COMPUTER STUDIES NOTES

FORM 4 SIMPLIFIED VERSION

QUICK REVISION NOTES

An Updated Well-Organized Detailed Revision Notes for the Current Form 4 Syllabus.

SERIES 1

THIS IS A FREE SAMPLE OF THE ORIGINAL NOTES

CONTACT US FOR FULL VERSION OF THE NOTES

Mr Isaboke 0746 222 000

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00100

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0746-222-000

mwalimuconsultancy@gmail.com

Mwalimu Consultancy Ltd.

INTRODUCTION TO NETWORKING AND DATA COMMUNICATION

INTRODUCTION

A computer network forms whenever 2 or more computers are interconnected together with other related accessories to work together.

Non computer networks include:

a) Road networks that facilitate transfer of goods and services.

b) Telephone networks (voice networks) with many lines that criss cross a country.

c) Blood circulatory system in the human body.

d) The neuron system in the human brain.

DEFINITION OF TERMS USED IN NETWORKING

1. COMPUTER NETWORK

- A collection of independent entities that are arranged in such a manner as to exchange data, information or resources.
- A collection of computers linked together using transmission media for the purpose of communication and resource sharing.

2. TRANSMISSION MEDIA

- Transmission media refers to any physical or non-physical link between two or more computers and in which a signal can be made to flow from source to destination.
- Some of the shared resources include:

a) Application programs.

b) Printers.

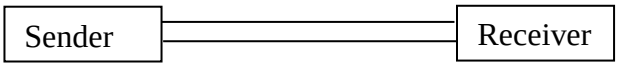
c) Fax machines.

d) Modems.

e) Storage devices.

3. DATA COMMUNICATION

- It is the process of transmitting data signal from one point to another through the network.
- It is the movement of data by telecommunication systems.



TERMS USED IN DATA COMMUNICATION

1. Data signal.
2. Signal modulation and demodulation.
3. Multiplexing.
4. Band width.
5. Base band.
6. Broad band transmission.
7. Attenuation.

1. DATA SIGNAL

- Computers communicate by transferring data signals between themselves.
- Refers to a voltage level in the circuit which represents the flow of data.
- There are two types of data signals:

a) **Analog signal**: data made up of continuous varying wave form similar to voice or sound wave.

b) **Digital signal**: data made up non-continuous discrete signal.

2. SIGNAL MODULATION AND DEMODULATION

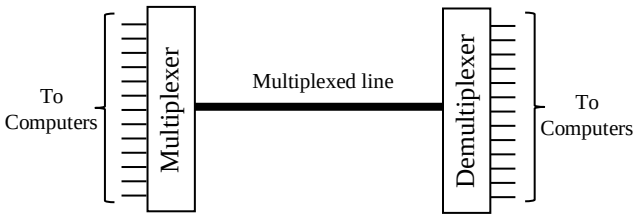
- Process of converting data signals to a form that is suitable for transmission over a transmission medium.

a) **Modulation**: converting digital data signals into analog data signals.

b) **Demodulation**: converting digital data by superimposing it on analog carrier signal which can be transmitted over analog telephone lines.

3. MULTIPLEXING

- Process of sending multiple data signals over the same medium i.e. a wire conductor can be made to carry several data signals either simultaneously or at different times.
- Demultiplexing is the process of separating the multiplexed signals at the receiving end.
- The different data signals are made to have different frequencies on the cable hence they do not interfere with one another.
- The different frequencies cause what is called different logical channels in the medium.



A multiplexed link

4. BAND WIDTH

- The maximum amount of data that a transmission medium can carry at any one time. For example, a certain cable may have a bandwidth of 100 Mbps (Mega bits per second).

5. BASE BAND SIGNAL

- A signal that is generated and applied to the transmission medium directly without modulation.
- The signal takes the form of voltages of different magnitudes applied to the medium.

6. BROAD BAND TRANSMISSION

- This is where an analog signal is send over the transmission medium using a particular frequency.
- Several data signals can be send simultaneously through the same medium but at different frequencies.

7. ATTENUATION

a) This is the loss of signal strength (decrease in magnitude and energy) as a signal progressively moves along a transmission medium.

b) If the signal is not boosted, it will totally be lost along the way and may never reach the destination.

c) This condition is usually corrected by placing signal amplifiers also called repeater stations along the medium at appropriate distances in order to receive the weak signal, clean it, amplify it then retransmit it.

MODES OF DATA COMMUNICATION

1. Simplex.
2. Half duplex.
3. Full duplex.

1. SIMPLEX

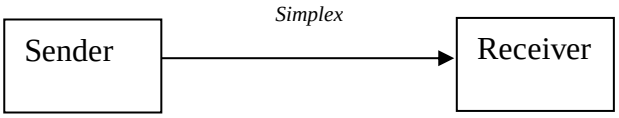
- Communication is only in one direction.
- They re only meant to send or receive messages.

Example

a) Radio broadcast – the listener cannot communicate back through the radio receiver.

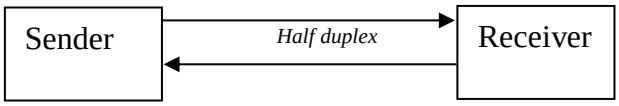
b) Television broadcast.

c) Transmission from a computer to a line printer.



2. HALF DUPLEX

- Communication takes place in both directions but one direction at a time.
- Two interconnected devices exchange data alternately where the devices switch between send and receive modes after each transmission.

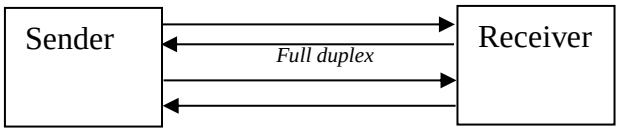


Example

1. Walkie talkies
2. Fax machines.
3. Modems.

3. FULL DUPLEX

- Occurs in both directions simultaneously.



Example:

a) Telephone system, a person can talk without waiting for the other to finish.

b) Computers can send and receive data on a network.

TYPES OF COMPUTER NETWORKS

1. Local Area Networks (LAN)
2. Metropolitan Area Network (MAN)
3. Wide Area Network (WAN)

Classified according to size.

1. LOCAL AREA NETWORK

- A communication network that spans a relatively small geographical area like in one building or a school.
- LANs are characterized by:

a) Limited geographical area.

b) High data transmission rates.

c) Low cost transmission

d) Low intra-office traffic.

- LANs allow information and computer resources to be shared by many users e.g.

a) Mass storage devices.

b) Processors.

c) Printers.

d) Plotters.

e) Software.

LANs are also characterized by the following components:

a) Server.

b) Work stations.

c) Network interface cards (NIC)

d) Network transmission cables.

e) Network operating systems.

f)Network accessories.

A. SERVER

- A computer dedicated to servicing requests for resources from other computers (workstations) on a network.
- The server provides services to LAN users.

B. WORK STATIONS

- Any other computer connected to a network and can share resources with any other devices on the network.

2. METROPOLITAN AREA NETWORK (MAN)

- Type of a network which covers a geographical extended fashion area like a town or city (approximately a radius of 5 – 50 km).
- The MAN infrastructure may be owned by a single company that has offices across a metropolitan area.
- A MAN therefore is made up of many LANs in a metropolitan area.

3. WIDE AREA NETWORK (WAN)

- Also known as Long Haul Network (LHN).
- It is a type of a network that covers a large geographical area such as a country, a continent or the whole world.
- It consists of many LANs and Mans connected to form one large network such as the Internet.

CHARACTERISTICS OF WANs

a) Unlimited geographical area.

b) Low data transmission rates.

c) High transmission link costs.

d) Long distance transmission.

e) High degree of vender independence.

f)Costly to install and maintain.

PURPOSE AND LIMITATIONS OF NETWORKING

- These are the reasons for setting up computer networks, together with the challenges associated with the implementation of the computer networks.

PURPOSE OF NETWORKING

1. Resource sharing

2. Remote communication.

3. Distributed processing facilities.

4. Cost effectiveness.

5. Reliability.

1. *Resource sharing*

- Resource refers to data/information, files, printers, modems, communication links, storage devices, fax machines, application programs etc.
- As long as computers are connected, they can share their files, exchange mail, send faxes from any point on the network.
- Users do not need to transfer files via removable storage but would send the work to a network printer.
- The centralized access to data and information leads to less waste of time and hence greater productivity.
- In most network arrangements, the shared resources may be attached to a network server.
- The clients/workstations then send their requests to the server.
- The network server runs a special program (server software) which controls computers on the network and listen to client requests to service them over the network. – Illustration Page 6

2. Remote communication

- Refers to the transmission of data signals between the communicating devices located at different geographical locations.
- A remote client (a computer that accesses resources) from a remote host (the computer being accessed) provides remote communication mostly by use of wireless transmission media such as radio waves, microwaves and satellites.
- It is through remote communication that people can be able to share ideas and pass messages over the Internet.

- Remote communication thus eliminates the need of people to travel/roam for long distances by giving them a lot of freedom to the network which translates to more productivity.

3. Distributed processing facilities

- Refers to the act of running the same programs or databases on different computers which are on the same network.
- Computers can do processing at their own dispersed locations or departments and can share programs, data and other resources with each other.
- It simplifies flow of information and saves time and resources.

Advantages of distributed data processing:

a) The failure of the central computer does not affect the operations of the other terminals.

b) Processing load is shared equally hence no time wastage.

4. Cost effectiveness

- Although the initial cost and laying down of network components may be expensive, the savings experienced and the value added to service delivery make them a ready choice for enterprising managers.
- The network greatly increases the efficient use of scarce resources.
- Networks have also enhanced daily communication by providing a paperless communication environment.
- Users can send electronic messages and mail to each other instead of having to bear the cost of stamp duty or delivery charges.
- Company executives may not need to travel across continents to hold meetings. They can hold video conferences and save on traveling expenses.

5. Reliability

- Data can be transferred with minimum error from source to destination.
- Users can still access data and information from the other computers on the network incase one breaks down.

LIMITATIONS OF NETWORKING

1. Security issues.

2. High initial cost.

3. Moral and cultural effects.

4. Spread of terrorism and drug trafficking.

5. Over-reliance on networks.

1. Security issues

- Data and information is prone to more illegal access threats because there can be data access and sharing from various points.
- Data can also be tapped or listened to by unauthorized parties, during transmission of data from source to destination.
- One of the common methods of data protection in a networked environment is encryptioning.

2. High initial cost

- Networking is an expensive venture for an organization.
- It is expensive to acquire networking equipments.
- It is expensive to train network administrators, users and general maintenance of networks.
- The initial cost of buying network hardware and software is very high.

3. Moral and cultural effects

- The internet has chat rooms and messaging services that may enable under age children to meet peers and adults on the net, some of whom may have bad intentions.
- Access to pornography and other negative materials has also led to moral decay, leading to the fight against social problems like HIV/AIDS, bad sexual behaviour, drugs and substance abuse more complicated.

4. Spread of terrorism and drug trafficking

- The internet provides a rich recruitment ground for all types of illegal activities such as terrorism and drug trafficking.
- The easy flow of information from one place to another keeps even those who are on the wrong side of the law communicating easily.
- Terrorists and drug traffickers use information networks for their business communications.

5. Over-reliance on networks

- The danger of network failure can paralyze the operations of an organization besides damaging files.
- If by any chance the network fails, many systems in organizations can be brought to a halt.

ELEMENTS OF NETWORKING

A computer network is made up of several standard elements (components) which can be classified into 3 major categories:

1. Data communication media.
2. Communication devices.
3. Networking software.
4. Data signal.

1. DATA COMMUNICATION MEDIA

- A pathway used for carrying data and information from one point to another.
- The communication medium dictates the type of signals that will be used to transmit a message.
- Transmission media is the physical path (bounded) and non physical path (unbounded) between the transmitter and the receiver.
- The communication media/channels/pathways can be divided into two:

a) Communication using cables (bounded media).

b) Wireless communications (unbounded media).

A. COMMUNICATION USING CABLES (BOUNDED MEDIA)

- Communication signals are transmitted from the source to the destination through a restricted pathway such as a cable.
- Any radiation from the guided medium is regarded as signal loss.
- The most common types of bounded transmission media are:

i) Two wire open line cables.

ii) Twisted pair cables.

iii) Coaxial cables.

iv) Fibre optic cables.

I) TWO WIRE OPEN LINES CABLES:

- Made up of two parallel copper wires separated by a plastic insulator.
- Used in telecommunication network to transmit voice signal.
- Although the plastic insulator is meant to reduce inter-line interference called crosstalk, their linear nature allows an electromagnetic field to build around them during heavy data transmission which may cause interference to the signal.
- The wires also capture environmental frequencies e.g. radio waves hence causing noise in the transmission channel.
- Noise refers to random unwanted signals picked up by the channel.

Two wire open lines cables

- The most significant impairments during data transmissions are:

a) Attenuation: the loss of signal strength (amplitude) as is travels along the cable.

b) Cross talk: caused by signal coupling between the different cable pairs contained within a multipair cable bundle i.e. interline interference.

c) Noise: Random unwanted signals picked up by the channel, caused by either cross talk or externally included impulses e.g. from sources like motors, switching equipments, high current equipments etc.

d) Impendence: this is the resistance offered by the cable to the signal.

II) TWISTED PAIR CABLES

- Made up of two solid copper wire strands wound around each other in a double helix manner to reduce the development of an electromagnetic field around the two wires as they transmit data.
- Mostly used to transmit both voice and data signals.
- The two common types of twisted pair cables are:

a) The unshielded twisted pair (UTP)

b) Shielded twisted pair (STP)

a) Unshielded Twisted Pair (UTP)

a) They do not have a shield that prevents electromagnetic interference (EMI) also called (electric noise" from the environment like lightening sparks, radio signals and radiations from spark plugs in motor vehicles.

b) They are therefore not suitable for environments that are electrically "noisy".

b) Shielded Twisted Pair (STP)

- Similar to unshielded twisted pair except that a braided shield is wrapped around the wires to protect (shield) them from noise.
- The shielding may be a metallic foil or copper braid.
- Shielding minimizes electromagnetic interference (EMI) or radio frequency interference.
- Twisted pair cables are categorized into 5 groups according to the type of data transmitted and maximum rate of transmission as shown below:

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

KEY:

- Mbps – Megabits per second.
- Today's networks are approaching speeds of Gigabits per second.
- Most organizations today use category 5 twisted pair cables to set up their local area network.

Advantages of twisted pair cables:

a) They can support high data rates (bandwidth) of up to 100 Mbps.

b) Telephone systems use UTP which is present in most buildings hence it is easier to set up a network media because connection is already available.

c) Installation equipment is cheap and readily available.

d) It is cheap because of mass production for telephone use.

Disadvantages of twisted pair cabling

a) Suffers high attenuation – a repeater is needed to amplify the signal.

b) It is sensitive to electromagnetic interference and eavesdropping (tapping into communication channels to get information).

c) It has low data transmission rates as compared to other cables.

III) COAXIAL CABLES

- Specially wrapped and insulated cables that are able to transmit data at very high rate.
- They consist of central copper wire covered with a dielectric material (insulator).
- The dielectric material is then surrounded by a hollow mesh conductor which is covered by a shield making the cable more resistant to electromagnetic interference than the twisted pair cable.
- The signal is transmitted by inner copper wire and is electrically shielded by the other copper sleeve.
- The braid (mesh conductor) is made up of copper or aluminum and serves as the ground for the carrier wire.
- Together with the insulation and any foil shield, the braid shield protects the carrier wire from radio frequency interference (RFI) and electromagnetic interference (EMI).
- Although the cable has better protection against electrical interference than the TCP, they have moderate protection against magnetic interference.
- The diameter of the centre core or conductor determines the attenuation rate i.e. the thinner the core, the higher the attenuation rate.
- Data is carried on this cable using direct current (DC).
- Coaxial cables have bandwidths of up to 1Gbps, hence they are installed in a network to form the network backbone (a link that connects two or more separate local area networks).

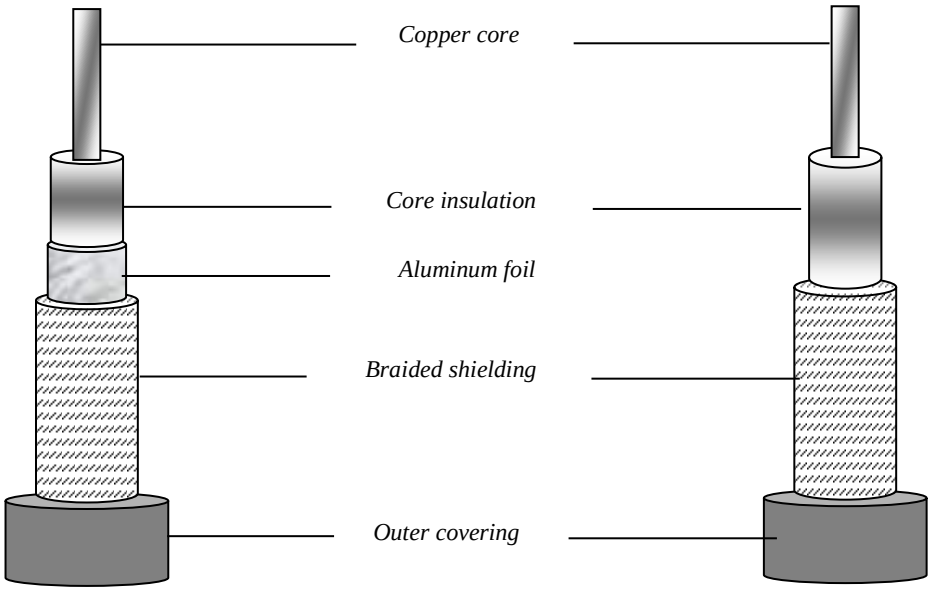
Types of coaxial cables:

a) Thin coaxial cable (Thinnet)

- Has one dielectric insulator.

b) Thick coaxial cable (Thicknet)

- Has two dielectric insulators around the core and is thicker than the thinnet.



a) Thinnet *a) Thicknet*

Advantages of coaxial cables

1. They are very stable even under high load.

2. Have a large bandwidth – up to 1Gbps compared to twisted pair.

3. Can carry voice, data and video signal simultaneously.

4. More resistant to radio and electromagnetic interference than twisted pair cables.

5. Extensively used for longer distance telephone lines and as cables for closed circuit TV.

6. Many are packaged in bundles that can handle 15000 telephone calls simultaneously.

7. Have a higher immunity to noise distortion and data loss.

Disadvantages of coaxial cables

1. Thick coaxial cables are hard to work with.

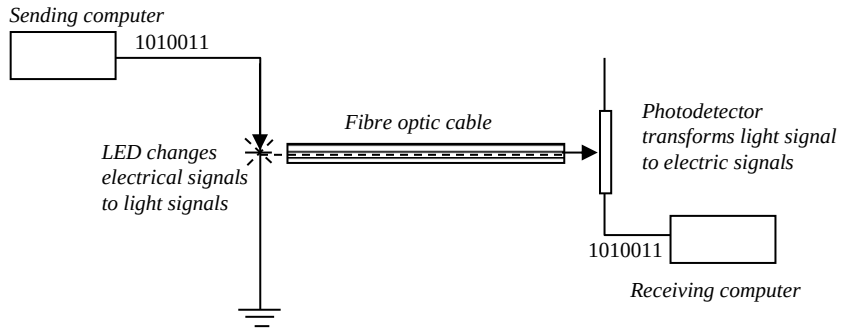
2. They are relatively expensive to buy and to install as compared to twisted pairs especially for longer distance transmission.

3. They are vulnerable to tapping.

4. Attenuation for long distance transmission.

IV) FIBRE OPTIC CABLES

- Utilize light (optic) to transmit data from one pint to another on the network.
- Electrical signals from the source are converted to light signals, and then propagated along the fibre optic cable.
- To convert an electric signal to light, you need a light emitting diode (LED) at the transmitter.
- At the receiving end, a photosensitive device can be used to convert the light signals back to electric signals that can be processed by the computer.



Fibre network.

Types of fibre optic cables

a) Single mode fibre.

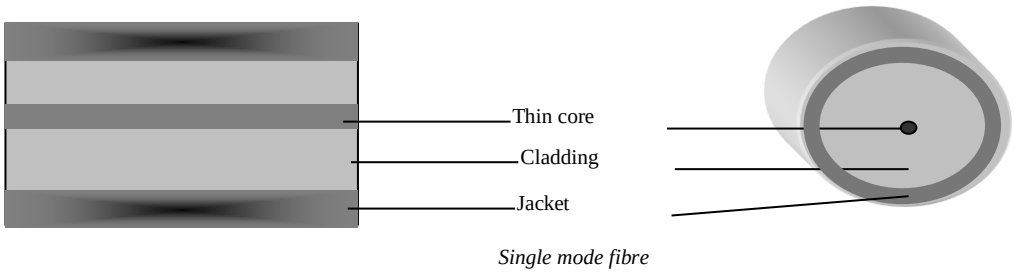
b) Multimode fibre.

a) Single mode fibre

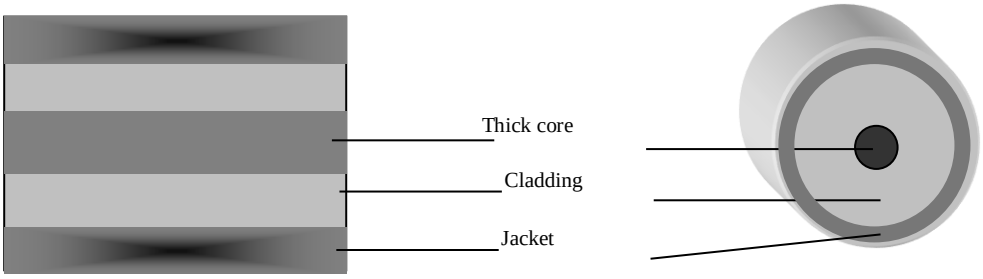
- Has a very narrow center core.
- Light in the cable can only take one path through it.
- Has a low attenuation rate.
- Preferred for long distance transmission.
- Has a bandwidth of 50 Gbps which is higher than that of the twisted pair's 100Mbps.
- It is very expensive.
- Requires very careful handling during installation.

b) Multimode fibre cable

- Has a thicker core.
- Allows several light rays to be fed in the cable at an angle.
- Distortion of signals is possible because of multiple light signals navigating the cable at the same time.
- Have a high attenuation rate.
- Usually used for shorter distances than single mode.



Single mode fibre



Multimode fibre

- Light signal travels through the core through a process referred to as total internal reflection.
- The process that causes total internal reflection is called refraction.
- Refraction is the bending of light when it crosses the boundary of two mediums that have different density.
- When light signal is inserted into the cable, it rises to cross from the core to the cladding.
- The light is bent back into the core hence propagates along the length of the cable as shown below:

The fibre optic cable is made up of:

a) The Core.

b) Cladding.

c) Buffer

d) Strength member.

e) Jacket.

a) The core:

- The central part of the cable made of a hollow transparent plastic glass.

b) Cladding:

- a single protective layer surrounding the core. It has light bending characteristics.
- When light tries to travel from the core to the cladding, it is redirected back to the core.

c) Buffer:

- Surrounds the cladding and its main function is to strengthen the cable.

d) Jacket:

- It is the outer covering of the cable.

Advantages and features of fibre optic cables

1. Offer high quality transmission of signals.

2. Light weight – a normal glass fibre is the size of a human hair.

3. Can transmit voice, data and video signals simultaneously.

4. Have a large bandwidth (up to 1Gbps).

5. Low cross talk.

6. Immune to interference and eavesdropping.

7. More resistant to radio and electromagnetic interference.

8. Long distance can be covered because they have low attenuation.

9. Can be used in hazardous places – high flammable, because the do not generate electrical signals.

10. Can withstand extreme temperatures – up to 1000^0C.

Disadvantages of fibre optic

1. Connectivity devices and the media are expensive.

2. Installation is difficult because the cable needs careful handling.

3. Relatively complex to configure.

4. A broken cable is difficult and expensive to repair.

5. Expensive for shorter distances.

6. Prone to water seepage and freezing.

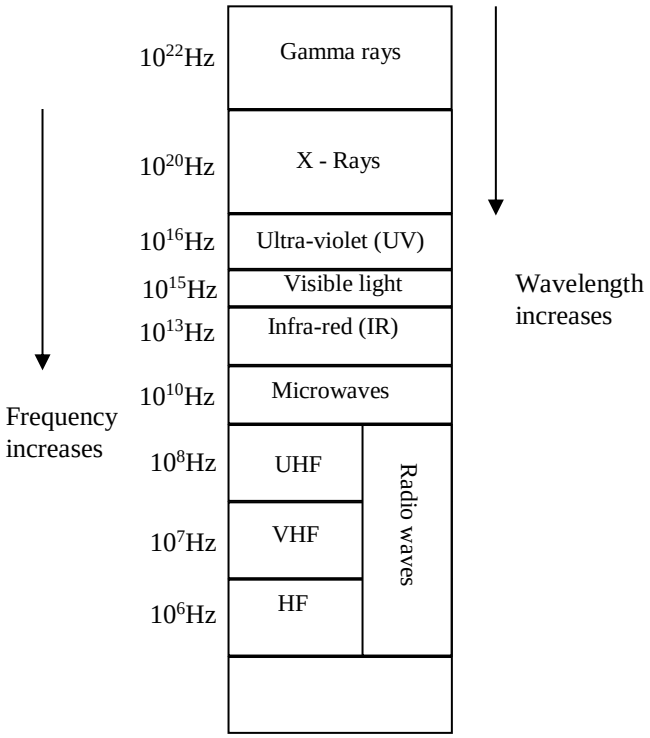
B. WIRELESS COMMUNICATION (UNBOUNDED MEDIA)

- Type of media used to transmit data from one point to another without using physical connections.
- A transmitting antenna and receiver aerial are used to facilitate the communication.

Examples of wireless transmission media:

i) Microwaves.
ii) Satellite.
iii) Radio waves.
iv) Infrared transmission.
v) Bluetooth technology.

- The transmission media above use different frequencies of the electromagnetic spectrum as shown below.



The electromagnetic spectrum

I) MICROWAVE TRANSMISSION

- A microwave is extremely high frequency (communication beam) that is transmitted over direct line of sight path.
- The method uses very high frequency radio signals to transmit data through space.
- The electromagnetic wave cannot pass obstacles and geographical barriers such as mountains.

- Due to their small wavelength, they easily release their energy in water as heat hence they are also used in making microwave ovens used in domestic kitchen appliances.
- In networking, microwaves are suitable for point to point transmissions.
- A signal is directed thorough a focused beam from transmitter to the receiver station.

II) SATELLITE COMMUNICATION

- A satellite is a microwave relay station.
- The microwave stations have parabolic dishes with an antenna fixed on them in order to focus a narrow beam towards the satellite in space.

Main Components of a satellite transmission system

1. Transmitter earth station:

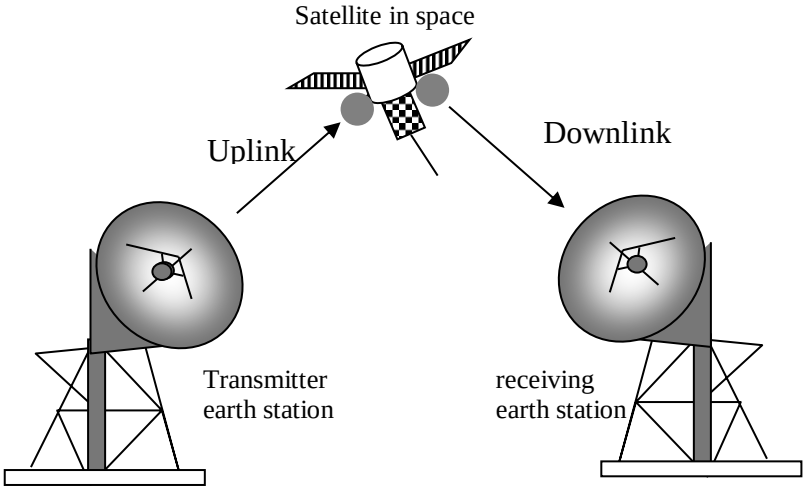
- Sets up an uplink to the satellite in order to transmit data.
- The uplink has a unique frequency.

2. A satellite:

- Launched somewhere in an orbit that receives, amplifies and retransmits the signal to a receiving earth station via a downlink frequency that is different from that of the uplink so as to avoid interference with the uplink signal.

3. Receiving earth station:

- Receives the sent signal on the other side of the globe.

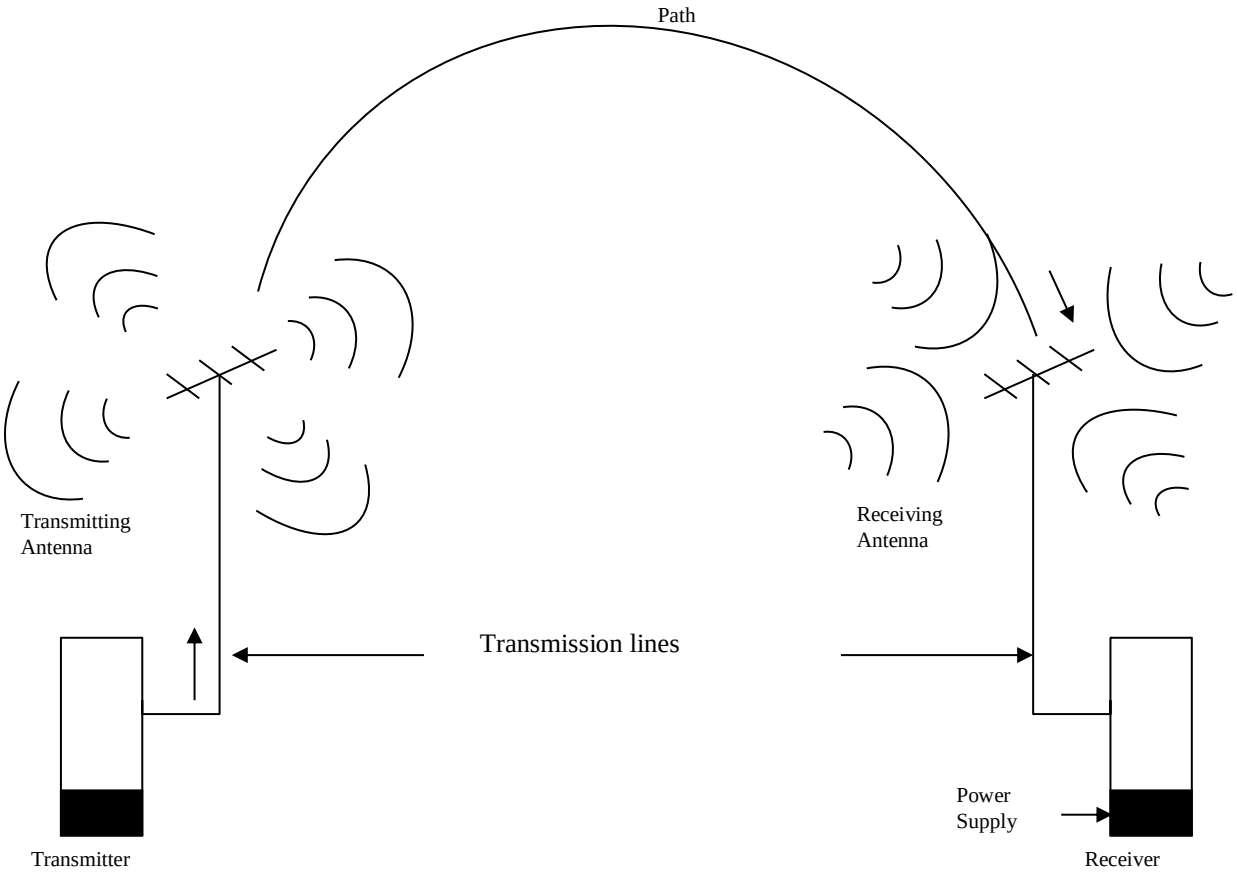


Satellite transmission system

- A communication satellite is usually launched into space about 36,000 km above the earth in such a manner that its speed will be relatively equal to the rotation speed of the earth.
- These types of satellites are called geostationary satellites.
- They are convenient because they eliminate the need to keep on moving the parabolic dish in a bid to track the line of sight.
- A geostationary satellite offers a large constant line of sight to earth stations.
- The area where the line of sight can easily be located is called the satellites footprint.
- The satellite transmits the signal to many recipient earth stations to form a point to multipoint transmission.
- The new trends in microwave transmission have seen the use of very small aperture terminal (VSAT) technology.
- It refers to a very small satellite dish used both in data, radio and TV communication.
- It enables direct communication instead of having to go through the state owned satellite gateways.
- The satellite produces strong signals that can be received by a satellite dish antenna of only about 2 meters in diameter.
- The signals are decoded using a decoder which is plugged directly to a television set or a computer.

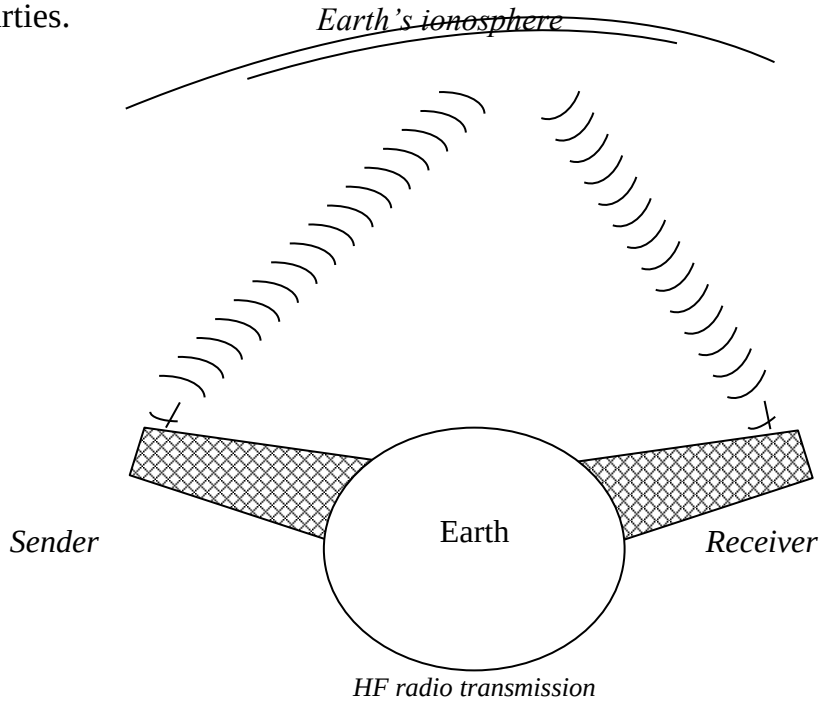
III) RADIO COMMUNICATION

- Radio waves travel just like surface water waves.
- They are omnidirectional i.e. they start from a central point and spread outwards in all directions.
- 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.
- They are used in radio and television broadcasts.
- Data can also be transmitted over radiowaves communication channels.
- Radiowaves can be of high frequency, very high frequency or ultra-high frequency.



a) High frequency (HF) radio waves

- A Signal is propagated by directing it to the ionosphere of the earth.
- The iron sphere will reflect it back to the earth's surface and the receiver will pick the signal.
- The biggest challenge of HF communication is the danger of signal interception by unauthorized parties.



HF radio transmission

b) Very high frequency (VHF) radio waves

- Transmitted along the earth's surface.
- Due to the curvature of the earth, the signal will most likely attenuate at the horizon.
- Repeater stations have to therefore be placed strategically to maintain a line of sight in order to receive, amplify and propagate the signal from one area to another.
- Common technology with the hand held radio devices like 'walkie-talkie' radios.
- The range of VHF is limited but preferred to high frequency where no major obstructions are encountered on the landscape, because it is possible to make the wave to follow a narrower and more direct path to the receiver.
- To overcome the obstructions on the earth surface like mountains and buildings, repeater stations are built on raised areas.

c) Ultra high frequency (UHF) radiowaves.

- They are like VHF when it comes to the line of sight principle i.e. there should be no barrier between the sending and the receiving aerial.
- They require smaller aerials.
- The TV aerial for VHF is bigger than the one for UHF radiowaves because UHF radiowaves can be made to follow an even narrower and direct path to the receiver than VHF radiowaves.
- Therefore UHF is popular for horizon limited broadcasts.

IV) BLUETOOTH TECHNOLOGY

- A new transmission technology i.e. a short range technology that enables people to use hand held communication devices like cell phones and PDAs to access the internet.
- It enhances communication of personal communication devices through wireless technology.
- The main component in Bluetooth is a small low power two-way radio transceiver, small enough to be inserted in small devices.
- A network of Bluetooth enabled devices is called a wireless personal area network (WPAN) or piconet.

V) INFRARED TRANSMISSION

- Fall just below the visible light on the electromagnetic spectrum.
- They are not visible to the human eye.
- Communication is achieved by having infrared transmitters and receivers (transceivers).
- Transceivers of infrared signals must be within a line of sight in the same room.
- Unlike radio signals, infrared signals cannot penetrate obstacles like walls. However, the signal can be reflected off surfaces like walls and ceiling until they reach their destination.
- An example is the infrared transceiver on most mobile phones.
- Once activated, two people in the same room can send messages to each other on their mobile phones without going through the mobile service provider.
- In computer networking, the technology can be used to connect devices in the same room to each other without need for cables e.g. a computer to a printer.
- The computers infrared transceiver must maintain a line of sight with the one for the printer.

Advantages of wireless communications

1. Wireless medium is flexible in operation as compared to bounded media i.e. devices can be moved around without losing access to the network.
2. Wireless networks can span large geographical areas easily.
3. It can take place via satellite even in very remote areas that do not have high cost physical infrastructure like telephone lines.

Disadvantages of wireless communications

1. Relatively difficult to establish or configure.
2. The initial cost is very high.

COMMUNICATION DEVICES

NOTE!

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