New Delhi offices as "Front Office", "Back Office" and "Work Office". The company has three more regional offices as "South Office", "East Office" and "West Office" located in other three major cities of India. A rough layout of the same is as follows :



Approximate distances between these offices as per network survey team is as follows :

Place From	Place To	Distance
Back Office	Front Office	10 KM
Back Office	Work Office	70 Metre
Back Office	East Office	1291 KM
Back Office	West Office	790 KM
Back Office	South Office	1952 KM

Path Wala

In continuation of the above, the company experts have planned to install the following number of computers in each of their offices :

Back Office	100
Front Office	20
Work Office	50
East Office	50
West Office	50
South Office	50

(*i*) Suggest network type (out of LAN, MAN, WAN) for connecting each of the following set of their offices :

- Back Office and Work Office
- Back Office and South Office

(*ii*) Which device you will suggest to be produced by the company for connecting all the computers with in each of their offices out of the following devices ?

- Switch/Hub
- Modem
- Telephone

(*iii*) Which of the following communication medium, you will suggest to be procured by the company for connecting their local offices in New Delhi for very effective and fast communication ?

- Telephone Cable
- Optical Fibre
- Ethernet Cable

(*iv*) Suggest a cable/wiring layout for connecting the company's local offices located in New Delhi. Also, suggest an effective method/technology for connecting the company's regional offices-"East Office", "West Office" and "South Office" with offices located in New Delhi. (Delhi 2007)

12. (*a*) Differentiate between Internet and Intranet.

(*b*) Expand the following terms : (*i*) CDMA (*ii*) URL (*iii*) HTTP (*iv*) WAN

(*c*) Write one advantage of STAR topology as compared to BUS topology.

(*d*) UNIVERSITY OF CORRESPONDENCE in Allahabad is setting up the network between its different wings. There are 4 wings named as Science (S), Journalism (J), ARTS (A) and Home Science (H). Distance between various wings are given below :

Wing A to Wing S	100 m
Wing A to Wing J	200 m
Wing A to Wing H	400 m
Wing S to Wing J	300 m
Wing S to Wing H	100 m
Wing J to Wing H	450 m

Number of Computers

Wing A	150
Wing S	10
Wing J	5
Wing H	50

Path Wala

(i) Suggest a suitable Topology for networking the computer of all wings.
(ii) Name the wing where the Server to be installed. Justify your answer.
(iii) Suggest the placement of Hub/Switch in the network.
(iv) Mention in economic technology to provide internet accessibility to all wings (Delhi 2006)

13. (a) Name two transmission media for networking.
(b) Expand the following terms : (i) XML (ii) GSM (iii) SMS (iv) MAN
(c) Differentiate between Hackers and Crackers ?
(d) INDIAN PUBLIC SCHOOL in Darjeeling is setting up the network between its different wings. There are 4 wings named as SENIORS(S), JUNIOR(J), ADMIN(A) and HOSTEL(H).

Distance between various wings are given below :

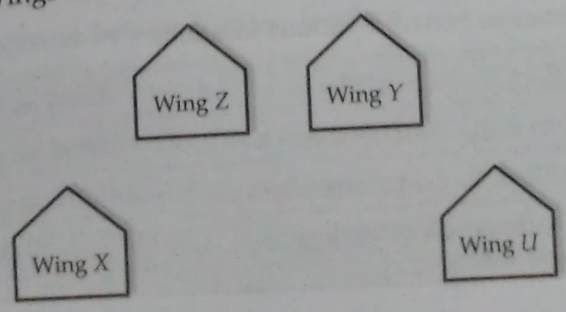
Wing A to Wing S	100 m
Wing A to Wing J	200 m
Wing A to Wing H	400 m
Wing S to Wing J	300 m
Wing S to Wing H	100 m
Wing J to Wing H	450 m

Number of Computers

Wing A	10
Wing S	200
Wing J	100
Wing H	50

(i) Suggest a suitable Topology for networking the computer of all wings.
(ii) Name the wing where the server is to be installed. Justify your answer
(iii) Suggest the placement of Hub/Switch in the network.
(iv) Mention an economic technology to provide internet accessibility to all wings. (Outside Delhi 2006)

14. (a) What is the difference between Message Switching technique and Packet Switching technique ?
(b) Expand the following terminologies :
(i) TCP/IP (ii) XML
(iii) CDMA (iv) WLL
(c) Write two applications of Cyber Law.
(d) The Great Brain Organisation has set up its new Branch at Srinagar for its office and web based activities. It has 4 Wings of buildings as shown in the diagram :



Path Wala

Center to center distances between various blocks

Wing X to Wing Z	50 m
Wing Z to Wing Y	70 m
Wing Y to Wing X	125 m
Wing Y to Wing U	80 m
Wing X to Wing U	175 m
Wing Z to Wing U	90 m

Number of Computers

Wing X	50
Wing Z	30
Wing Y	150
Wing U	15

(*i*) Suggest the most suitable cable layout of connections between the Wings, and topology.

(*ii*) Suggest the most suitable place (*i.e.*, Wing) to house the server of this organisation with a suitable reason, with justification.

(*iii*) Suggest the placement of the following devices with justification :

(1) Repeater (2) Hub/Switch

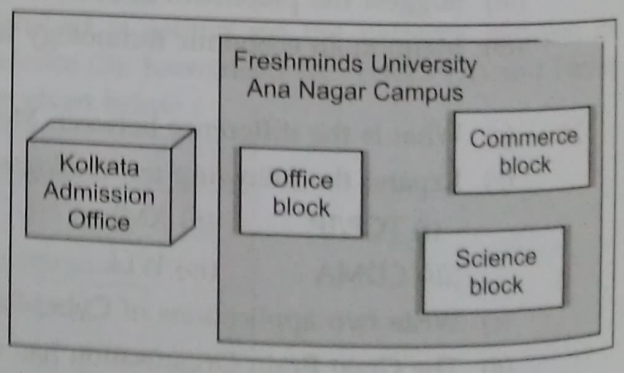
(*iv*) The organization is planning to link its head office situated in Delhi with the offices at Srinagar. Suggest an economic way to connect it ; the company is ready to compromise on the speed of connectivity. Justify your answer. (Delhi 2005)

15. (*a*) What is difference between Star Topology and Bus Topology of network ?

(*b*) Expand the following abbreviations : (*i*) GSM (*ii*) CDMA

(*c*) What is protocol ? Which protocol is used to search information from Internet using an internet browser ?

(*d*) Freshminds University of India is starting its first campus in Ana Nagar of South India with its center admission office in Kolkata. The university has 3 major blocks comprising of Office Block, Science Block and Commerce Block in the 5 km area Campus.



As a network expert, you need to suggest the network plan as per (E1) to (E4) to the authorities keeping in mind the distance and other given parameters.

Expected Wire distances between various locations :

Office Block to Science Block	90 m
Office Block to Commerce Block	80 m
Science Block to Commerce Block	15 m
Kolkata Admission office to Ana Nagar Campus	2450 km

Path Wala

Expected number of Computers to be installed at various locations in the University are as follows :

Office Block	10
Science Block	140
Commerce Block	30
Kolkata Admission office	8

(E1) Suggest the autohrities, the cable layout amongst various blocks inside university campus for connecting the blocks.

(E2) Suggest the most suitable place (*i.e.*, block) to house the server of this university with a suitable reason.

(E3) Suggest an efficient device from the following to be installed in each of the blocks to connect all the computers :

- MODEM
- SWITCH
- GATEWAY

(E4) Suggest the most suitable (very high speed) service to provide data connectivity between Admission Office located in Kolkata and the campus located in Ana Nagar from the following options :

- Telephone line
- Fixed-Line Dial-up connection
- Co-axial Cable Network
- GSM
- Leased line
- Satellite Connection

((Delhi 2009)

16. (*a*) What is difference between LAN and WAN ?

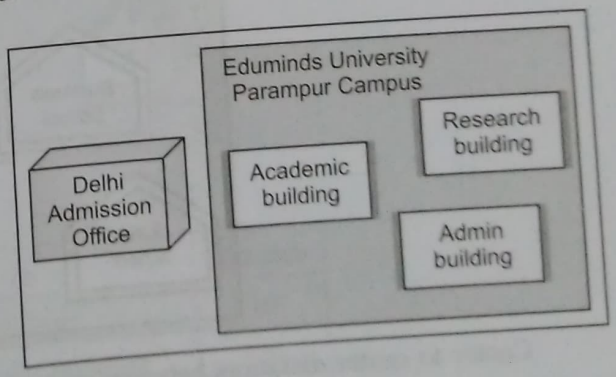
(*b*) Expand the following abbreviations :

(*i*) HTTP (*ii*) ARPANET

(*c*) What is protocol ? Which protocol is used to copy a file from/to a remotely located server ?

(*d*) Name two switching techniques used to transfer data between two terminals (computers).

(*e*) Eduminds University of India is starting its first campus in a small town Parampur of Central India with its center admission office in Delhi. The university has 3 major buildings comprising of Admin Building, Academic Building and Research Building in the 5 KM area Campus.



As a network expert, you need to suggest the network plan as per (E1) to (E4) to the authorities keeping in mind the distances and other given parameters.

Expected Wire distances between various locations :

Research Building to Admin Building	90 m
Research Building to Academic Building	80 m
Academic Building to Admin Building	15 m
Delhi Admission Office to Parampur Campus	1450 km

Path Wala

Expected number of Computers to be installed at various locations in the University are as follows :

Research Building	20
Academic Building	150
Admin Building	35
Delhi Admission Office	5

(E1) Suggest the autohrities, the cable layout amongst various buildings inside the university campus for connecting the buildings.

(E2) Suggest the most suitable place (*i.e.*, building) to house the server of this organisation, with a suitable reason.

(E3) Suggest an efficient device from the following to be installed in each of the buildings to connect all the computers :

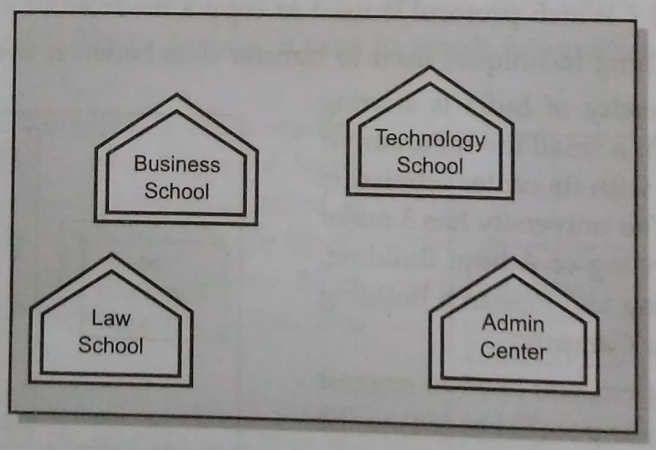
(*i*) GATEWAY (*ii*) MODEM (*iii*) SWITCH

(E4) Suggest the most suitable (very high speed) service to provide data connectivity between Admission Building located in Delhi and the campus located in Parampur from the following options.

- Telephone line
- Fixed-Line Dial-up connection
- Co-axial Cable Network
- GSM
- Leased line
- Satellite Connection

(Outside Delhi 2009)

17. Great Sudies University is setting up its Academic schools at Sunder Nagar and planning to set up a network. The university has 3 academic schools and one administration center as shown in the diagram below :



Center to center distances between various buildings is as follows :

Law School to Business School	60 m
Law School to Technology School	90 m
Law School to Admin Center	115 m
Business School to Technology School	40 m
Business School to Admin Center	45 m
Technology School to Admin Center	25 m

Path Wala

Number of Computers in each of the Schools / Center is as follows :

Law School	25
Technology School	50
Admin Center	125
Business School	35

(*a*) Suggest the most suitable place (*i.e.*, Schools/Center) to install the server of this university with a suitable reason.

(*b*) Suggest an ideal layout for connecting these Schools/center for a wired connectivity.

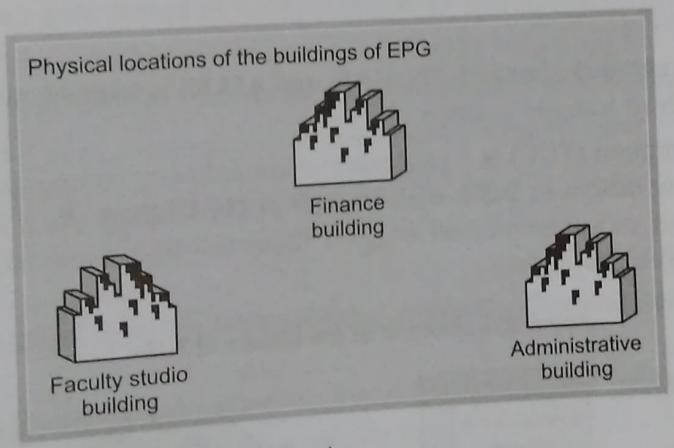
(*c*) Which device you will suggest to be placed/installed in each of these Schools/center to ***efficiently*** connect all the computers within these Schools/center ?

(*d*) The university is planning to connect its admission office in the closest big city, which is more than 350 km from the university. Which type of network out of LAN, MAN or WAN will be formed ? Justify your answer. (Outside Delhi 2011)

18. (*a*) What is the difference between domain name and IP address ?

(*b*) Write two advantages of using an optical fibre cable over an Ethernet cable to connect two service stations, which are 190 m away from each other.

(*c*) Expertia Professional Global (EPG) is an online corporate training provider company for IT related courses. The company is setting up their new campus in Mumbai. You as a network expert have to study the physical locations of various buildings and the number of computers to be installed. In the planning phase, provide the best possible answers for the queries (*i*) to (*iv*) raised by them.



Building to Building Distance (in Mtrs) :

From	To	Distance
Administrative Building	Finance Building	60
Administrative Building	Faculty Studio Building	120
Finance Building	Faculty Studio Building	70

Expected Computers to be Installed in each Building :

Buildings	Computers
Administrative Building	20
Finance Building	40
Faculty Studio Building	120

Path Wala

(i) Suggest the most appropriate building, where EPG should plan to install the server.

(ii) Suggest the most appropriate building cable layout to connect all three buildings for efficient communication.

(iii) Which type of network out of the following is formed by connecting the computers of the buildings ?

- LAN
- MAN
- WAN

(iv) Which wireless channel out of the following should be opted by EPG to connect to students of all over the world ?

- Infrared
- Microwave
- Satellite

(d) Write two advantages of using proprietary software over open source software.

(e) Which of the following crime(s) is/are covered under cybercrime ?

(i) Stealing brand new hard disk from a shop.

(ii) Getting into unknown person's social networking account and start messaging on his behalf.

(iii) Copying some important data from a computer without taking permission from the owner of the data. (Delhi 2013)

19. (a) Write two characteristics of Wi-Fi.

(b) What is the difference between E-mail and Chat ?

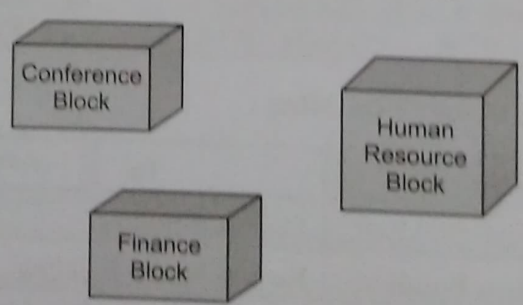
(c) Expand the following :

- GSM
- GPRS

(d) Which type of network (out of LAN, PAN and MAN) is formed, when you connect two mobiles using Bluetooth to transfer a video ?

(e) Tech Up Corporation (TUC) is a professional consultancy company. The company is planning to set up their new offices in India with its hub at Hyderabad. As a network adviser, you have to understand their requirement and suggest them the best available solutions. Their queries are mentioned as (i) to (iv) below :

Physical Locations of the blocks of TUC



Block to Block distance (in Mtrs.)

Block (From)	Block (To)	Distance
Human Resource	Conference	60
Human Resource	Finance	120
Conference	Finance	80

Path Wala

Expected Number of Computers to be installed in each block

Block	Computers
Human Resource	125
Finance	25
Conference	60

(*i*) What will be the most appropriate block, where TUC should plan to install their server ?

(*ii*) Draw a block to block cable layout to connect all the buildings in the most appropriate manner for efficient communication.

(*iii*) What will be the best possible connectivity out of the following, you will suggest to connect the new setup of offices in Bangalore with its London based office ?

- Infrared
- Satellite link
- Ethernet Cable

(*iv*) Which of the following devices will be suggested by you to connect each computer in each of the buildings ?

- Gateway
- Switch
- Modem

(*f*) Write names of any two popular Open Source Software, which are used as operating systems.

(*g*) Write any two important characteristics of Cloud Computing. (Outside Delhi 2014)

20. (*a*) Illustrate the layout for connecting 5 computers in a Bus and a Star topology of Networks.

(*b*) What kind of data gets stored in cookies and how is it useful ?

(*c*) Differentiate between packet switching over message switching ?

(*d*) Out of the following, which is the fastest (*i*) wired and (*ii*) wireless medium of communication ?

Infrared, Coaxial Cable, Ethernet Cable, Microwave, Optical Fiber

(*e*) What is Trojan Horse ?

(*f*) Out of the following, which all comes under cyber crime ?

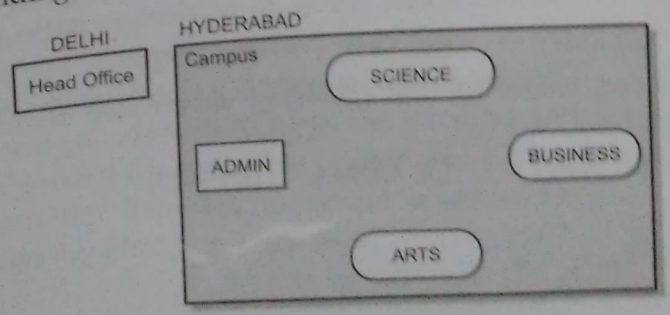
(*i*) Stealing away a brand new hard disk from a showroom.

(*ii*) Getting in someone's social networking account without his consent and posting pictures on his behalf.

(*iii*) Secretly copying data from server of an organization and selling it to the other organization.

(*iv*) Looking at online activities of a friends blog.

(*g*) Xcelencia Edu Services Ltd. is an educational organisation. It is planning to set up its India campus at Hyderabad with its head office at Delhi. The Hyderabad campus has 4 main buildings – ADMIN, SCIENCE, BUSINESS and ARTS. You as a network expert has to suggest the best network related solutions for their problems raised in (*i*) to (*iv*), keeping in mind the distances between the buildings and other given parameters.



Path Wala

Shortest distances between various buildings :

ADMIN to SCIENCE	65 m
ADMIN to BUSINESS	100 m
ADMIN to ARTS	60 m
SCIENCE to BUSINESS	75 m
SCIENCE to ARTS	60 m
BUSINESS to ARTS	50 m
DELHI Head Office to HYDERABAD Campus	1600 km

Number of computers installed at various buildings are as follows :

ADMIN	100
SCIENCE	85
BUSINESS	40
ARTS	12
DELHI Head Office	20

(*i*) Suggest the most appropriate location of the server inside the HYDERABAD campus (out of the 4 buildings), to get the best connectivity for maximum number of computers. Justify your answer.

(*ii*) Suggest and draw the cable layout to efficiently connect various buildings within the HYDERABAD campus for connecting the computers.

(*iii*) Which hardware device will you suggest to be procured by the company to be installed to protect and control the internet uses within the campus ?

(*iv*) Which of the following will you suggest to establish the online face-to-face communication between the people in the Admin Office of HYDERABAD campus and DELHI Head Office ?

(*a*) E-mail, (*b*) Text Chat

(*c*) Video Conferencing (*d*) Cable TV

(Outside Delhi 2015)

21. (*a*) Damodar Mohan has been informed that there had been a backdoor entry to his computer, which has provided access to his system through a malicious user/programs, allowing confidential and personal information to be subjected to theft. It happened because he clicked a link provided in one of the pop-ups from a website announcing him to be winner of prizes worth 1 Million Dollars. Which of the following has caused this out of the following :

(*i*) Virus (*ii*) Worm (*iii*) Trojan Horse

(*b*) Tarini Wadhawa is in India and she is interested in communicating with her uncle in Australia. She wants to show one of her own designed gadgets to him and also wants to demonstrate its working without physically going to Australia. Which protocol out of the following will be ideal for the same ?

(*i*) POP3 (*ii*) SMTP (*iii*) VoIP (*iv*) HTTP

(*c*) Write the expanded names for the following abbreviated terms used in Networking and Communications :

(*i*) MBPS (*ii*) WAN (*iii*) CDMA (*iv*) WLL

(CBSE Delhi 2019)