Computer studies Form four work

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Chapter 1
Introduction to networking and data communication

Computer network

- It's a collection of computers linked together using transmission media for the purpose of communication and resource sharing.

Data communication

- Refers to the process of transmitting data signals from one point to another through the network

Terms used in data communication 1

- Bandwidth – it's the maximum amount of data that a transmission medium can carry at any one time.
- Base band signal – it's a digital generated and applied to the transmission medium directly without modulation.
- Broadband transmission – refers to sending analog signal over transmission medium using a particular frequency.

Terms used in data communication 2

A multiplexed link
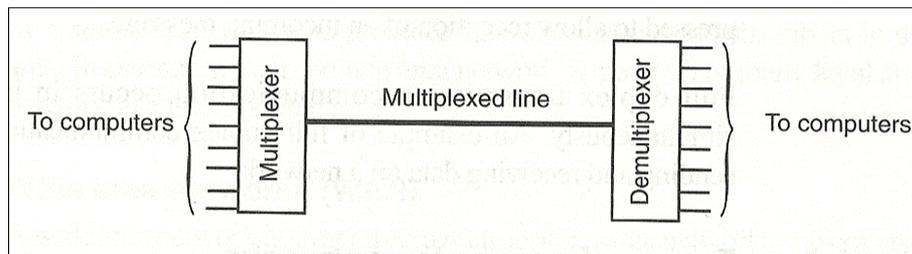
- Multiplexing – it's a process of sending multiple data signal over the same medium while demultiplexing is the process of separating the multiplexed signals at the receiving end.

Modes of data communication

- Simplex transmission – refers to communication in only one direction e.g. radio transmission.
- Half duplex – refers to communication in both directions but one direction at a time e.g. police walkie talkie.
- Full duplex – in this transmission communication occurs in both directions simultaneously e.g. computers connected in network.

Types of computer network

- Local Area Network (LAN) – this is formed whenever computers are connected together in a small geographical area e.g. floors, building, school etc within a radius of 10m up to 3km.
- Wide Area Network (WAN) – this covers unlimited geographical area e.g. across states, entire country or entire world. They are expensive to build and have low data rates and higher speed (over 100Mbps or higher).
- Metropolitan Area Network (MAN) – this network covers a metropolitan are like a town or city within a radius of between 5 and 50km. They are data rates of 100Mbps and above and are more expensive than LANS.
- Computer Networking – refers to a collection of independent entities that are arranged in such a manner as to exchange data, information or resources.

Purpose of networking 1

A server on a network
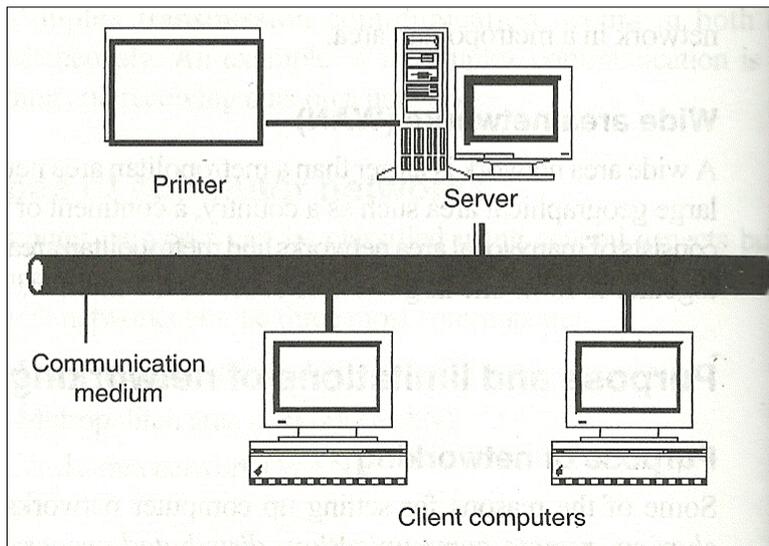
- Resource sharing – different computers are connected to each other hence a user at one site may be able to use the resource available at another site e.g. printers, programs etc.

Purpose of networking 2

- Remote communication – this involves transmission of data signals between two communication devices located at different geographical location. Through remote communication, people can be able to share ideas and pass messages over the network.

- Cost effectiveness – reduction of resources in networking lead to reduction in costs. Example instead of purchasing many computers resources, one buys one which can be shared hence reducing the costs.

- Distributed processing – if a particular process can be sub-divided into several sub-process then each sub-process can be processed at different sites co-currently hence speeding up the entire process.

- Reliability – if one site fails in a computer network, the remaining site can potentially continue operating.

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Limitation of networking

- Cost – it's expensive to acquire networking equipments, train network administrators and users and maintenance of network. The cost are high.
- Data security – data and information held on a network is prone to more illegal access, danger of data theft and also tapping by unauthorised people during transmission.
- Network failure – there is a danger of failure which may paralyze the operational of an organisation besides damaging files and programs.
- Moral and cultural effects – large networks like Internet have chat rooms and messaging services that may enable underage children to meet peers and adults on the net some of whom have bad intentions. Access to pornographic and other negative materials is also a problem.
- Over-reliance on networks – most organisations have done away with manual operations. This means that all business process and society depend on computer networks. The disadvantage of over-reliance is that if the network fails then many systems will stop operating.

Elements of networking

- Data communication media – a data communication is a channel through which data is transmitted between computers and other devices. Data communication media are categorised into two:
  - ☐ Communication with cables (bounded media)
    - Two wire open lines cables
    - Twisted pair cable
    - Coaxial cable
    - Fibre optic cables
  - ☐ Wireless communication (unbounded media)
    - Microwave
    - Satellite
    - Radio transmission
    - Infrared transmission

Two wire open line cables

Two wire open lines cables

- Are made up of two parallel copper wires separated by a plastic insulator as shown figure right. They are used in telecommunication network to transmit voice signal.
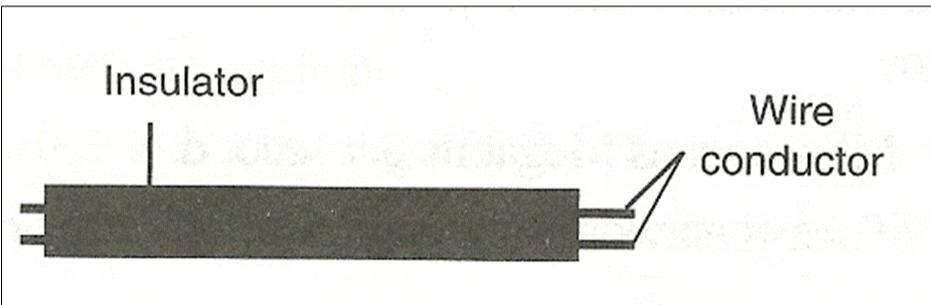
Twisted pair cable

- This consists of two insulated copper wires twisted in a spiral pattern to minimize electromagnetic interference. It's the cheapest media used for both analogue and digital signals. Mainly used in telephone system. There are two types of twisted pair
  - ☐ Unshielded Twisted Pair (UTP)
  - ☐ Shielded Twisted Pair (STP)

# Unshielded Twisted Pair (UTP)

Unshielded twisted pair cables

twisted pairs

Cover stripper

Outer
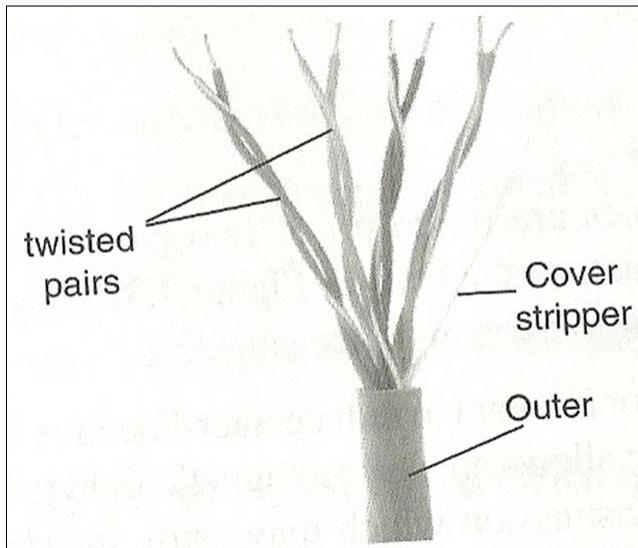
- They do not have a shield the prevents electromagnetic interference hence they are susceptible to noise and signal interference.

Shielded Twisted Pair (STP)

Shielded twisted pair cables
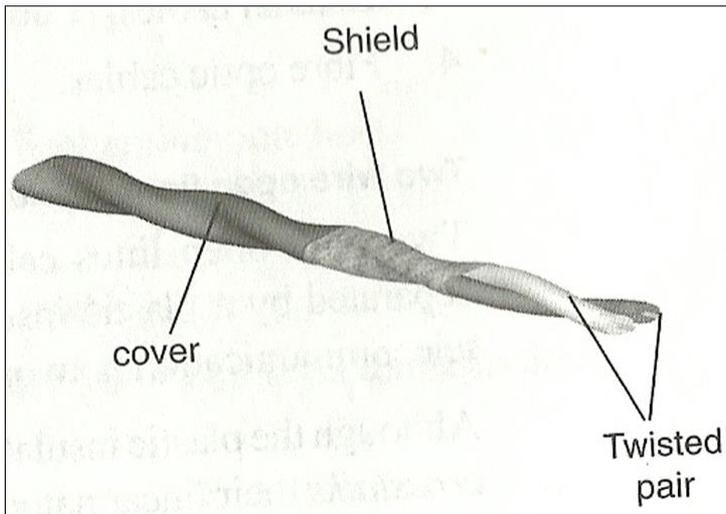
- They have a braid wrapped around the wires to shield or protect them from noise.

Category of twist pair cables

Category	Suitable for transmitting	Speed (max, limit)
1	Voice	Less than 1Mbp
2	Data	1Mbps
3	Data	16Mbps
4	Data	20Mbps
5	Data	100Mbps

- Twisted pair cables are categorised into five groups according to the type of data transmitted and maximum rate of transmission, as shown in table right.

Advantages and disadvantages of twisted pair cable

- **Advantages**
  - ☐ Easy to install
 - ☐ Very cheap

- **Disadvantages**
  - ☐ Has low data transmission rates.
  - ☐ It's sensitive to electromagnetic interference.
 - ☐ Suffers high attenuation.

Coaxial cable

- This cable has a central copper core which may be solid or stranded wires surrounded by an insulator. The insulator is then surrounded by a hollow mesh conductor covered by a shield to prevent electromagnetic interference. The diameter of the centre core or conductor determines the attenuation rate. There are two types of coaxial cables:

  - Thin coaxial cable (thinnet) which has one dialectric insulator.

  - Thick coaxial cable (thicket) has two dialectric insulator around the core and is thicker than thinnet.

Samples of coaxial cables

Thinnet

- plastic jacket
- dielectric insulator
- metallic shield
- centre core

Thincknet

- Outer conductor
- Foil
- Jacket
- Insulation
- Inner conductor
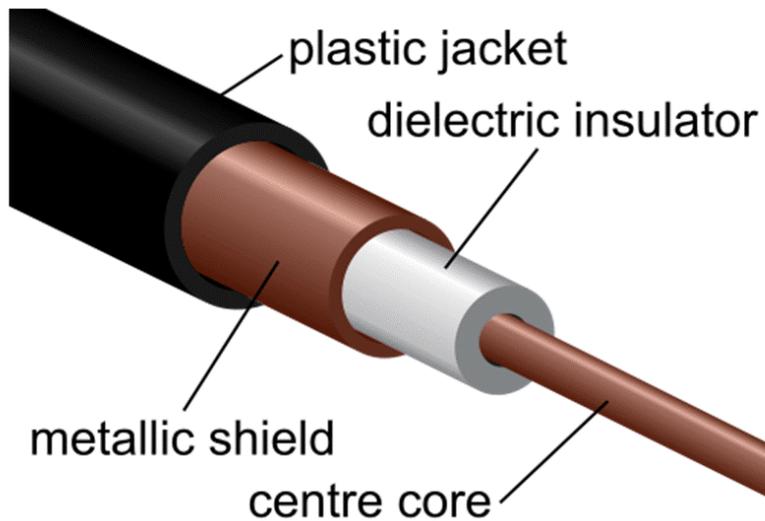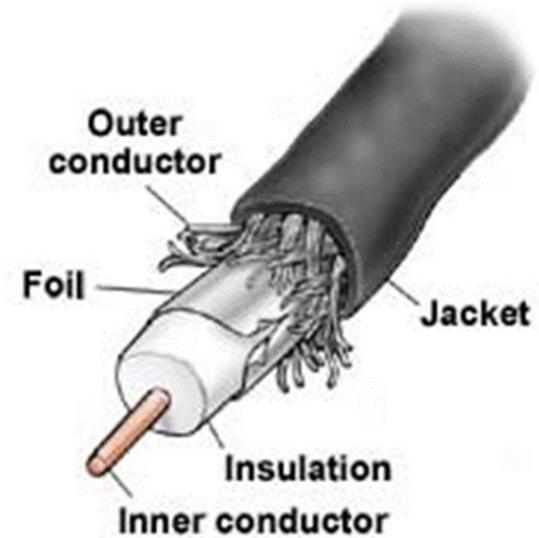
Advantages and disadvantages of coaxial cables

Advantages

- They are immune to external electrical interference because of insulation.
- High data transmission rate.
- Has capability of carrying more signals.
- They are very stable even under high loads.

Disadvantages

- Lack of security due to illegal taps.
- They are relatively expensive to buy.
- It's bulky therefore difficult to work with i.e. install.

Fibre optic cables

- These are made of glass fibres and transmit information in light form. The cable is made up of:
  - ☐ The core – the central part of the cable which is made of transparent plastic or glass.
  - ☐ Cladding – it's a single protective layer surrounding the core, and has some light bending characteristic inside it.
  - ☐ Buffer – it surrounds the cladding and its function it to strengthen the cable.
  - ☐ Jacket – outer covering of the cable.

Types of fibre optic cables 1

Single mode fibre
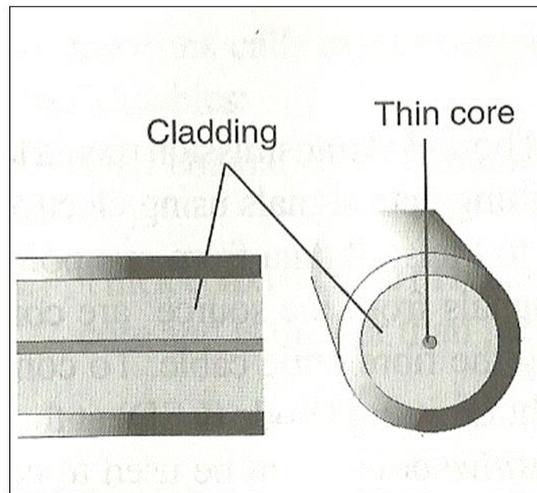
- Single mode fibre – it has a very narrow centre core. The light in the cable therefore take only one path through it making it to have a low attenuation rate.

Types of fibre optic cables 2

Multimode fibre
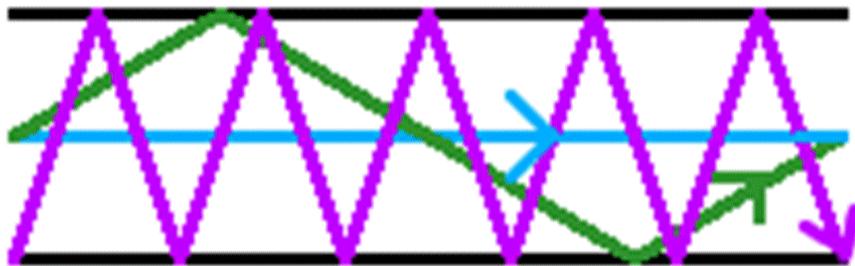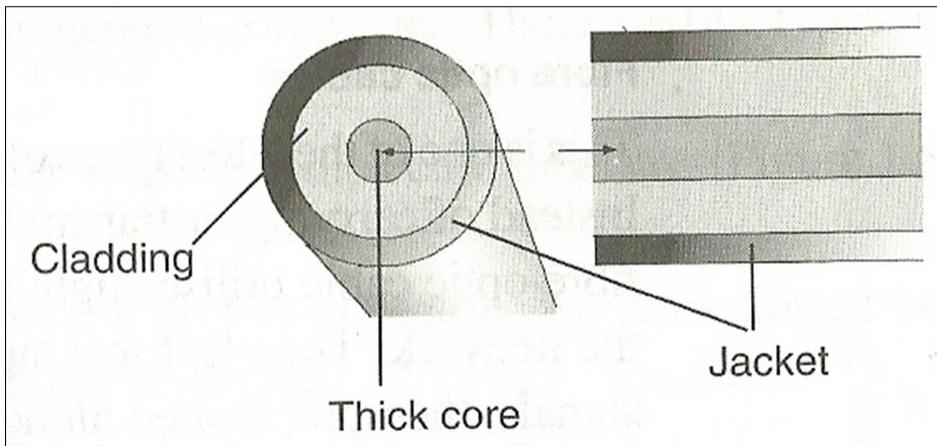
- Multimode fibre – it has a thicker core and allows several light rays to be fed in the cable have a high attenuation rate and they are mainly used for shorter distance transmission. The light is bent back into the core hence propagates along the length of the cable as shown in figure right below.

Fibre based network transmits data

Sending computer

LED changes electrical signals to light signals

Fibre optic cable

Photodetector transforms light signal to electric signals.

Receiving computer
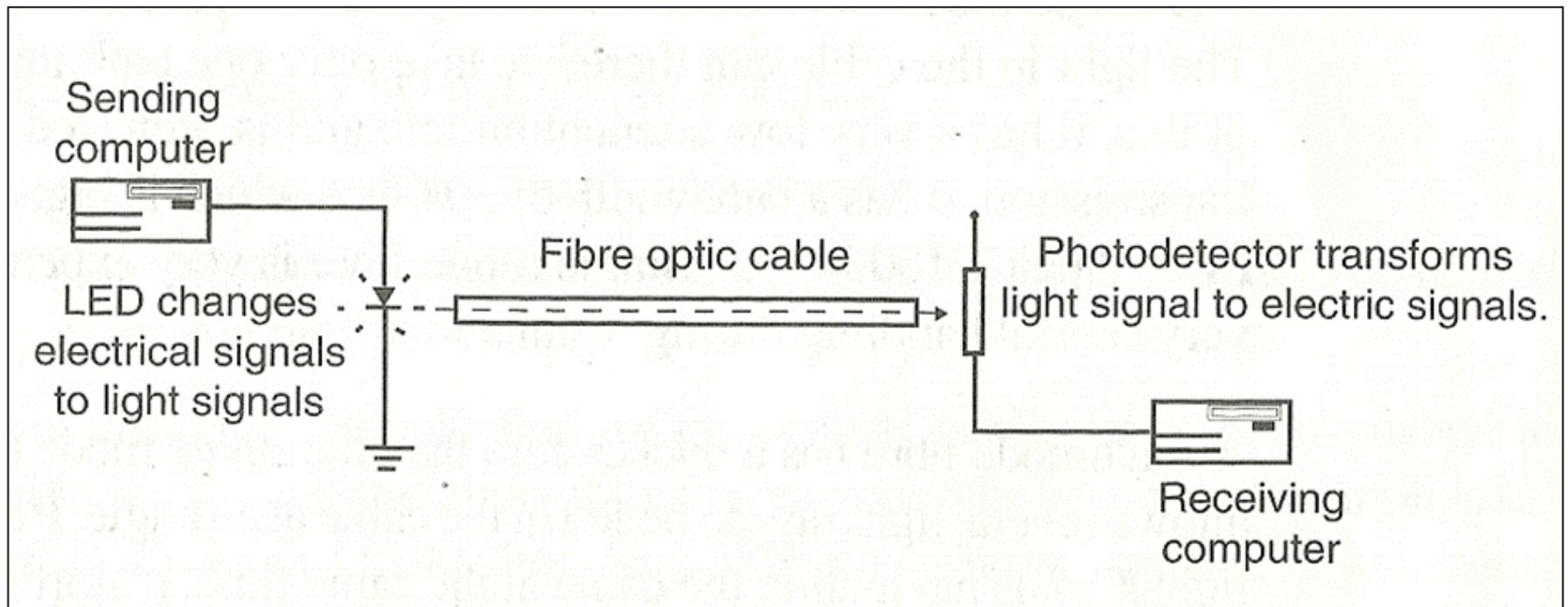
Advantages and disadvantages of fibre optical cable

Advantages

- Has high bandwidth hence high carrying capacity.
- It's immune to electromagnetic interference.
- Covers large distances because of low attenuation.
- Very secured because they are un-tappable.

Disadvantages

- Very expensive
- Installation is difficult.
- It's complex to configure
- Broken cable is difficult and expensive to repair

Wireless communication (unbounded media)

- This communication transmit data from one point to another without physical connections. Example of wireless transmission includes:

  - ☐ Microwave
  - ☐ Satellite
  - ☐ Radio transmission
  - ☐ Infrared transmission

The electromagnetic spectrum

The electromagnetic spectrum
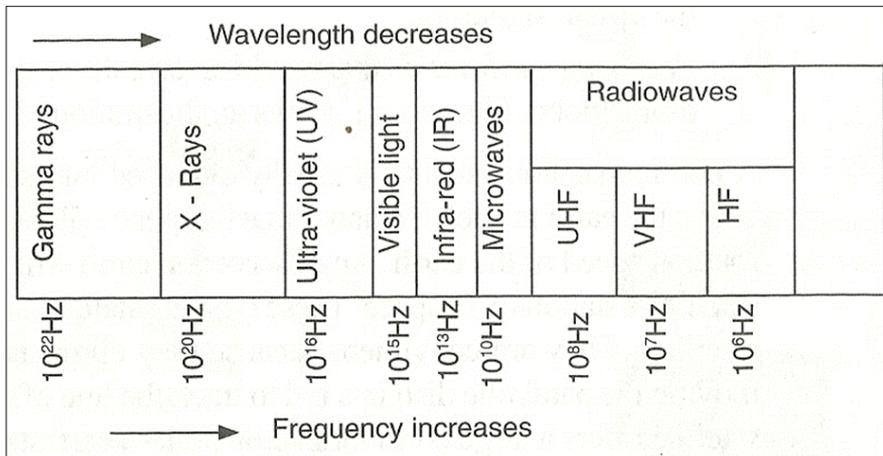
- Figure right is a diagrammatic representation of an electromagnetic spectrum. All these waves travel at the speed of light. For our concern here, we will only deal with microwaves radiowaves and infrared waves.

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Microwave

Point to point microwave transmission
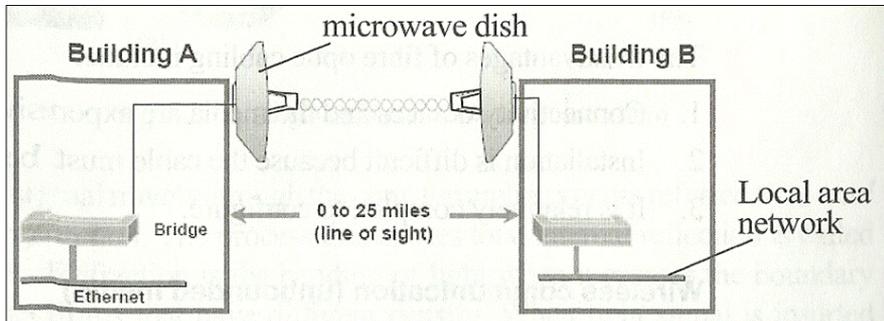
- In microwave transmission signals travel in a straight line and therefore the transmitter and receiver must be in a direct line of sight of each other.

Advantages and disadvantages of microwave

Advantages

- They operate at a high speed.
- It's less prone to transmission errors unlike twisted wire pair.
- Are capable of operating in digital or analog data.

Disadvantages

- Signal is affected by atmospheric conductor like lightning.
- Additional number of repeaters are added after every few kilometres.

Satellite

- In this transmission microwave radio signal is transmitted from antennae from the ground to a satellite on the orbit around the earth. The microwave radio signal is beamed to the satellite on a specific frequency called **uplink** freq1uency where it is received, amplified and then rebroadcasted on a different frequency called **downlink**. The satellite transmit the signal to many earth stations to form a point to multipoint transmissions. Very small aperture (VSAT) is a new technology used in microwave transmission. It's a very small satellite dish used both in data, radio and TV communication. This technology enables direct access to satellite communication instead of having to ft through the sate owned or licensed satellite gateways.

Satellite transmission system
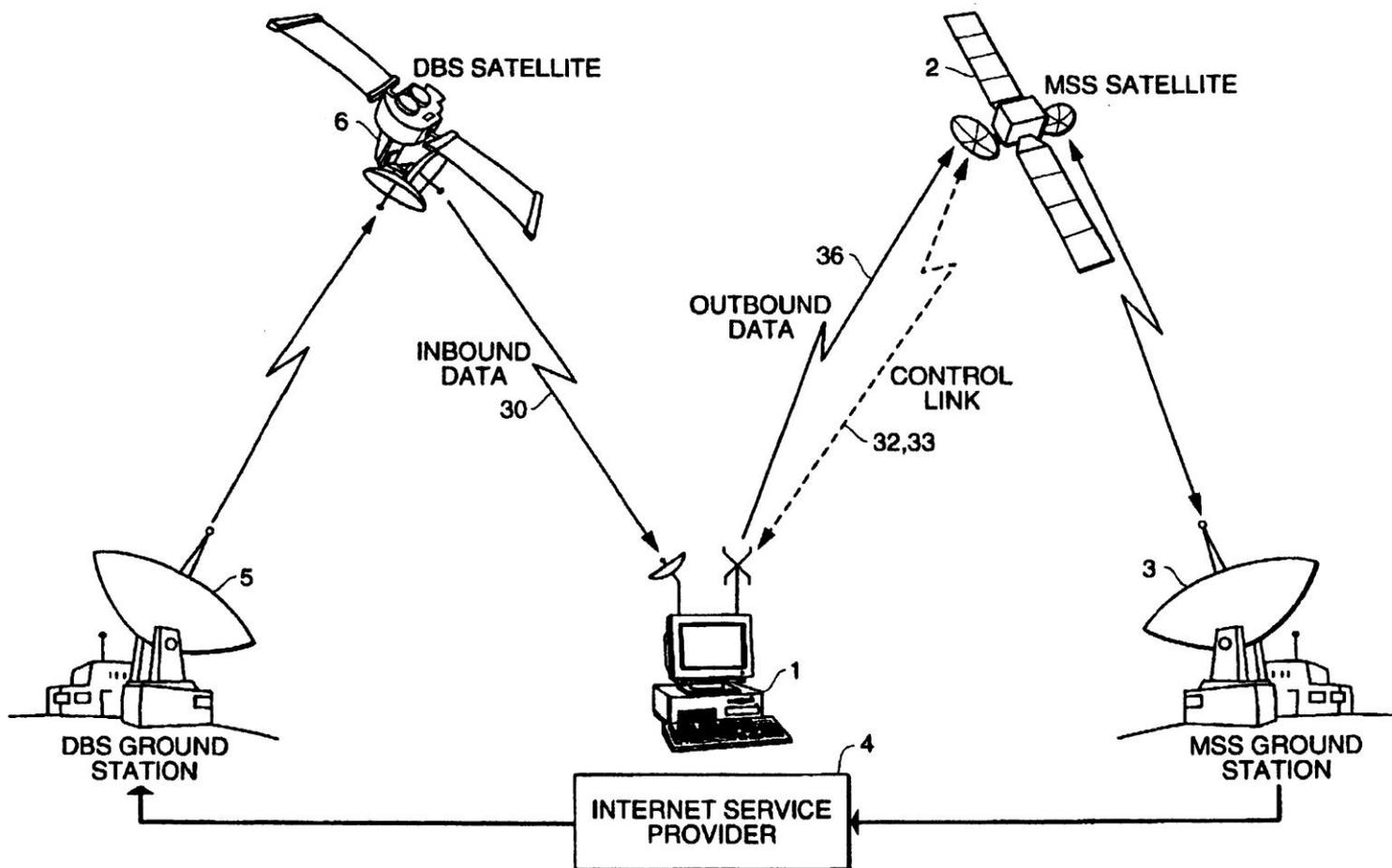
Advantages and disadvantages of satellite

<u>*Advantages*</u>

- The cost is not dependant on distance.
- Has the second highest bandwidth after optical cable.
- Earth station can be installed on a customer property than layering extensive cables.

<u>*Disadvantages*</u>

- Any station can receive the signals.
- It's expensive to install ground stations.
- Heavy rains or bad weather will increase loss of signals

VSAT technology
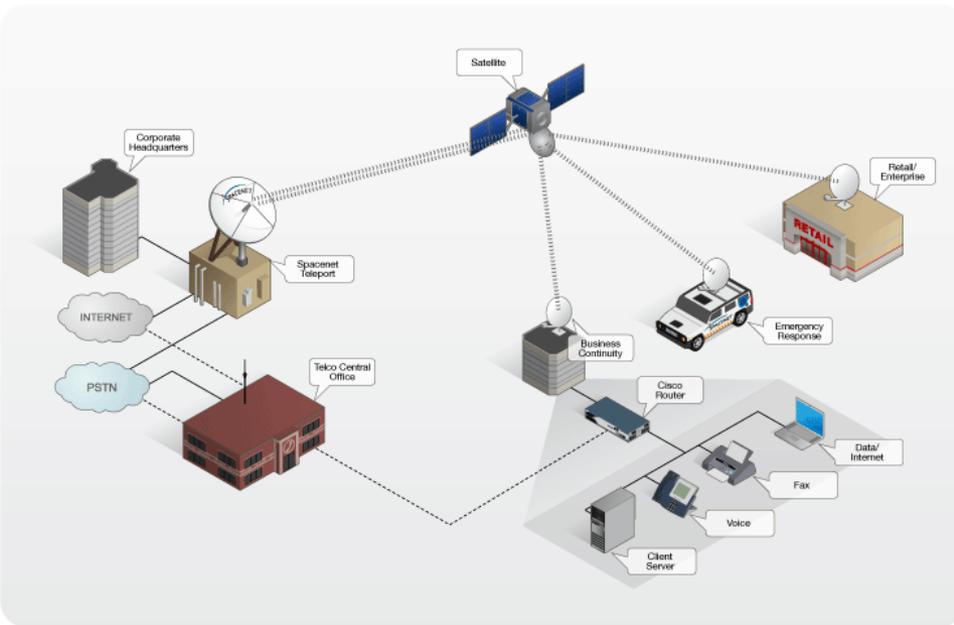
- The new trends in microwave transmission have seen the use of *very small aperture terminal (VSAT)* technology. This refers to a very small satellite dish used both in data, radio and TV communication. Many businesses are adopting this new technology because it enables direct access to satellite communication instead of having to go through the state owned satellite gateway. Figure right shows VSAT technology as set up to enable two laptops in geographically disparate locations to communicate.

Radio communication

A typical radio transmitter and receiver link
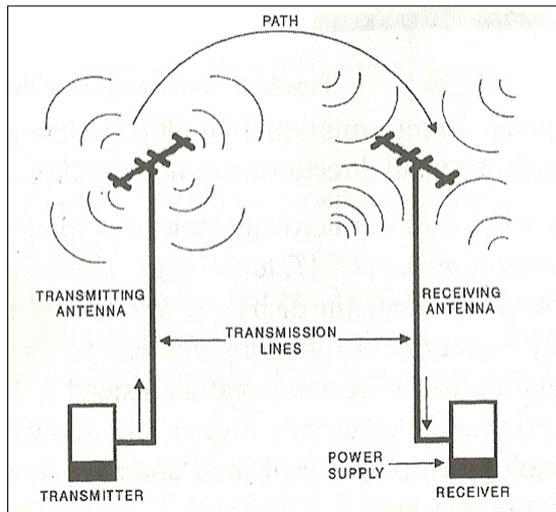
- Radio waves travel just like surface water waves, i.e. they are *omnidirectional.* This means that they start from a central point and spread outwards in all directions. As they travel outwards, their energy spreads outwards over the covered area. The waves are radiated into the atmosphere by a radio frequency antenna at constant velocity. Radio waves are not visible to the human eye. Figure right shows a typical radio waves link between two separate geographical locations.

Radio transmission
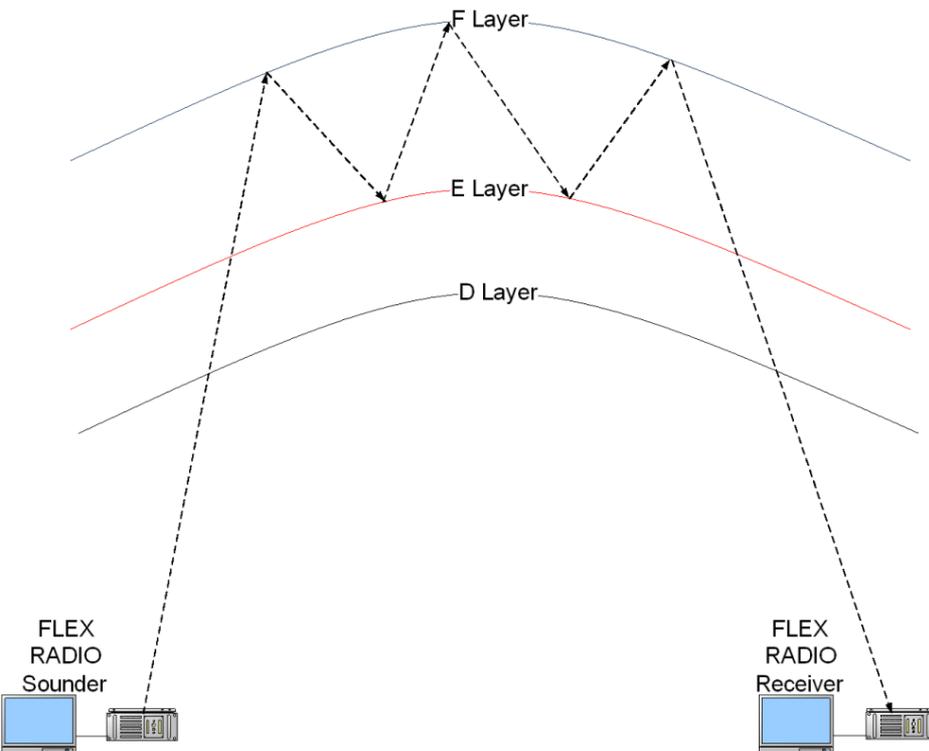
- Data can be transmitted over radio waves communication. The radio waves can be High Frequency (HF), Very High Frequency (VHF) or Ultra-High Frequency (UHF). The high frequency radio waves signal is transmitted by directing it to ionosphere of the earth. The ionosphere will reflect it back to the earth's surface and the receiver will pick the signal. Very high frequency radio waves are transmitted along the earth's surface. Ultra high frequency radio waves use the line of sight principle thus there should be no barrier between the sending and receiving devices.

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Blue tooth technology

A piconet of two devices
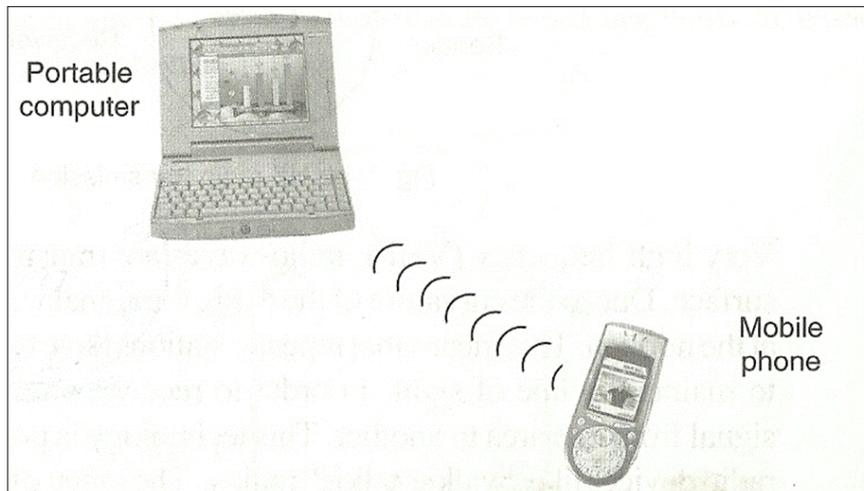
- This is a new transmission technology that enable people to use hand held communication devices like mobile phones and personal digital assistant to access the Internet. It enhance communication of personal communication devices through wireless technology.

Infrared transmission

- Communication through this medium is achieved by having infrared transmitters and receivers. The transmitter and receiver of infrared signals must be within a line of sight in the same room.

Advantages and disadvantages of wireless communication

Advantages

- They can cover larger geographical area easily.
- They are flexible in operation unlike the bounded media.

Disadvantages

- Initial cost is very high.
- Relatively difficult to establish or configure.

Communication media 1

Modem

3G wireless modem

A 24 port hub

- Modem – It's a device used to connect computer to a telephone line. It changes the digital signal to analog form and then analog back to digital signal.

- Hub – it's a component that connects computers on a network and is able to relay signals from one computer to another on the same network.

Communication media 2

Router

Repeater – it receives a signal from one segment of a network, cleans it to remove any distortion, boosts it and then sends it to another segment.

Routers – its interconnects different networks and directs the transfer of data packets from source to destination.

Communication media 3

A bridge segmenting a network

Interconnection by a gateway PC to Internet
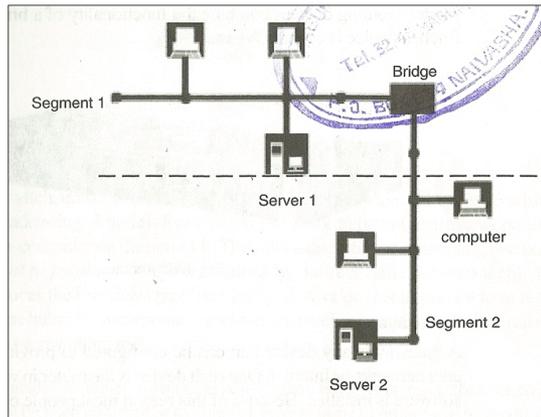
- Bridge – it's a network device that selectively determines the appropriate network segment for which a message is meant for delivery through address filtering.

- Gateway – it's a device that can be configured to provide access to wide area network or Internet.
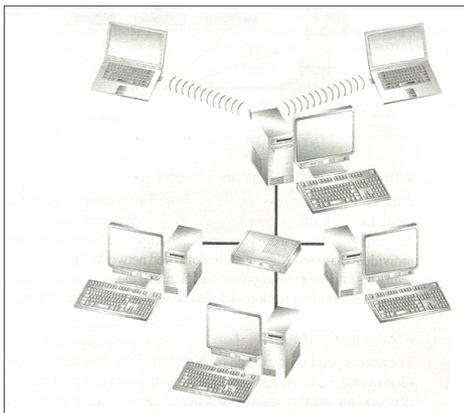
Communication media 4

Network interface card

A switch on a network
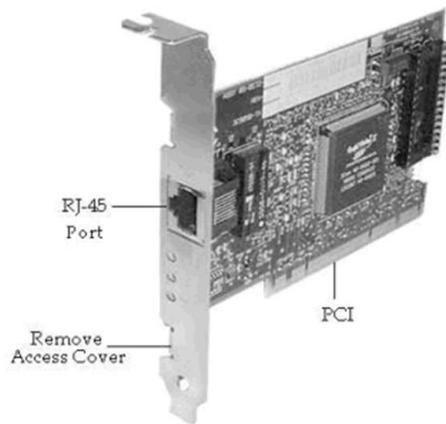
■ Network Interface Card – it's a circuit board that fits inside an expansion slot of a workstation and creates a physical link between the computer and the transmission media.
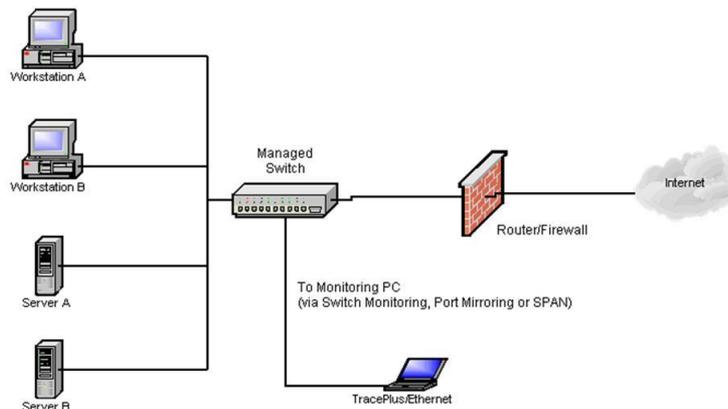
■ Switches – unlike the hub, the switch forwards a packet of data directly to the address mode without broadcasting. It transmits the packet using a point to point transmission.

Wireless communication devices 1

■ Access points (AP) – mainly used for wireless devices such as personal digital assistants, laptops and computers with wireless links. These devices need to have antennas in order to detect signals in the surrounding.

Wireless communication devices 2

- Personal Computer Memory Card International Association Cards – the PCMCIA is an add on card inserted into a device such as personal digital assistants or a laptop in order to enable wireless communication between the devices and a wired network server.

Network software

■ This refers to programmes that generally manage a network. They include:

☐ Network operating system

☐ Protocols

Network operating system

- It's function involves
  - Making sharing of resources possible.
  - Transmitting data around network.
  - Respond to requests from application programs running on the networks.
  - Enables nodes on the network to communicate with each other more efficiently.
  - Implementing network security features.
  - Supporting services.

Examples of network operating systems

- Windows NT/2000/2003

- Unix

- Linux

- Novell Netware

Protocols

- Network protocols are rules and technical procedures that govern communication between different computers. Data transmission process is broken into discrete systematic steps. At each step, a certain action takes place and it has its own rules and procedures.

How protocols work

	Layer	Function
7	Application layer	User applications run here and generate for data transmission or open received information.
6	Presentation layer	Add formatting, display and encryption information to the data being sent.
5	Session layer	Sets up data transmissions sessions between two communicating devices.
4	Transport layer	Manages data transfer over the network to ensure reliability.
3	Network layer	Address information is added to the packet and routing to destination.
2	Data link layer	Adds error checking information and prepares data for going onto the physical connection.
1	Physical layer	The data packets are finally transmitted via the network card through the transmission media in form of bits.

- The data transmission process over the network has to be broken down into discrete systematic steps. At each step, a certain action takes place. Each step has its own rules and procedures as defined by the network protocols. The work of these protocols must be co-ordinate so that there are no conflicts or incomplete operations. This co-ordination is achieved through protocol layering. Network protocols are designed after the *open system interconnection (OSI)* model. The open systems interconnection model is not a protocol as such but is meant to help designers to come up with high quality layered protocol it has seven layers, each performing distinct functions as shown in table right

Examples of protocols

- Transmission Control Protocol / Internet Protocol (TCP/IP) – TCP is responsible for delivery of sequenced data over network. The IP handles the address scheme i.e. it does packet forwarding and routing.

- File Transfer Protocol (FTP) – allows the user to connect to remote system, to sent and receives files from that system.

Network topologies

- This refers to the way in which computers and other devices have been arranged or how data is passed from one computer to another in the network.

  - ☐ Logical topology – this involves the way data passes from one device to the next don the network.

  - ☐ Physical topology – refers to the physical layout or arrangement of components on the network.

Examples of logical topologies

- Ethernet topology – in this topology, all computers listen to the networks media and can only send data when none of the others is sending.

- Token ring topology – in this topology the token (data packed) goes around the network and only the computer whose address is on the data held in the token will take up the token to read the data then release the token.

Example of physical topology 1

Computer

Computer

HUB

Computer

Computer

Printer
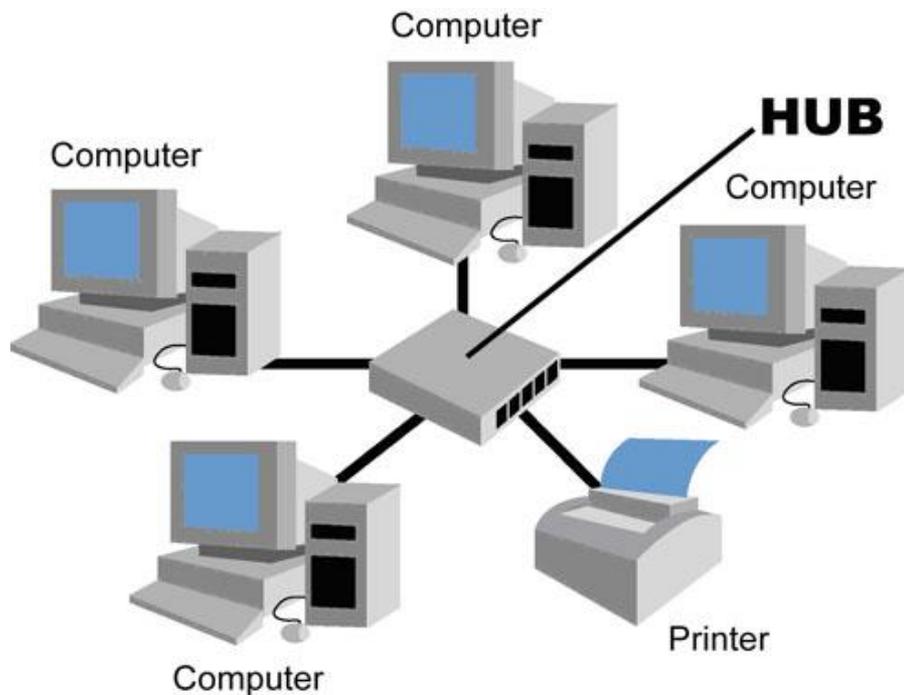
Computer

- Star topology – in this topology, all devices are connected to a central hub. Workstations communicates across the network by passing data through the hub. When the hub receives data from a transmitting computer, it broadcasts the message to all the other workstations on the network.

Advantages and disadvantages of star topology

Advantages

- Easy to configure.
- It's easily expanded.
- If one workstation fail it does not affect the others.
- Allows centralization of key networking resources e.g. server.

Disadvantages

- If the central hub fails, the entire network will be down.
- Requires more cables to install hence more expensive.
- Installing this type of network topology is time consuming.

Example of physical topology 2
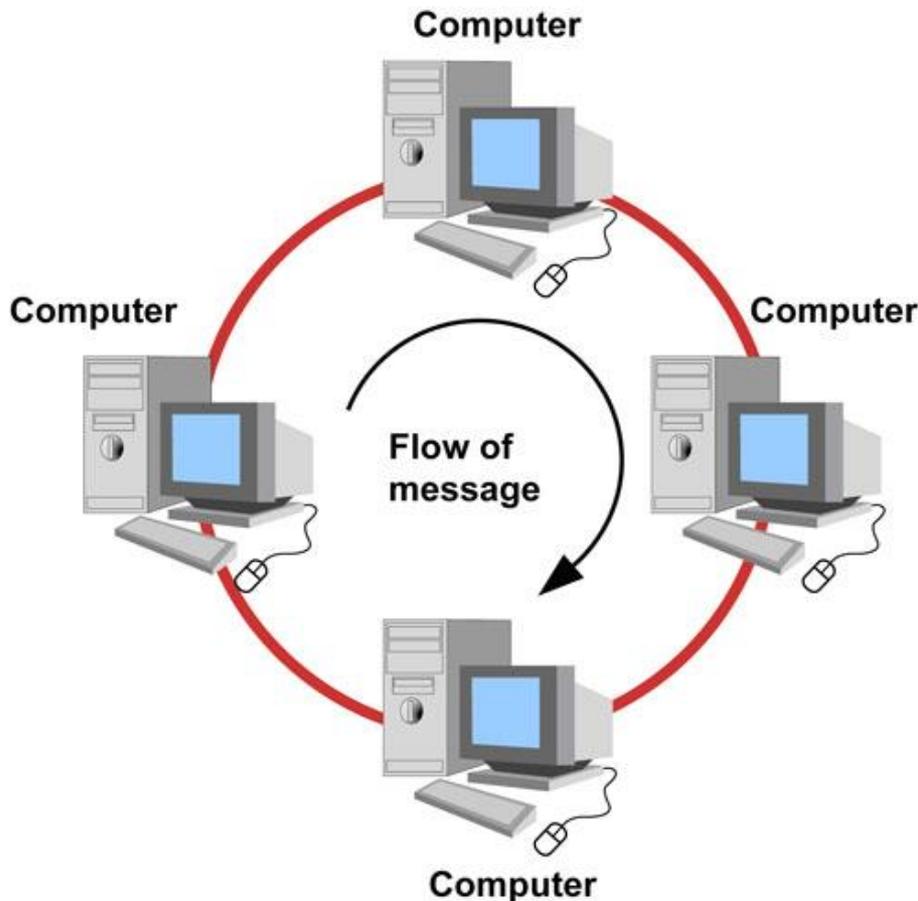
- Ring topology – in this topology all the components are connected to a single cable forming a ring. The data flows in only one direction and the signal is actively retransmitted by each node to its neighbour if its not addressed to it.

Advantages and disadvantages of ring topology

Advantages

- It's simple to install.

- Data transmission is very fast.

- Use a short length cable hence cheap.

Disadvantage

- If one site fails it affects all the other nodes.

- Troubleshooting can be difficult.

- Modification may be difficult because adding or removing a device can disrupt the entire network.

Example of physical topology 3
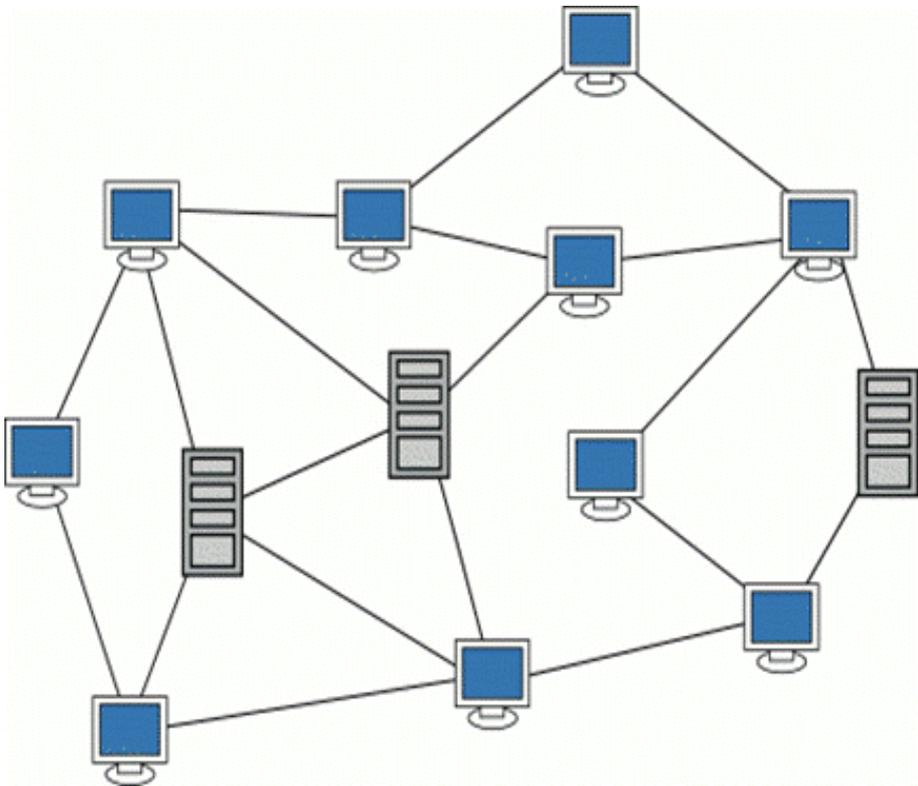
■ Mesh topology – this topology uses separate cables to connect each device to every other devices on the network providing a straight communication path.

Advantage and disadvantages of mesh topology

Advantages

- Easy to troubleshoot.

Disadvantage

- Costly to provide the redundant cables.
- Difficult to install and maintain.

Example of physical topology 4

Nodes

Nodes

Concentrator
(Hub)

Backbone Cable
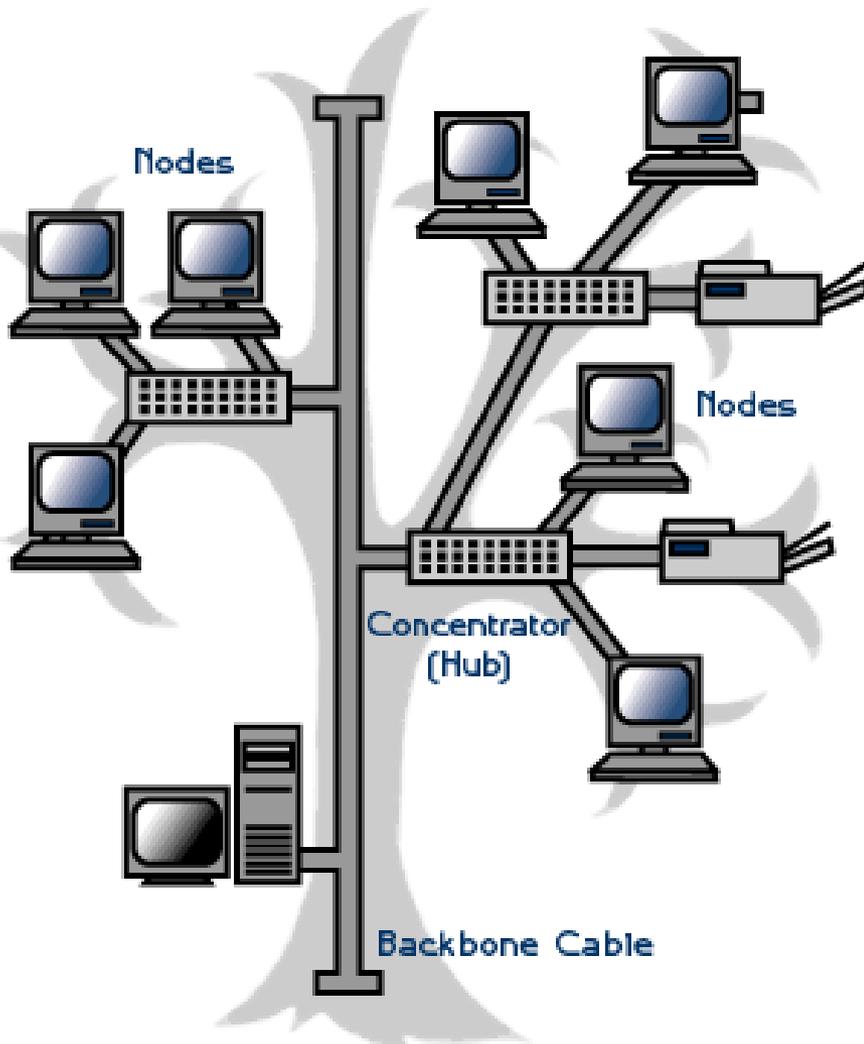
- Tree/Hierarchical topology – all the nodes are connected in form of a tree with nodes as leaves and links as branches. The transmission medium is a branching cable with no closed loops. The branches in turn can have more sub-branches. Branches are connected to each other by means of devices called hubs.

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Advantage and disadvantages of tree/hierarchical topology

Advantage

- If the workstation below the main workstation fails, the network does not fail.

Disadvantages

- If the top node fails the network fails because it control all other nodes.

- Installation is expensive and complex.

Example of physical topology 5
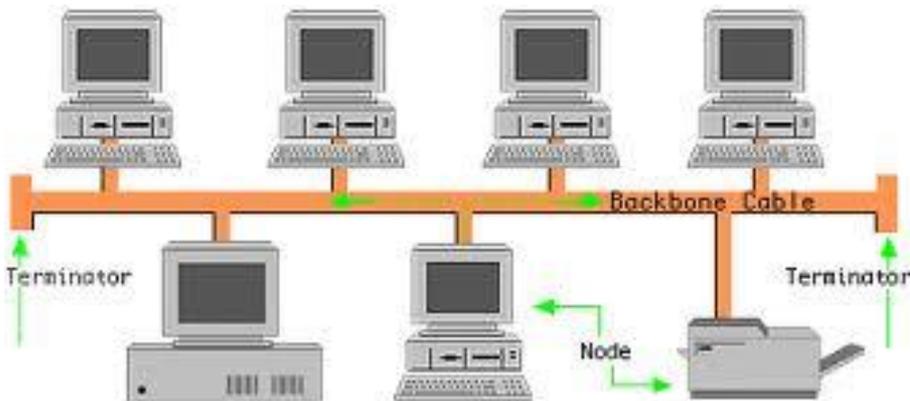
- Bus topology – all devices are connected to a central cable called the bus or backbone. Transmission and reception of a message is done by all the nodes. However, only one node can carry out a transmission at any one time.

Advantages and disadvantages of bus topology

Advantages

- It's easy to install.
- It's less expensive.
- If one mode fails, others are not affected.

Disadvantages

- The failure of the cable will bring the whole network to a stand still.
- Only one node can transmit message at a time.
- Difficult to troubleshoot.

Review questions 1

1. List four network systems that are not computer-based networks.
2. Define the term computer network.
3. Define the term communication.
4. Differentiate between a baseband and broadband signal.
5. State four advantages of networking.
6. Give two disadvantages of networking.
7. Differentiate between a network server and a workstation.
8. Explain the concept of distributed processing in networking.
9. Why is a network more reliable than stand alone computers?
10. Explain the three most common types of computer networks in use today.
11. Differentiate between remote client and remote host.
12. Explain the term bandwidth.
13. What is a "resource" in networking?
14. Differentiate between half duplex and full duplex transmission.

Answer of review questions 1-1

1. Road networks, telephone networks, nervous system and railway network
2. A computer network can be defined as a collection of computers connected together using transmission media for the purpose of communication and resource sharing.
3. Data communication is the process of transmitting data from one location to another through a transmission media.
4. Baseband refers to a digital signal that is generated and applied to the transmission medium directly without modulation while broadband transmission refers to a process where analog signal is sent over the transmission medium using a particular frequency.
5. Advantages of networking
    A) Sharing of resources
    B) Efficient communication
    C) The running cost is low
    D) Reliable and error free

Answer of review questions 1-2

6. Disadvantages of networking
   - A) High initial installation cost
   - B) Security threats
   - C) Moral and cultural effects
7. A network server is a computer dedicated to servicing requests from other computers on the Internet while a workstation is a computer connected to a network on which users do their work.
8. Distributed processing is a configuration in which terminals with processing power are located in a wide geographical area.
9. If one of the computers breaks down information can still be accessed from the server using another computer on the network.

Answer of review questions 1-3

10. Common types of computer networks
    A) Local Area Network (LAN)
    B) Metropolitan Area Network (MAN)
    C) Wide Area Network (WAN)
11. The computer mailing a remote request is called a remote client while the computer that is being accessed is called a remote host.
12. Bandwidth is the maximum amount of data that a transmission medium can carry at any one time.
13. A resource is anything that can be shared on a network.
14. Half duplex refers to communication in both directions but one at a time while full duplex transmission refers to communication in both directions simultaneously.

Review questions 2-1

1. Define the term transmission media.
2. Differentiate between a router and a gateway.
3. Why is a switch preferred to a hub on the network?
4. Compare and contrast a brouter and a router.
5. Describe an electromagnetic spectrum?
6. Describe at least five devices used in data communications.
7. What is the function of a repeater on a network?
8. Give one disadvantage of a hub on a network.
9. Give one application area of infrared transmission.

Answer of review questions 2-1-1

1. A transmission medium is a pathway used for carrying data and information from one station to another.

2. A router is a device used to interconnect different networks and direct the transfer of data packets from source to destination. On the other hand a gateway is any device that can be configured to provide access to WAN or Internet. This means that a gateway may not necessarily be a router.

3. Unlike a hub, a switch directs a packet directly to the addressed node without broadcasting.

4. A router connects logical networks while a brouter has both functionalities of a router and a bridge.

Answer of review questions 2-1-2

5. Electromagnetic spectrum is a diagrammatic representation of carious electromagnetic wave frequencies. It consists of radiowaves, microwaves, infrared radiation, visible light, ultraviolet rays, X-rays, Gamma rays and cosmic rays.

6. Network Interface Card (NIC's), modems, hubs, bridges, repeaters, routers, switches and brouters.

7. A repeater receives a weak signal on the network, cleans it and amplifies it for transmission over the next portion of the network. Signals become weak due to attenuation.

8. A hub may cause broadcast problems.

9. Communication in wireless devices.

Review questions 2-2

10. Explain the importance of a gateway on a network.
11. State two advantages of satellite communication.
12. Give two advantages of fibre optic media.
13. Define the term pitch as used in twisted pair cabling.
14. Give two advantages of coaxial cables.
15. Differentiate between single mode and multimode fibre.
16. Describe the VSAT technology.
17. Explain the concept of a geostationary satellite.
18. Explain the importance of the wire braid in coaxial cable.
19. Explain the line of sight principle in wireless transmission.

Answer of review questions 2-2-1

10. Gateway provide access to the wide area networks and Internet.
11. Advantages of satellite communication:
    A) Covers a wide area.
    B) As opposed to earth-to-earth microwaves, it overcomes line of sight problem.
12. Advantages of fibre optic media:
    A) Allows faster communication.
    B) Transmits data over longer distances compared to other cables.
    C) It is immune to interference and eavesdropping.
    D) Supports high bandwidth.
13. Pitch refers to the twists per foot of each pair of the UTP cable.
14. Advantages of coaxial cables:
    A) Supports higher bandwidth compared to twisted pair cables.
    B) It's installation is relatively simple.
    C) It can carry voice, data and videos on the network.
    D) It is more resistant to radio and electromagnetic interference than twisted pair cables.

Answer of review questions 2-2-2

15. Single mode fibre has a very narrow centre core compared of multimode.

16. VSAT refers to a very small satellite dish used both for data and radio communication. It enables direct access to satellite transmission instead of having to go through the state owned satellite gateway.

17. Geostationary satellite's speed in its orbit is relatively equal to the rotation of the earth hence, an observer on earth will see as if the satellite is stationary in space.

18. The braid protects the carrier wire from radio frequency interference and electromagnetic interference.

19. In line of sight principle, a signal is directed through a focused beam from the transmitter station to receiver station without obstructions in between them.

Review questions 3

1. List two types of network software.
2. Give three examples of protocols used in networking.
3. Outline the seven Open Systems Interconnection (OSI) reference model layers.
4. Define the term network topology.
5. Distinguish between logical and physical network topology.
6. Explain the importance logical and physical network topology.
7. List four examples of network operating system.
8. Outline the functions of network operating system.

Answer of review questions 3-1

1. Types of network software
   A) Network operating systems.
   B) Network protocols.
2. Examples of protocols used in networking:
   A) Transmission control protocol / Internet protocol (TCP/IP). It is the main internetworking protocol that has enabled the setting up of the Internet.
   B) OSPF – it stands for Open Shortest Path First. This protocol is used by routers to forward the packages on the network through the path that is not only shortest but has least load.
   C) NetBEUI – a local area network protocol and is limited to Microsoft and IBM networks.
   D) IPX/SPX – is an internetworking protocol like TCP/IP. It also routes packets. However, duplication of network addresses is the main.
3. OSI model layers – application layer, presentation layer, session layer, transport layer, network layer, data link layer, physical layer.
4. Network topology refers to the layout of the computers, printers, and other equipment connected on the network.

Answer of review questions 3-2

5. Logical topology also called signal topology deals with the way that data passes from one device to the next on the network. Physical topology on the other hand refers to the physical layout or arrangement on the network.

6. Does the actual sending of data on the transmission medium in binary form.

7. Microsoft Windows NT/2000/2003, UNIX, Novell Netware, Linux.

8. Functions of network operating systems:

    A) Provides access to network resources e.g. printers and folders.

    B) Enables nodes on the network to communicate with each other.

    C) Supports inter-process communication i.e. enables the various processes on the network to communicate with one another.

    D) Responds to requests from application programs running on the network.

    E) Supporting network services like network card drivers and protocols.

Revision questions

1. Determine the type of a network characterised by:
   a. Connection between computers, printers and other resources using UTP cables.
   b. Over 180 stand alones in an office building.
   c. Over 254 computers connected to share resources in a city.
2. Explain the function of a NIC in networking.
3. The computer that is dedicated to serving requests from other computers in a network is called a (   ) while the computer that sends requests is called (   ).
4. Distinguish between thinnet and thicknet coaxial cables.
5. Distinguish between radio and microwave transmission.
6. The layer that surrounds the core of a fibre optic cable is called (   ).
7. Describe any three types of physical network topologies used in LAN.
8. The device that connects workstations and the server to a central point is called a (   ).
9. Define the term protocol.

Answer of revision questions 1

1. A). Unshielded twisted pair cabling – LAN.
   B). Stand alones – None.
   C). Over 254 computers in a city – MAN.
2. Network interface card creates a physical link between the computer and the transmission media.
3. Server, Client.
4. A thicknet is thicker than the thinnet and has two insulators around the core.
5. Microwave transmission is point-to-point while in radio transmission the signals are Omni directional i.e. they originate from a central point and then spread outward.

Answer of revision questions 2

6. Cladding.
7. Types of physical network topologies used in LAN:
   A) Star topology.
   B) Bus topology.
   C) Ring topology.
   D) Mesh topology.
   E) Tree topology.
8. Hub.
9. A protocol is a special set of rules that enable computers on a network to communicate.

Practical exercise

Njabini Boys high school

Form four work

Setting up a peer-to-peer local area network

■ This practical activity is a step by step guide on how to set up a simple local area network. The following are some of the requirements you need.

1. Hardware requirements.
2. Tools
3. Installing a network card
4. Installing the drivers manually
5. Adding protocols
6. Identifying your computer in a workgroup
7. Configuring transport control protocol/Internet protocol (TCP/IP)
8. Media preparation and connection
9. Connecting the computers to hub/switch

Hardware requirements

1. A computer running on any version of Microsoft Windows especially Windows 9x/2000/ME/windows XP.

2. Network interface card. Some computers may have it already installed onboard so that you do not have to purchase one.

3. A hub or a switch.

4. Transmission media preferably unshielded twisted pair category 5.

5. RJ45 connectors.

Installing a network card

- The network interface card acts as the physical interface or connection between the computer and a properly terminated transmission cable. As mentioned earlier, come motherboards come with on-board network interface cards hence you may not need to plug in a separate add-on card.

Steps of physically install an add-on card 1

Inserting network interface card
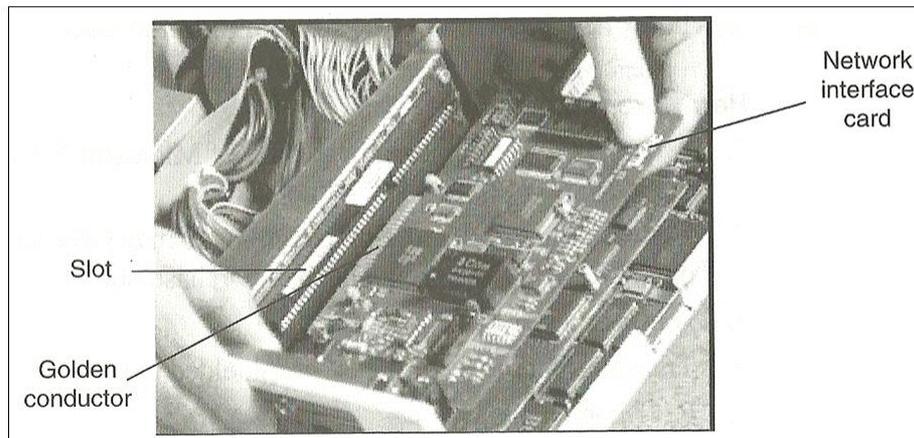
1. Disconnect the computer from the power source.

2. Open te system unit and identify an empty expansion slot on the motherboard.

3. Insert the card as shown in figure right and screw it into place. Some little force may be needed to push the card into place squarely. Make sure that all the conductor points of the card sink into the expansion slot. Avoid touching the golden conductor points and chip on the card with your bare hands.

Steps of physically install an add-on card 2

4. Replace the casing then connect the computer to the power supply and boot it up. If you are using Microsoft Windows 9x and above, the computer will detect the new hardware because of the plug and play feature found in the operating system. It may install the protocols and device software needed for the proper operation of the network interface card automatically. If there is a problem of the card being detected, you may have to configure the card manually using a disk that comes with the card.

NB: some cards are slotted into Industry Standard Architecture (ISA) slots while others for Peripheral Components Interconnect (PCI) slots. Make sure you install in the right slot and then screw into place.

Installing the drivers manually 1
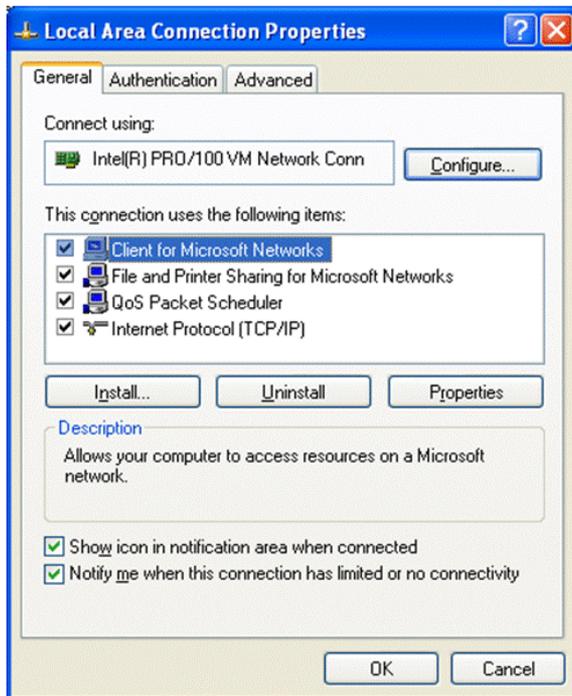
1. Click "Start", "Settings" then "Control Panel". In the "Control Panel" window double click the "Network/Network Connection" icon. A dialog box such as the one shown in figure right will be displayed. (*In some Windows versions you may have to double click the "Network and Dial-up Connection" icon found in the "Control Panel" then double click the "Local Area Connection" icon.*)
2. Click the "Configure" button.
3. Click "Adapter/drivers" and then click "Add". Follow the on screen instructions screen.

Adding protocols

1. Make sure the "Network" dialog box is open.
2. Click "Add" then "protocols".
3. Click "Microsoft", select "TCP/IP" and "NetBEUI" from the network protocols list then "OK".
4. Click "Apply".

Identifying your computer in a workgroup

- A workgroup is a collection of computers that are on the same network. To specify your computer and the name of the workgroup:

  1. If you are using Windows 9x, click the "Identification: tab from the :Network dialog box. If you are using Windows Me, 2000 or XP. Identification (*computer Name)* tab is located in system properties dialog box. Right click "My computer", click "Properties" then click the computer name tab.

  2. Type your computer name and the workgroup name. the computer name you give must be unique.

Configuring TCP/IP 1

■ In order to communicate with other computers, you need to install and configure a protocol. In our case let us use TCP/IP. To configure TCP/IP,

1. Select the TCP/IP Ethernet adapter from the list titled. the following network components are installed / This connection uses the following items.

2. Click the "Properties" button then the "Specify and IP address" option.

Configuring TCP/IP 2
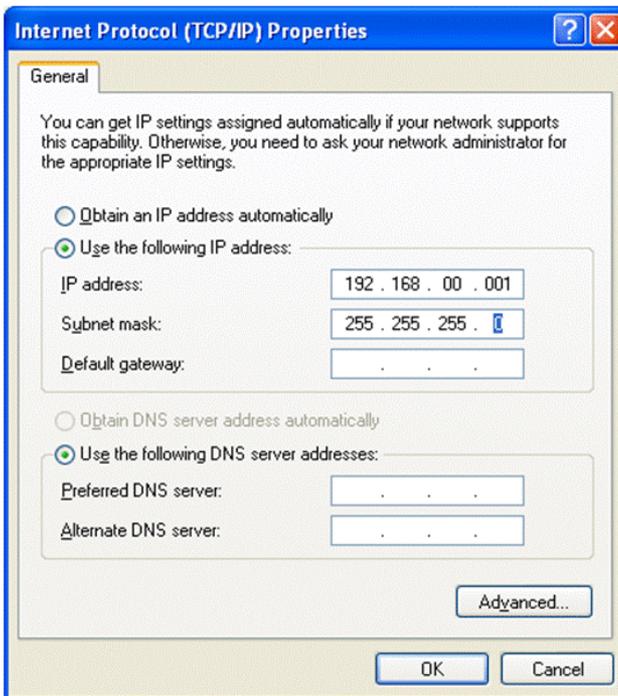
3. Type in the IP address such as 192.168.00.001. Each computer should have unique IP address. Figure right shows a TCP/IP properties dialog box in Microsoft Windows XP.

Configuring TCP/IP 3

4.   Specify the *subnet mask.* Subnet masks are values that allow the router to distinguish the *network ID* from *host ID* portions of the IP address. If the IP address is examined by the subnet mask and found to be identical, the message is destined to a host on the same network otherwise it is routed to another network. Typically, subnet masks use the format 255.x.x.x. In our case let us use a subnet mask such as 255.255.255.0.

5.   Click "Apply" then "OK". The computer will prompt you to restart in order for the changes to be effected.

6.   Restart the computer.

Media preparation and connection
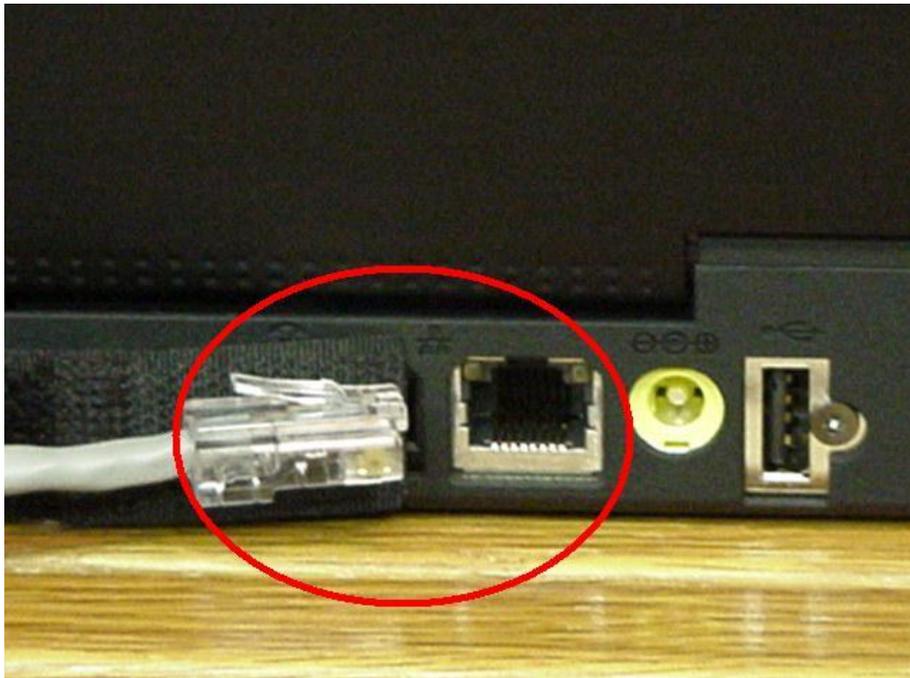
- In this practical exercise, we are going to use twisted pair cabling technique because it has become almost the default method. This type of media uses a connector known as RJ45 to terminate the cable. Figure right shows illustration of RJ45 port and RJ45 terminated cable. RJ45t is attached to a UTP cable using crimping tool.

Steps of attach an RJ45 connector to a UTP cable 1

Class 568A cabling diagram

RJ45 connector
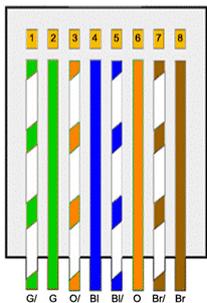
1. Green stripe
2. Green
3. Orange striped
4. Blue
5. Blue striped
6. Orange
7. Brown striped
8. Brown

568A

1. Cut a piece of cable of suitable length approximately 3 metres.
2. Strip off approximately a dimension centimetres of the cable sheath on both ends to expose the inner pairs.
3. Untwist the pairs.
4. Using the wiring diagram shown in figure right, place the wires in the correct order and trim the edges to make them even.

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Steps of attach an RJ45 connector to a UTP cable 2

Patch cable (code)

RJ45 connector
at one end

UTP cable

RJ45 connector
at the other and

5. Insert the wires into the RJ45 connector, plug it in their correct order and then push it into the crimping tool.

6. Squeeze the handles of the tool to make sure the wires are pierced and held tightly in the connector.

7. Repeat steps 5 and 6 at the other end of the cable. Your cable should now be terminated on both ends and should be like the one shown in figure right.

8. You can then test the media for continuity and correct termination using the cable tester.

Connecting the computers to the hub/switch

- It is now time to connect the computers together through the hub. To connect the computer do the following:

  1. Connect one end of the cable to the RJ45 port of the network card and the other end to one port in the hub. If the hub is powered, a LED will indicate the connection. Repeat all this process for all other computers that you wish to connect on the network.

  2. To see if the networking is successful, right click the *Network Neighbourhood / My Network Places* on the desktop. If all the connected computers in the same workgroup can *"see"* one another then you have succeeded setting up a peer-to-peer network.

  3. If not, you may decide to test the connection using the *PING* command to test connection. For example if you have two computers with the IP addresses 192.168.001.001 and 192.168.001.002.

Steps of test the connection between the two

Connection failed

Connection successful
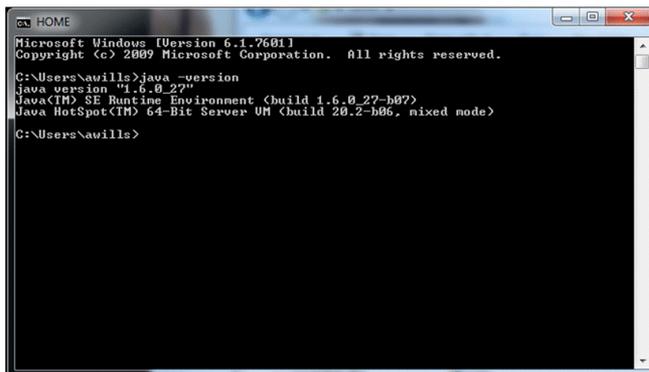
1. From the "Start" menu of the computer with IP address 192.168.001.001, choose the "Run" menu and type the command [PING 192.168.001.002].

2. Click "OK"

■ A connection failure will be displayed on the screen as shown in figure right above while a successful network is shown on figure right below.

Sharing network resources

■ If you have successfully installed the network, you can then start enjoying the benefits of networking by enabling resource sharing. For example if you are using Windows XP, you can share resources by enabling sharing and security as follows:

1. Open "Windows Explorer"
2. From the explorer window, right click the drive folder or file you wish others on the network then select sharing and security.
3. Click the "Sharing" tab then enable "share this folder".
4. Type in the share name and set other options as required.
5. Click "OK".

Chapter 2
Application areas of information and communication technology (ICT)

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Form four work

Reservation systems

- This are distributed networked systems that are used mainly to make bookings in areas such as:

  - ☐ Hotels booking

  - ☐ Airline booking

Hotels booking

- Booking and reservation of rooms in hotel are made from remote terminal connected to a centralized computer database. A customer makes enquiries via the remote terminal connected to the central computer.

Airline booking

- Major airline have centralized databases. This means that all flights and passengers records are stored in a computer system in one location. Travel agents from all over the world can access each data via communication lines. In that way, agents book in client where tickets have not been bought.

Retail system

Electronic point of sale terminal

- Point of sale system – an Electronic Point Of Sale (EPOS) is a computer terminal in retail stores to input and output data at the point where sales are transacted e.g. supermarket checkout counters.

- Stock control – a computerized stock control is used to track what is in stock and what needs recording.

Banking system 1

- Processing customer transactions – computers are used in banks to carry out financial transactions such as recording, deposits, withdrawals and calculating interests on loans and savings.

- Electronic funds transfer – involves movement of money using information and communication technology e.g. when paying goods using credit card, payment is transferred electronically from the customers account to recipient account.

- Cheque processing – the use of Magnetic Ink Character Reader (MICR) details of the cheque are automatically entered into a computer for cheque processing.

Banking systems 2

- Cash dispensers (ATM) – they allow customers to do their banking at any hour of the day or night seven days a week.

Educational systems 1

- Computer Aided Learning (CAL) – this presents educational materials the way a teacher does in a classroom. In this program there are clear graphical presentations such as video clips and voice for demonstration or for explaining concepts.

- E-learning – lessons and lectures are presented from central site and presentation is transmitted to remote conference terminals. Learners can also access learning materials on the Internet.

- Computer based simulation – refers to the science of representing the behaviour of a real life situation by using computerized models. This programs creates real situation which replaces very dangerous and expensive experiments in science. Mainly used in areas where practical skills have to be learnt like training pilots, engineers etc.

Educational systems 2

Learning how to type using typing tutor program
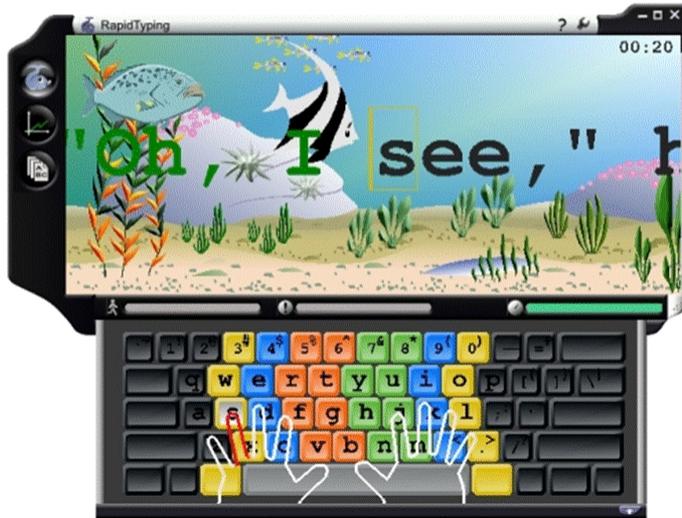
■ Computer Aided Instructions (CAI) – refers to the use of a computer to learn, drill and practice particular educational principles. The learner is presented with explanation of the concept. The computer then presents questions from which the learner is to select correct answer.

Industrial systems 1

- Modelling – computer modelling is the creation of electronic representations of objects or ideas. Computer model shows what something might look like when the real thing would be too difficult or too expensive to create and visualize.

- Process control – refers to the use of a computer system to control an ongoing physical process especially in manufacturing e.g. regulating temperature, fluid flow etc.

Industrial systems 2

Non destructive testing

(a) Before crash   (a) After crash
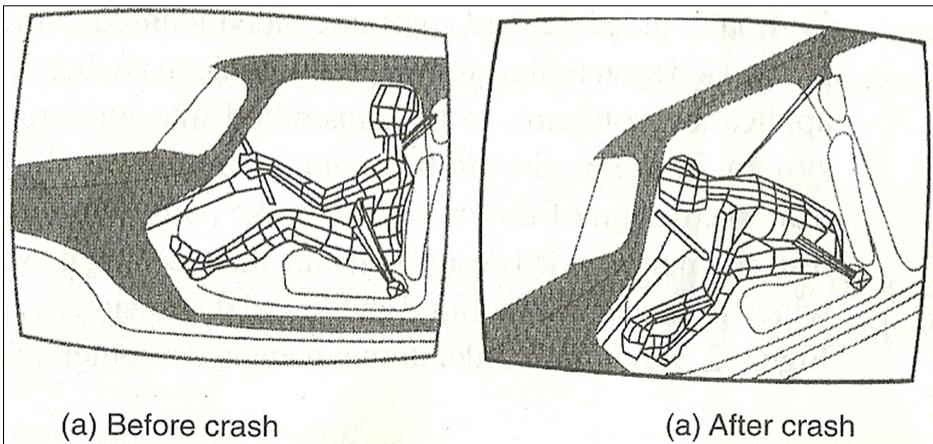
- Industrial simulation – this allows some activities that would otherwise be expensive and dangerous in real life situation to be put under test e.g. a plane crash test simulation with the use of a virtual model on the computer screen that represents the real situation or object.

Industrial systems 3

3D CAD drawing
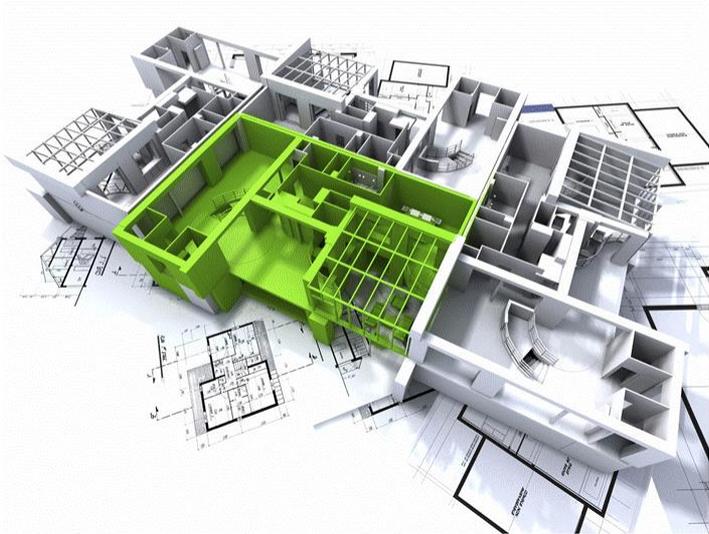
- Computer Aided Design (CAD) / Computer Aided Manufacturer – this involves use of a system that allows products that have been designed using design application software, to be transmitted into a automated manufacturing system for the product to be manufactured as per the computer model e.g. a motor vehicle engines designed using CAD then feeding it to an automated machine which engineers the required specifications.

Transport system

- Air traffic control – airports and airstrips have been computerized. Computers are used to monitor air traffic movement, take off and handling of crafts. The human control errors and mistakes have been eliminated due to computerized systems. Computers are used for air reservations and also to direct aircrafts to follow the shortest path between two locations.

- Shipping control – computers are used to load and offload an also in docking of ships. Records are also handled with much ease at the ports with use of computers also are used to control and guide the paths taken by spaceships and water vessels.

- Automobile traffic control – computers are used to control both human an motor vehicle traffic using a computerized lighting system. These lights are controlled using a computer system or a clock switch. Computerized traffic light systems have sensor pads laid underneath the road which detect the pattern of the traffic flow. The collected data is sent to a computer system which detects and analyses the traffic flow.

Scientific Research systems 1

World Ecosystem Complexes (Olson et ol., 1985)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
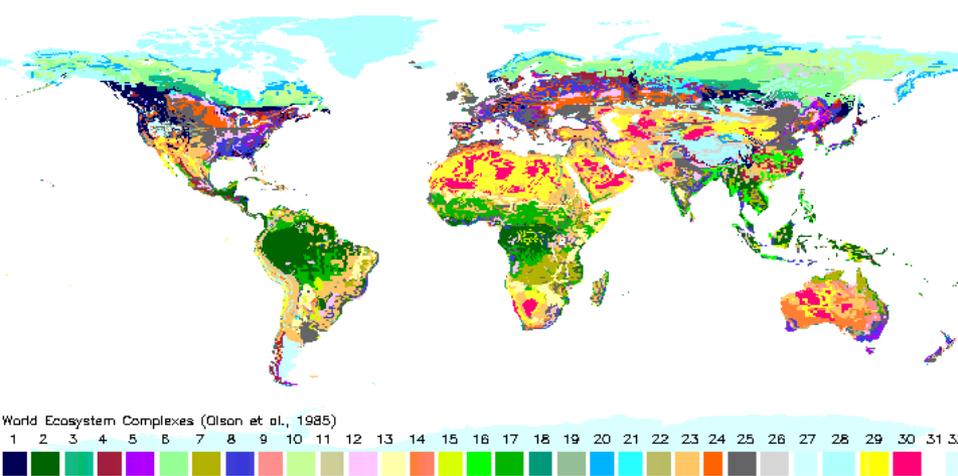
- Weather forecasting – modern weather forecasting have been automated using computerized systems, hence weather predictions are more accurate and reliable. The data collected from rainfall air, pressure, humidity, temperature, clouds etc are analysed with the help of computer to predict the weather patterns. Also computers are used in Geographical Information System (GIS) and the geographical data in graphical form by positioning and superimposing it on the world map.

Scientific Research systems 2

- Medical research – the health care industry uses computer based information systems for data processing operations such as patient billing, accounting, inventory control, calculation of health care statistics etc. they are also used in scheduling lab times and operating room times, automating nurses stations, monitoring intensive care patients, providing preliminary diagnose etc. Computers are also used to control devices that help to care for the handicapped such as deaf, blind etc. expert systems are also used to assist physicians in making diagnoses because they can remember more facts that human doctors can. Computerization of laboratory tests, such as the types of blood and the testing of sugar levels leads to faster and more accurate reporting of test results.

Scientific Research systems 3

- Military and space – many nations today have developed strong military bases which have international coordinates. This is managed by computerized radar and other complex communication machine. The jet fighters are computerized, control centres are also connected to create swiftness and efficiency in all operations. Space exploration is another area where scientists have applied the use of computers. The spacecrafts and rockets are computers. The spacecrafts and rockets are computerized which explore space and planets which are controlled from manufacturing bases by qualified computer experts.

Entertainment systems

- Music and video – in music industry, computers are used in recording, synthesizing, editing and adding special effects to music. In video industry, computers are used to produce highly simulated and animated movies, generate scenes and actors.

- Games – three dimensional multimedia games are now possible on personal computers. There are computer games that simulate sports e.g. driving, war combat etc. such games gives the player maximum pleasure in a virtual environment on the screen.

Library systems

- Inventory control – computers are used to manage stock which includes checking for books currently in shelves and those on high demand that need adding and also those that have become obsolete can be retired to archives.

- Cataloguing – computerised catalogues have replaced manual card catalogue which enhance service delivery and efficiency. The electronic catalogue is updated constantly when new reference materials are acquired.

- Lending system – computerised library system manages the issuance and return of borrowed reading materials. Books, magazines, reports etc are given unique identification numbers or codes. Members details are recorded once a book is borrowed and updated when the book is returned to reflect new status.

Marketing system

- Electronic commerce (E-learning) – e-commerce involves the carrying of day to day transactions of an enterprise electronically through the Internet. The transactions involves sales, promotions etc. companies and organisations have logged websites for online transactions. The online buying website tracks the whole session as the customer chooses various items and calculates the total bill. Payment is then made through a cheque, credit card or electronic fund transfer.

- Electronic presentation – marketing agents can create exiting presentations concerning the procedures of business and present them to audience using presentation software.

- Advertising – it's possible to create advert materials and video clip using simulation, presentation and animation software and then have them displayed on billboards, broadcasted over television or place them in Internet.

Communication systems

- Effective and efficient data communication is achieved by use of high speed electronic devices such as computers, cell phones, radios and television. Some of the communication systems include:
  - ☐ Facsimile (fax)
  - ☐ Radio communication
  - ☐ Television sets
  - ☐ Voice messaging
  - ☐ Video conferencing
  - ☐ Telecommuting
  - ☐ Internet

Facsimile (Fax)

- This is a telecommunication device used to send documents via telephone lines. A document is placed in the machine, scanned and converted into analog form then transmitted over the telephone line. The receiving fax machine converts the analog data into the original softcopy and prints a hardcopy. Sending fax over the Internet, a special modem called fax modem is attached to sending and receiving computers.

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Radio communication

- Computer used in broadcasting stations to:

  □ Record and manage radio programmers.

  □ Automate running of selected programmes.

  □ Create slides, simulate objects and sound effects to prepare adverts.

  □ Download information from Internet to prepare programmes like international news.

Television sets

- Data and information is transmitted via a TV channel same way. It is used to broadcast conversional TV programmes. The most common types of data transmitted via TV include:

  - Teletext – this refers to a computerized service whereby news and other information are provided on TV screens to subscribers. TV is configured using a special adapter. The subscriber can browse for information using a remote controlled device.

  - Videotext (view data) – this is an interactive computer information service that can transmit text and graphics. Computers and phones are used for two way communication to order goods and services. A subscriber can interact with the service provider databases and the information is displayed on home TV screen.

Voice messaging and telecommuting

- Voice messaging – this is a combination of a telephone and a computer to create a computerized system that allows a message to be sent in human voice without the receiver needing to be present at the same time to receive the message.

- Telecommuting – this is a term used to refer to a situation whereby a person uses a computer and a communication channel to establish a link with a remote office computer. With a personal computer connected to a company's computer, an office employee can communicate with the office.

Video conferencing
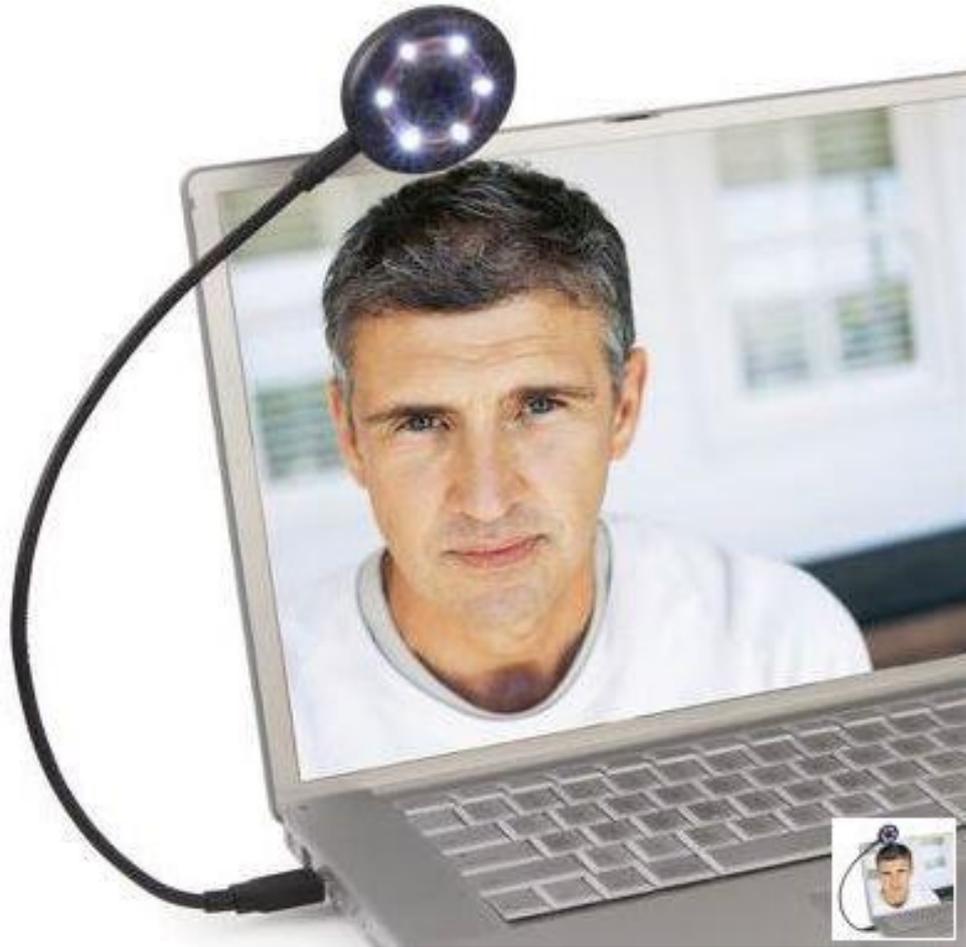
- This refers to the use of computers, a digital video camera, audio capturing equipments and communication networks to enable people in different locations to see and talk to one another.

Internet

- This Internet transmits huge amounts of information in form of words, images and sounds. Some of the services available on the Internet are:

  - World Wide Web (www) – www refers to a collection of web pages, which may be made up of text, images, animations, sounds and video held on web servers. One can access information using a computer or other devices like mobile phones.

  - E-mail – once you subscribe for Internet services through a service provider, you can send or receive e-mails to or from anyone connected to Internet using a computer or a WAP enabled cellular phone.

Law enforcement systems

A biometaric analysis of finger prints

- Immediate and accurate information is very crucial in crime detection, biometrics analysis using computers is used in this area which involves the study, measurement and analysis of human biological characteristics. The biometric devices attached to computer are used to identify people by recognizing one or more specific attributes such as finger, lips, facial features e.g. iris etc.

Virtual reality (artificial reality)

■ This refers to a condition in which a person becomes psychologically immersed in an artificial environment generated by a computer system. The following interactive sensory equipments are used to achieve virtual reality effect.

☐ Head mounted display (HMD) headgear

☐ Gloves

☐ Virtual reality software

☐ Body suit

Head mounted display headgear

Headgear

BOOM
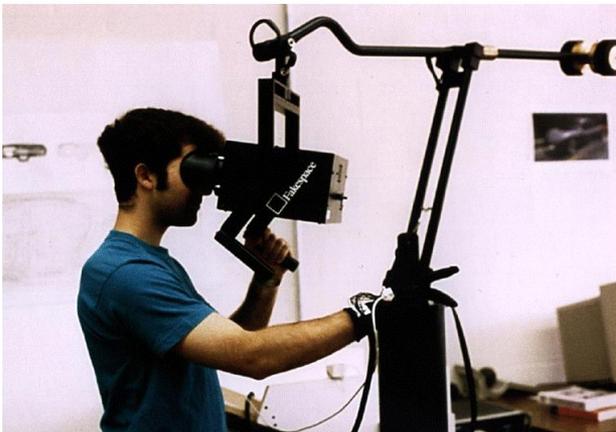
- A headgear is made up of two tiny display screens and sound systems that channel images and sound from the source to the eyes and ears thus presenting a stereo three dimensional sound effect in the virtual world. The wearer of the headgear is able to look around in the virtual environment. A boom is an alternative to the often-uncomfortable headgear. Screen, optical and sound systems are housed n a box (figure right below). The user looks into the box through the two screens to see the virtual world.

Gloves and body suit

Hand glove

■ They are worn on the hands to allow the user navigate through the virtual world and interact with virtual objects. The gloves have sensors that collect data about the movement of the hands and relay the data into the system. They give the wearer a sense of touch in the virtual world.

Virtual reality software and body suit

- Virtual reality software –this software gives the wearer of the sensory devices an interactive virtual sensory experience that makes him/her feel as if he/she is in a world.

- Body suit – this is made of conductor wires wound in a rubber suit. Te wires sense the body movement and relay the data into the virtual reality system which in turn adjusts the position of the user in virtual reality world.

Application of virtual reality

- Virtual reality is used to represent any three dimensional object or ideas that are either real or abstract. Real objects include buildings, landscapes, spacecrafts, human anatomy crime scene reconstruction etc. for example a client can be allowed to virtually move through a house to build, pull drawers, touch objects etc. all in a computer generated environment. Other applications include: entertainment, training military, simulation, education, design evaluation, medicine, aircrafts, assembly of sequences etc.

Review questions 1-1

1. Explain at least five areas where computers used.

2. State the advantages of using electronic point-of-sale terminals as opposed to manual entry at a supermarket checkout counter.

3. Discuss how a computer is used in

   A) Reservation systems.

   B) Banking.

   C) Law enforcement.

4. Explain how computers have made it possible for most organisations or institutions to have a paperless office.

Answer of review questions 1-1-1

1. A). Financial systems:
   A) Payroll systems
   B) Accounting systems
   C) Banking systems

   B). Retail systems:
   A) Stock control
   B) Electronic point of sale terminals

   C). Computers in reservation systems:

   D). Educational systems:
   A) Computer aided instruction
   B) Computer aided learning
   C) Computer simulation
   D) Electronic learning

   E). Communication systems:
   A) Facsimile
   B) Radio – internet radio
   C) Television – video streaming
   D) Telecommunication
   E) Internet
   F) E-mail

   F). Computers in industry.

2. A). Fast entry of data.

   B). Less errors at point of entry.

   C). Good stock management procedures.

Answer of review questions 1-1-2

3. A). Reservation systems:
   - A) Keep record of reservations.
   - B) On-line reservation system (remote services).
   - C) Paperless transactions – paying via credit cards.
   - D) Easy to check for vacant positions.

   B). Banking:
   - A) 24 hours banking facilities like automated teller machines (ATM).
   - B) Immediate transfer of funds (electronic transfer) across geographic locations.
   - C) Records keeping and accounting.
   - D) Efficiency enhanced.

   C). Law enforcement:
   - A) Finger print record keeping.
   - B) Biometric analysis.

4. Electronic transactions

Review questions 1-2

5. Identify at least two areas where expert systems are used.

6. Differentiate between
   A) Computer aided instruction and computer aided learning.
   B) Computer aided design and computer aided manufacturing.
   C) Simulation and virtual reality.

7. Explain the role of robots in a motor vehicle assembling plant.

8. Explain the term virtual reality giving examples of devices used.

9. Discuss the devices required in order conduct a video conference.

Answer of review questions 1-2-1

5. A). In medical institutions for diagnosis of diseases.
   B). In mining companies for prospecting minerals.

6. A). Computer aided instructions involves drilling students on techniques and content while computer aided learning presents content and asks questions to the learner later.

   B). Computer aided design enables the user to design products while computer aided manufacturing involves controlling the manufacturing process using computers.

   C). Simulation is creation of computer models on the screen based on mathematical expressions. Virtual reality is generation of 3 dimensional virtual models of real world environments.

7. Robots carry out tasks that would have otherwise been repetitive, hazardous and boring to human beings.

Answer of review questions 1-2-2

8. Virtual reality is a kind of computer simulation that constructs models of real world environments. The computer user can interact with the environment by wearing special components namely:

    A)   The headgear/boom.
    B)   The glove.
    C)   The body suit.

9. A). A computer.

    B). A digital video camera attached to a computer.

    C). A network software for video conferencing.

    D). A microphone.

Field work report

- Visit one in the information and communication technology (ICT) application areas discussed in this chapter and write a detailed report of about five pages on the use of computers in the area. The report should include the following:
  - ☐ Title page
  - ☐ Table of contents
  - ☐ Introduction
  - ☐ A detailed description of information and communication technology implementation in the area of field work study
  - ☐ Conclusion

Revision questions

1. Differentiate between an electronic point of sale and a cash register.
2. Explain how computers are used in accounting systems.
3. Define the following terms:
4. Differentiate between computer aided design and computer aided manufacture.
5. Explain why computer have become important library management tools.
6. List some of the interactive sensory devices used in virtual reality.

Answer of revision questions 1

1. EPOS is connected to a computerised system hence utilizes computer's intelligence and processing power. A cash register simply records cash transactions.

2. A). Generating payroll reports.

    B). Generating ledger, balance sheets and accounts payable.

    C). Balancing books.

    D). Capturing daily transactions.

3. A). Biometric analysis: a computer system that can recognise features of human body parts like fingerprints, iris colour, facial features etc.

    B). Telex: sending/receiving of text via television.

    C). Videotex: sending/receiving of video via television.

    D). Telecommuting: working from home via a computer network instead of commuting to work.

Answer of review questions 2

4. CAD involves designing models using computers. CAM involves controlling manufacturing processes using computers.

5. A). Keeping book records and stock management.

   B). Tracking overdue books.

6. Headgear, glove and body suit.

Chapter 3
Impact of information and communication technology (ICT) on society

Introduction

- An impact is a positive or negative effect. Information and communication technology sector, like any other sector has its positive and negative effects at different levels in society.

Issues resulting from the use of ICT

- A number of issues have risen as a result of use of ICT. These issues include:

  - ☐ Effects on employment
  - ☐ Automated production
  - ☐ Issues of workers health
  - ☐ Environment issues
  - ☐ Cultural effects

Effects on employment

- The computer based information systems have altered the job market. Incorporation of computers has changed the way work has traditionally been done. Also it has its effect in employment through job creation, job replacement and job displacement.

Job creation

- ICT has introduced new employment opportunities that never existed before. The use of computers in banks, industries, communication, reservation system etc has created new jobs titles such as computer operators, programmers, network administrators, software engineers, system analysts, web administrators etc.

Job replacement

- Job replacement – this is a situation whereby certain jobs disappears in an organisation but reappears in another form requiring more and high skilled manpower e.g. copy typist using typewriters are still needed in organisations but now use computer word processor instead of typewriter.

Job displacement

- Job displacement – this is the process of replacing man power with computerized machines, their own or with the help of a few skilled and highly trained people. In most cases, the eliminated jobs are those involving monotonous and unskilled labour e.g. factory jobs can be displaced by machine like robots.

Automated production

- This involves computerization of production process in industries i.e. the use of computer aided production which does not require high manpower.

Pros of using automated production are:
- It reduces the costs of production because of the efficiency of machines.
- It leads to improved quality of services and better range of products.
- Has helped in reduction of accidents in sectors like mining and chemical production where much work is potentially hazardous.
- Efficient utilization of resources e.g. raw materials, personnel equipments hence less operating expenses are incurred.

Cons of automated production
- It may lead to unemployment in some areas that are labour intensive.
- High initial cost of setting up an automated system.

Example of automated production

A robot testing a piano

- Automated production may lead to unemployment in some areas that are labour intensive. For example, what would have been done by thirty people may be done one person using a machine. Figure right shows a robot used in the manufacture of pianos and keyboards.

Issues of workers health

- The use of ICT and computers has some effect on our health. Some of the negative effects include:
  - Repetitive strain injuries
  - Electromagnetic emissions
  - Eye strain and headache
  - Stress
  - Isolation
  - Radiation and visual display unit
  - Computer chip toxin

Repetitive strain injuries

- Repetitive strain injuries – these are injuries resulting from wrist, hand, arm and muscle strain, neck strain due to forced repetitive movement e.g. when entering data using keyboard. This can be avoided by sitting in a relaxed position and changing typing techniques.

Electromagnetic emissions

- Electromagnetic emissions – these are waves of electrical and magnetic energy that are emitted by current carrying conductors. Computer users are advised to use low emission devices in order to avoid exposing themselves to excess emissions.

Eye strain and headache

- Eye strain and headache – since computer users have their eyes at close range with the monitor, there is danger of developing the Computer Vision Syndrome (CVS). The syndrome is characterised by eye strain, headache etc. the solution to this problem is to use monitors with good resolution and fitted with antiglare screen that filters excess light, specific changes in screen brightness.

Stress

- Stress – mental stress is another compliant. Many people who work at computer feel that they are expected to produce more and do it faster because computer s themselves are fast. Also those been monitored by computers frequently feel additional pressure.

Isolation

- Isolation – people can conduct business and communication without ever coming face to face. Computer operators can work an entire shift, taking their instructions from a computer screen, sending and receiving memos to each other electronically without engaging in personal conversation. These people feel isolated from other workers.

Radiation and visual display unit

- Radiation and visual display unit – there have been reports that VDU emit radiations that causes, birth defects, blindness, cancer, miscarriages, sterility etc.

Computer chip toxin

- Computer chip toxin – workers in computer chip manufacturing industries are exposed to toxic chemicals that may pose health hazards similar to those feared from VDU

Ergonomics

- The science of designing the workplace for the comfort and safety of the worker. This is the study of how living and working conditions can be adapted to the information technology. The need for better working environment has resulted to designing of special furniture to prevent backaches, special monitors to prevent eyestrain etc.

Environmental issues 1

Energy server star

Energy server star logo

- Energy consumption and radiation – initially computers consumed a lot of energy hence generated a lot of heat and emitting electromagnetic radiation. In recent years the Environment Protection Agency (EPA) launched energy star policy to encourage minimal use of power of electronic devices.

Environmental issues 2

- Environmental pollution – it has contributed to environmental pollution e.g. garbage dumps of dead computer parts, printers, monitors etc are disposed in landfills hence causing environment pollution Nickie-Cadmium laptops batteries contain cadmium and when buried in landfills can leak into underground water tables and catchments areas.

Cultural effects

- Moral effects – it has changed the way we talk, affected our primary, human rights and integrity. Internet users are exposed to so many things e.g. watching pornographic materials, chatting online, sending dirty messages online etc that affect morals negatively. People also use computers as a tool to accomplish their vices e.g. forging documents such as certificates, passports etc.

- Computer crimes – this is the use of computers software for illegal purpose.

Types of computer crimes 1

- Data manipulation – refers to altering the data that enter or exit a computer e.g. changing data on a certificate.
- Time bomb – this is coding a computer program to destroy itself after it has been run a certain number of times.
- Computer virus – a program entered into a computer with aim of destroying or altering data and spreading the distraction to other computers.

Types of computer crimes 2

- Trap door – creating of a special password that gives its creator a sole access to the system.

- Data stealing – is using a computer to steal information that has been gathered for someone else legitimate purpose.

- Eavesdropping – tapping without authorization into communication lines over which computer data and messages are sent.

Types of computer crimes 3

- Industrial espionage – using a computer to steal designs, marketing plans or other trade secrets from one company and sell them to another company.

- Piracy – this is making unauthorized copies of copyrighted computer software.

- Fraud – this is the use of computers to cheat other people with the intention of gaining, money or information.

Types of computer crimes 4

- Sabotage – this is illegal destruction of data and information with the aim of causing great loss to organisation.

- Logic bomb – it's a program that is executed when a certain set of condition is made e.g. a fired employee can load a logic bomb to a computer to destroy when his records are updated on database.

Evolution of computer systems

- Future trends in ICT will be characterised by:

  - ☐ Rapid evolution in computer hardware and software

  - ☐ Artificial intelligence

  - ☐ Expanded information superhighway

Rapid evolution in computer hardware and software 1

- Computers will be more intelligent, computers will be able to learn in their environment, understand human voice, respond etc.
- Software will be more versatile and easier to use.
- Technology will result to cheaper and more powerful computers which will have faster processor.
- Industries will become more automated.
- More application software will be available because of high speed, large available memory for programs.
- Education will have to fear itself to training students to computer assisted services rather than teaching them physically.

Rapid evolution in computer hardware and software 2

A pocket PC that resembles a mobile phone

- Technology will result to small size computers.
- Operating system that will handle real time data analysis and object oriented will be developed.
- Will have improved user interfaces that offers users easier and more intuitive access to information

Artificial intelligence

- This is the ability of computers to think and reason like human being e.g. learning, reasoning, communicating. Seeing and hearing. To accomplish this technology a more computer speed, more powerful and more memory to accomplish this program application areas of artificial intelligence.

Application area of artificial intelligence

- Expert systems
- Natural language processing
- Voice recognition
- Voice synthesis
- Computer vision
- Neural networks
- Robotics

Expert systems

- This is software that store the knowledge of human experts and is then used as consultant in a particular field e.g. to help doctors diagnose patients.

Examples of expert system

- Mycin – used to diagnose blood and meningitis infections.

- Prospector – used in predicting mineral deposits in certain geographical sites.

- Delta – used to help people repair diesel electric locomotive.

- Xcon

Components of expert systems

- User interface – this displays screen that enables the user interact with the system.

- Knowledge base – this is the expert systems database of knowledge about a particular subject. It contains relevant facts, beliefs, assumptions and produces for solving a particular problem.

- Inference engine – is a software that applies the rules from a knowledge base in the data provided by the user to draw conclusion.

Natural language processing

- Natural language processing – this is the ability of a computer to understand human language and translate it to instructions upon which the computer can understand. The problem of natural language is that they may be ambiguous and interpreted differently by different people.

Voice synthesis

- Voice synthesis – these are machines that are able to create human voice or talk e.g. a computerized bank teller giving you your account balance in human like voice.

Voice recognition

- This is a system that will allow voice input. The user inputs data by speaking into a microphone. A few systems can't satisfactory perform this task because of:

  - ☐ Words with similar sound e.g. here, hear.

  - ☐ Different people pronounce same words differently.

  - ☐ One word has multiple meanings.

  - ☐ Computers that can recognise and read properly human voice will make information systems and other computerized applications accessible to people who can't enter data in the normal way i.e. blind, handicapped etc.

Computer vision and neural networks

- Computer vision – scientists hope to develop computers that will process and interpret lights waves just as the human brain does, such a system would use scanning devices to sense and interpret objects, graphics and text character shapes. It will allow a computer to see as human do, read and interpret text in almost any format.

- Neural networks – this is use of electronic devices and software to emulate the neurological structure of the human being. The idea is to try and emulate the cognitive learning process of the human brain and how it recognises patterns. Artificial neural networks work similar manner by perceiving stimuli and hence decide whether to pass it on to the system or not.

Robotics

Robot ASIMO
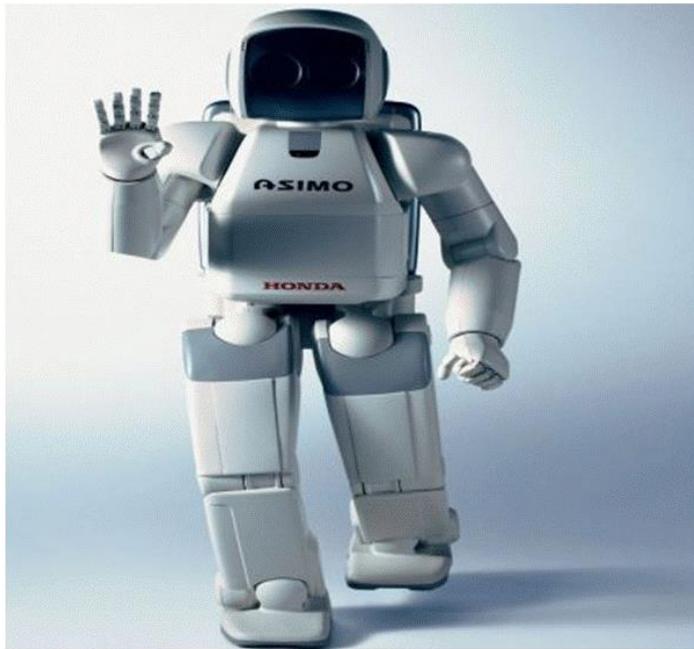
■ A robot is a computer controlled device that emulates human being in carrying out tasks that would otherwise be dangerous and difficult. Robots are mainly used for simple repetitious tasks on industries also in dangerous jobs. Researchers are coming up with robots that will incorporate perception systems i.e. a robot that will sense, feel shapes of objects, listen to ultrasound, detect smell etc.

Expanded information superhighway

- This involves the integration of cables and wireless technologies for the purpose of data and information transmission. Fibre optic cables are used to carry millions and millions of data items per second.

Review questions 1

1. Explain at least three effects of introduction of ICT in workplaces.

2. List three advantages and two disadvantages of automated production.

3. Describe some of the effects of ICT on human health.

4. Why is there concern on the disposal of Nickel-cadmium batteries?

Answer of review questions 1

1. A). Job replacement: workers without IT skills are replaced by computerised machines and people who have the skills to operate the machines.

   B). Job displacement: employees moved to another department where IT skills are not needed.

   C). Job creation: new jobs are created.

2. A). Advantages of automated production.
   A) Efficiency, increase in production.
   B) Productivity increases in work place.
   C) Cost effectiveness.
   D) Improved communication.

   B). Disadvantages of automated production
   A) Unemployment.
   B) Data and information insecurity.
   C) Over reliance on ICT may cause a disaster if systems go down.

Answer of review questions 2

3. A). Repetitive strain injuries.

   B). Exposure to radiation.

   C). Eye strain and headaches.

   D). Pollution of environment due to dumping of ICT related components like batteries.

4. Nickel-cadmium battery contents are not biodegradable hence may seep down to the underground water table causing poisoning.

Revision questions

1. Explain the effects of ICT on employment.
2. Explain how the use of ICT may affect health and the environment.
3. Explain the role of Environmental Protection Agency (EPA).
4. Define the term flaming.
5. Why should a parent be concerned when a child requests oftenly to be given some money to go and browse Internet in a cyber cafe?
6. (   ) is an electronic device designed to emulate the human nervous system.
7. Explain the four main areas of artificial intelligence.
8. Give a reason why success in natural language processing is important.
9. Define the term robot.
10. Describe the features and capabilities of an intelligent robot
11. Briefly explain the possible features of microcomputer and information technology in a few years to come.
12. Briefly explain the concept "information superhighway", its services and potential growth.

Answer of revision questions 1

1. Effect on employment – job creation, replacement and displacement.
2. Effect of ICT on:
   A) Health – repetitive strain injury, eye strain, headaches and electromagnetic emissions.
   B) Environment – energy consumption, pollution etc.
3. Environmental Protection Agency (EPA) launched the energy star policy to encourage minimal use of power by electronic devices.
4. Flaming refers to the use of derogatory, obscene or dirty language.
5. Because the child might have discovered some dirty sites e.g. on pornographic materials that are likely to affect the child morally.
6. Artificial neural networks.
7. Main area of artificial intelligence.
   A) Expert systems.
   B) Natural language processing.
   C) Artificial neural networks.
   D) Robots.

Answer of revision questions 2

8. This will make data processing task faster.
9. A robot is an automated device used to perform tasks that are difficult and dangerous to a human being.
10. An intelligent robot has artificial senses that emulate the five common senses of a human being. (this is an open question that seeks to test whether students have any vision of ICT in future).
11. Sublimation of ICT into a totally intelligence driven capacity with devices that can emulate or simulate human communication, speech, reasoning, learning and performance.
12. Information superhighway mainly deals with communication of data and information on a large scale based on cable networks and more sophisticated wireless communication. It is aimed at making communication more efficient and reliable.
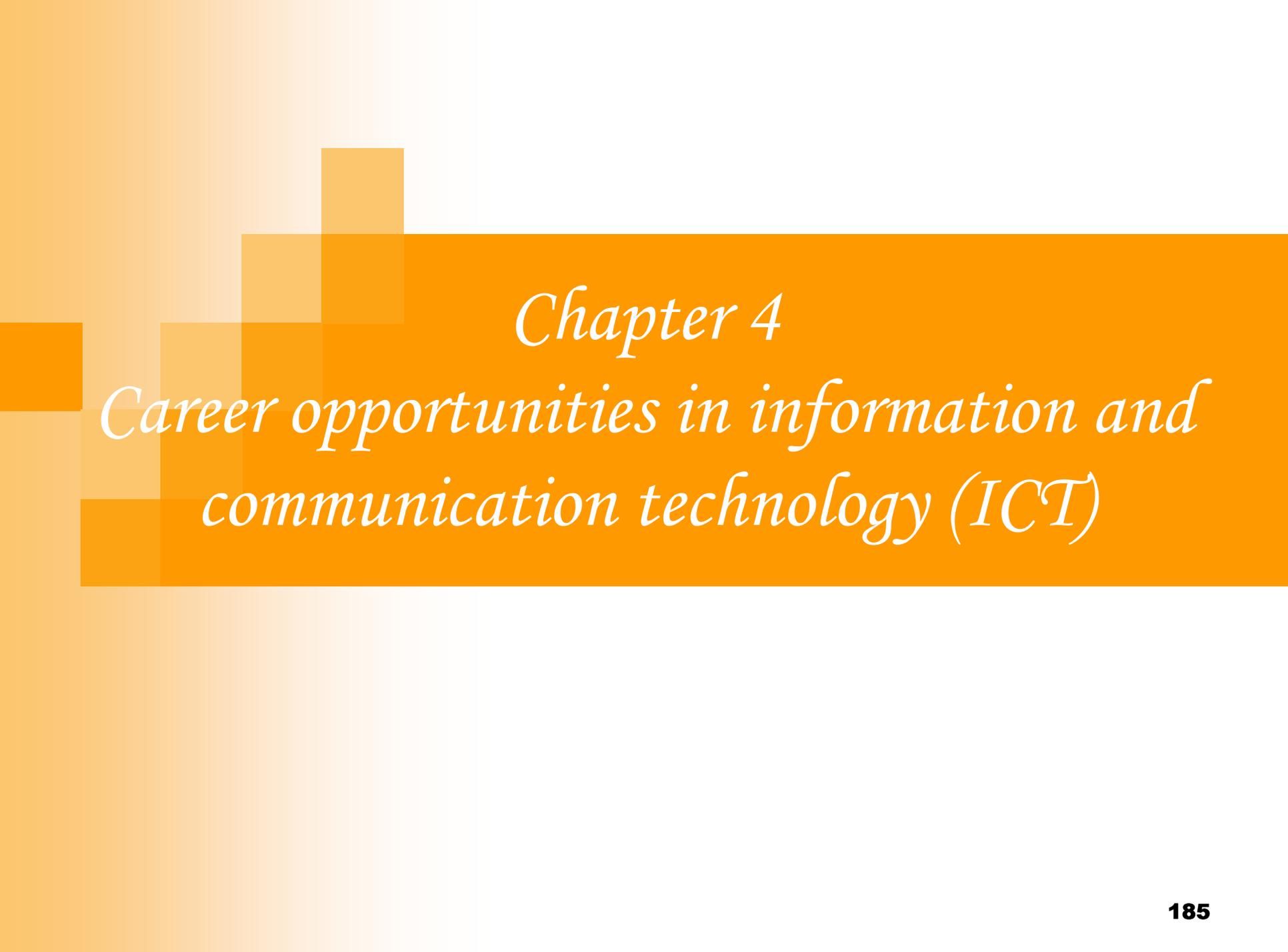
Chapter 4
Career opportunities in information and communication technology (ICT)

Introduction

- ICT has created new job titles. Some of the computer career opportunities include:

  - System analysts
  - Chief programmer/programming manager
  - Computer programmers
  - Database administrator (DBA)

  - Software engineer
  - Computer engineer
  - Web designers
  - Computer operator
  - Computer technician
  - Duties processing manager
  - Information system manager
  - Computer trainer
  - Network administrator
  - Computer typesetters
  - Librarian

System analysts

- This is a person who is responsible for analysing a company's needs or problems then design and develop a computer based information system.

Qualities of a good system analysts

- Should have good problem solving skills and creativity.
- Should have good communication skills.
- Must have business knowledge.
- Trained as analyst.
- Have general knowledge of the firm including its goals, objectives.
- Should have knowledge of data processing methods and current hardware and familiarity with available programming language.

Duties of a system analyst

- Gather, record and analyze facts of the systems.
- Design new system and recommend changes to existing systems.
- Prepare instructions manuals.
- Co-ordinates training for users of new system.
- Work with programmers to construct and test the system.
- Prepares system specifications.
- Co-ordinates the implementation of new or modified system.

Chief programmer/programming manager

- He reports to data processing manager what has been reported by programming group, junior and senior programmers.

Duties

- Managing the programmers.
- Liaising with chief system analyst.
- Review and control program documentation.
- Reviews programs performance.
- Ensures that all programme are well tested before put into use.
- Reviewing all the system specifications before handover to programmers.

Computer programmers

- These are people whose work entails coding i.e. formulating instructions for the computer to solve given problems.

Qualities of programmers

- Good command of programming language in use.

- Knowledge of general programming methodology and relationship between programs and hardware.

- Creativity for developing new problems solving methods.

- Patience and persistence.

Duties of programmers

- Coding computer program using appropriate programming language.
- Testing of programs for logical errors, syntax errors and semantic errors.
- Debugging of programs.
- Documenting programs i.e. program manuals.
- Designing and implementing programs.
- Maintaining and reviewing existing computer programs.

Database administrator

- This is a person responsible for the design and implementation of the database.

Duties

- Responsible for the design and control of organisation database.

- Controls and monitors database usage through assignment of user passwords.

- Keeping the database up-to-date by adding new records, modifying or deleting unnecessary records.

- He establishes the appropriate content and format of data records.

Software engineer

- This is a person who is killed in software development and technical operation of computer hardware.

Duties

- Developing system and application software.

- Developing user and technical documentation for the new software.

- Maintaining and updating the software to meet day-to-day requirements.

Computer engineer

- These are specialized personnel whose duties are to assemble the computer systems.

Duties

- Design and develop computer components e.g. motherboard, storage devices etc.
- Design and develop engineering and manufacturing computer controlled devices such as robots.
- Re-engineer computer components to enhance its functionality and efficiency.

Web designers

- Web designers design website using various software tools. These webs contains pages where individuals and organisation can advertise themselves when promoting the products.

Web administrators

- He administrate the web organisation, websites by making sure the website is updated periodically to give the right information.

Duties

- Developing and testing websites.
- Monitoring the access and use of Internet connection by enforcing security measures.
- Downloading information needed by an organisation from Internet website.
- Maintaining, updating and modifying information on the website.

Computer operator

- This is a person who interfaces the user demands to the computer hardware by use of set of special instructions known as commands.

Duties

- Entering data into the computer for processing.
- Keeping up-to-date records of all information processing activities.
- Responsible for the general equipment layout within the computer room.
- Activating the computer to obey programs through use of commands.
- Mounting the storage media e.g. disk to their drives.

Computer technician

- These are member of the technical staff whose job is service and repair computers.

Duties

- Troubleshooting computer hardware and software related problems.
- Ensuring that all computer related accessories such as printers, storage media etc are in good condition.
- Assembling and upgrading computers and their components.

Data processing manager

- This is the person in the data processing department within the organisation. His major duty is to ensure that the organisation's needs are met.

Duties and responsibilities

- In charge of data and information flow within the department.
- Responsible in data collection and preparation.
- Purchase of hardware and other facilities and their management.
- Software development and maintenance.
- Assessment and evaluation of staff performance.

Information system manager

- This person controls, plans, staffs, schedules and monitors all the activities of the ICT department in the organisation.

Responsibilities

- Making sure that all tasks in the IT department are done correctly and on time.

- Preparing budgets for the departments.

- Keeping the department inventory records up-to-date.

- Managing the human resource within the department.

Computer trainers

- These are specialized personnel in the field of computing, well conversant with various disciplines and computer related issues, which they can execute with ease for those who are first venturing into this field.

Duties

- Training people on how to use a computer and various application programs.
- Developing training reference materials.
- Guide learners on how to acquire knowledge through carrying out research.
- Preparing learners for ICAT examinations.

Network administrator

- This is a specialist who oversees the smooth running of network systems in an organisation.

Responsibilities

- Set-up a computer network.

- Maintain and enforce security measures on network.

- Monitor the use of network resources.

- Maintain and troubleshoot network rekated problems.

Computer typesetters

- Graphic designers and typesetters are required in order to design graphical objects and profession publications e.g. books, newspapers, magazines.

Librarian

- He is responsible for keeping the files in various storage devices. He is responsible for the physical security of storage media.

Duties

- Ensures that there are enough physical files available for use.

- Maintains the external files labels.

- Ensures duplicates files are kept.

- Ensures access of files is restricted to authorised persons.

Further educational opportunities in ICT

- There are other areas in computing where one would further his or her educational ambitions. These areas include institutions such as colleges, university, polytechnics, institutions etc.

ICT courses offered in tertiary institutions

- University
  - ☐ Public university
  - ☐ Private university

- Polytechnics

- Colleges

University

- This is considered as the highest institution in formal education. There are two categories of universities.

  - Public university – they are established by the state through the award of a charter and are run by a state appointed management team.
  - Private university – they are self sponsored institutions set up by individuals, churches or any other organisation.

Examples of university that offer ICT courses

■ *Public university*

- ☐ Jomo Kenyatta University of Agriculture And Technology (JKUAT)
- ☐ Kenyatta university
- ☐ Nairobi university
- ☐ Maseno university
- ☐ Moi university
- ☐ Egerton university

■ *Private university*

- ☐ Daystar university
- ☐ Catholic university Nazareth
- ☐ Kabarak university
- ☐ AUSI university

■ University are authorised to offer approved diploma, undergraduate and post graduate programmers.

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ICT related degree programmes

- Bachelor of computer science.
- Bachelor of information technology.
- Bachelor of science in computer engineer.
- Bachelor of computer networking.
- Bachelor of software engineering.
- Bachelor of business and information technology.
- Bachelor of science in information technology.
- Bachelor of computer programming.

ICT related masters programs

- Master in computer science.

- Masters in information technology.

- Masters in hardware engineering.

- Masters in science computer engineer.

Polytechnics

- They are institutions of higher learning that mostly offer diploma and certificate courses in technical fields like ICT.

Examples of polytechnics that offer ICT courses

- Mombasa polytechnic.
- Kenya polytechnic.
- Eldoret polytechnic.

ICT courses offered in polytechnic

- The courses can be diploma or certificate in the following lines.
    - ☐ Computer repair and assembly.
    - ☐ Computer operator.
    - ☐ Management information system.
    - ☐ Computer programming.
    - ☐ Computer networking.
    - ☐ Computer software engineer.
    - ☐ Computer studies.
    - ☐ Information technology.
    - ☐ Computer science.
    - ☐ Computer hardware engineer.
    - ☐ Web administrator.

Qualifications gained on study on sitting for an exam

- Diploma in computer studies, computer science, information technology etc.

- Higher diploma in computer studies, information technology etc.

- Certificate in computer studies, information technology etc.

Colleges

- This is middle level that offer diploma, certificates and craft courses in ICT and other fields.

NB: qualifications are same as the ones for polytechnic.

Examples of colleges

- Rift valley of science and technology.
- Kaiboi technical training institute.
- Thika institute of science and technology.
- Kiambu institute of science and technology.
- Coast institute of science and technology.
- Kirinyaga technical training institute.
- Nairobi technical training institute.
- Nyeri technical training institute.
- Kenya technical training institute.
- Kenya science teachers college.
- Machakos technical training institute.

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Examinations bodies for higher diploma, diploma and certificates

- Information Technology Standards Association (ITSA)

- Institute of Management Information Systems (IMIS)

- Kenya National Examination Council (KNEC)

- PITMAN

Factors to consider before joining a college to pursue ICT course

- Whether if offers ICT courses recognised both locally and internationally.

- The cost of training with such institution.

Review questions

1. Explain the role of the following ICT specialists:
   A) Database administrator.
   B) Software engineer.
   C) System analyst.
   D) Computer technician.
   E) Information systems manager.
2. Differentiate between a system analyst and a programmer.
3. Outline the roles of a network administrator.
4. Differentiate between a software engineer and a computer engineer.
5. List three types of job opportunities that are available in the field of computer hardware.

Answer of review questions 1

1. A). Database administrator – designs, develops, updates and maintains information system database.

   B). Software engineer – develops and updates software.

   C). System analyst – analyses, designs and develops information systems.

   D). Computer technician – troubleshoot computer hardware and software problems.

   E). Information system manager – managing ICT operations.

- A system analyst is mostly responsible for analysing the weaknesses of the existing system and designing an alternative system while a programmer mainly writes computer programs based on the system requirements.

Answer of review questions 2

3. A). Setting up a computer network.

   B). Securing the network against unauthorised access.

   C). Managing the network to enhance performance and uptime.

   D). Monitoring use of network resources.

4. Software engineer develops software/programs as per requirements. Computer engineer designs computer hardware and improves on existing ones.

5. Job opportunities in computer hardware:

   A) Computer engineer

   B) Computer repair and maintenance

   C) Computer assembling

Revision questions

1. Give at least six examples of public and accredited private universities that offer computer related courses in Kenya.
2. Identify at least three ICT related courses offered at
   1. University level
   2. Polytechnic level
   3. College level
3. Define the term accreditation as used in education.
4. Identify ICT courses you would enrol in at the postgraduate university level.
5. Identify three national polytechnics that offer ICT courses in Kenya.
6. Identify at least three colleges that offer computer science as a subject at diploma level.
7. State and explain some of the factors you would consider before enrolling for an ICT course in a college.

Answer of revision questions 1

1. A). Moi university
   B). Nairobi university
   C). Kenyatta university
   D). Jomo Kenyatta university of agriculture and technology
   E). Catholic university
   F). Daystar university
   G). Baraton university
2. A). University level:
   i. Bsc. Computer science
   ii. Bsc. Information technology
   iii. Msc. Information systems

B). Polytechnic level
   i. Diploma in information technology.
   ii. Diploma in computer hardware maintenance.
   iii. Diploma in computer programming.
C). College level
   i. Diploma in information technology
   ii. Certificate in information technology
   iii. Diploma in education (computer science).

Answer of revision questions 2

3. Accreditation is the process of recognising an institution as being able to offer degrees and diplomas.

4. A). Msc. information system /Ph.D

   B). Msc. Information technology /Ph.D

5. National polytechnics in Kenya are Kenya polytechnic, Mombasa and Eldoret Polytechnics.

6. Colleges that offer compute science as a teaching subject at diploma level are Kenya Science, Kagumo Teachers College, Kenya technical Teachers College etc. (The list is not exhaustive).

7. Factors to consider when enrolling for ICT course in a college:
   A) Cost
   B) Job opportunities
   C) Whether the examinations offered are recognised etc.
   D) The organisation offering the course.

END