COMPUTER COMMUNICATIONS

Computer communication: This refers to the movement or exchange of electronic signals between computerized devices.

Data communication: refers to the movement of data (electronic signals) across electronic devices.

Data communication is generally actualized in ***telecommunication*** studies.

Telecommunication: refers to a science of electromagnetic devices and systems for communicating over short and long distances. Such devices include; radios, broadcast TVs, telephones and cable TVs. It refers to the exchange of data between two or more computers via some transmission medium such as wire. Actualized
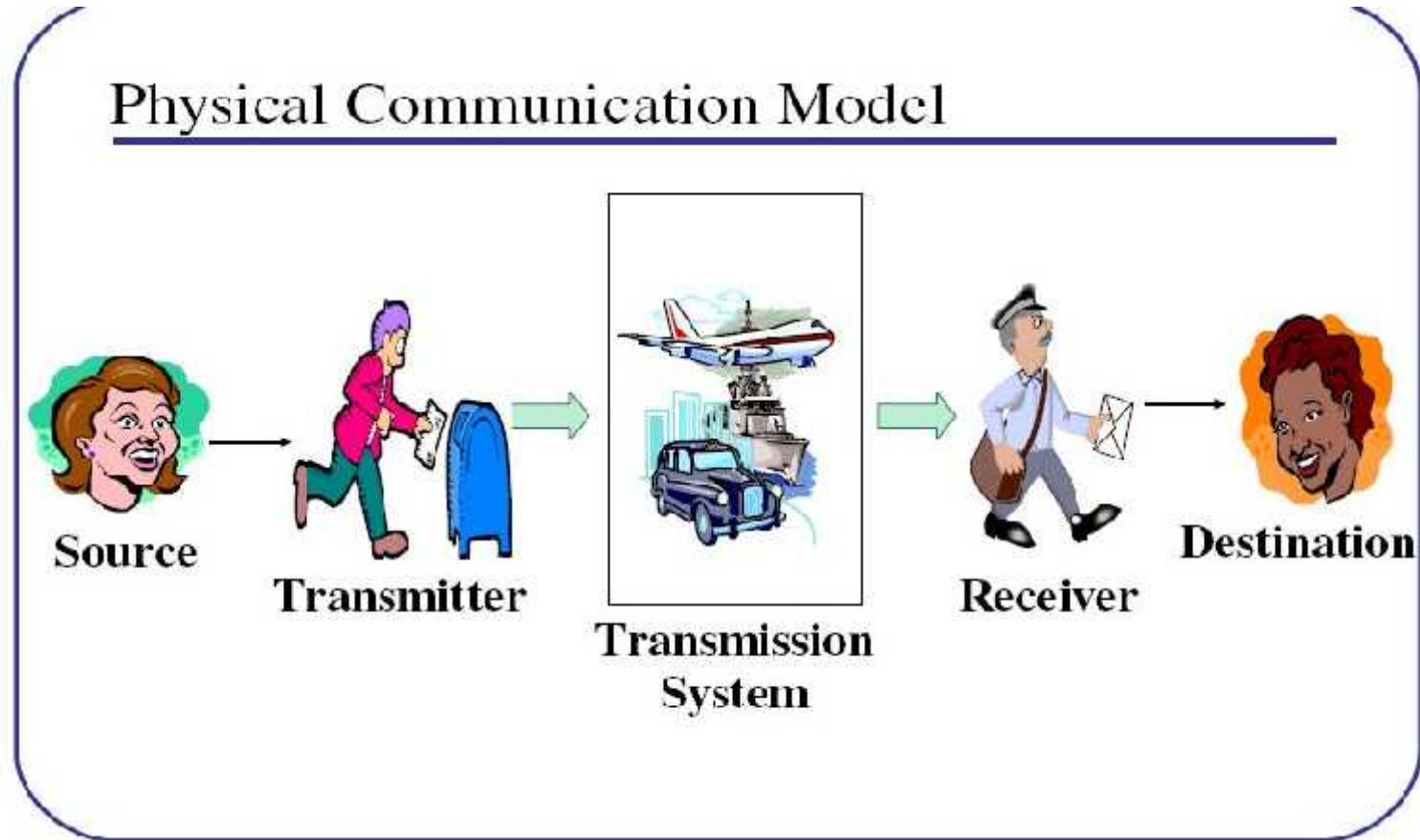
Computers and information systems are a collection of different devices and networks which keep interacting
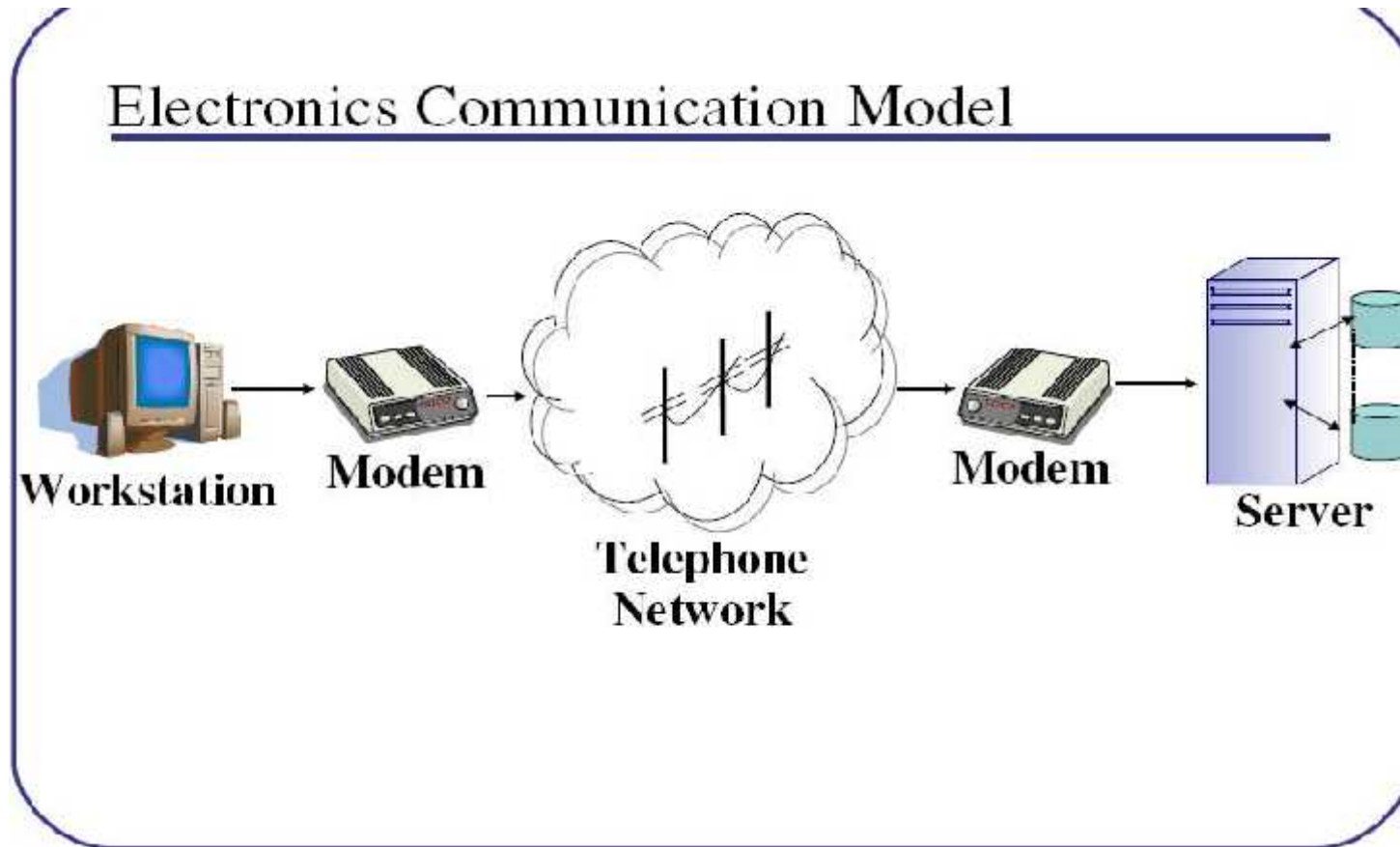
Communication model

A communication model is a collection of all elements (hardware, software, data communication professionals, principles and ethics that govern data exchange across devices.

Illustration 1: Physical communication model
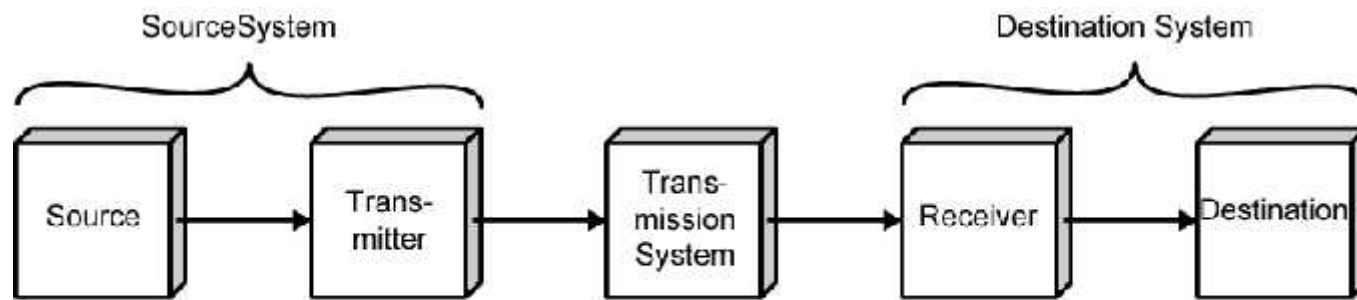
Illustration 2: Electronic data communication model

Electronics Communication Model

Workstation → Modem → Telephone Network → Modem → Server

Illustration 3: Communications model

(a) General block diagram

(b) Example

Illustration 4: Communication between two systems

Communication between two system

User A

User B

Hi, I want to chat with you

Ok, I am ready

Dialogue between A & B

Hi, Let us finish chatting

Ok, Let us disconnect
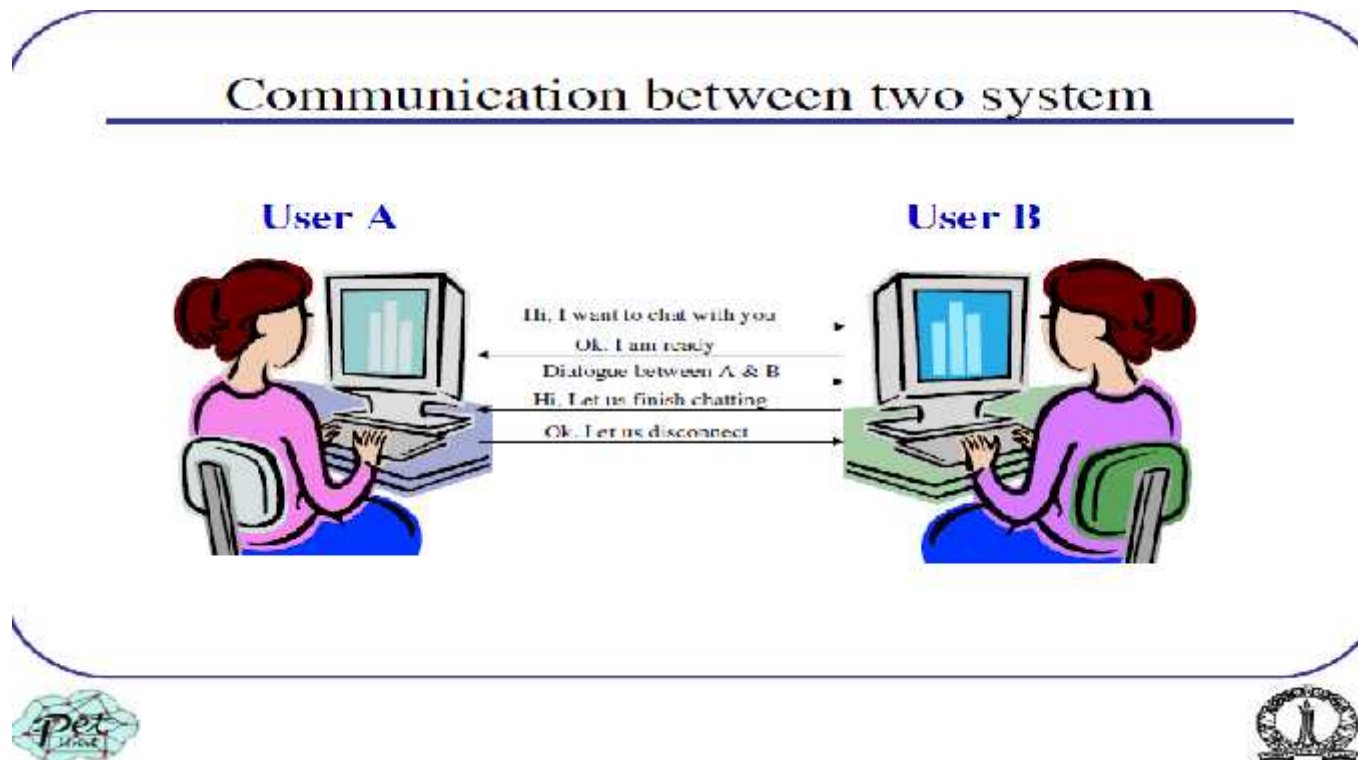
Elements of a data communication model

- Communication devices or hardware
- Communication channel or data transmission media
- Communication software
- Communication protocols or standards
- Communication professionals
- Communication laws and ethics

Elements of a data communication model

This consists of;

1) **Communication devices or hardware.**

These are physical devices that initiate an instruction to transmit or

receive data. They consist of;

- Sending communication devices (e.g. a desktop PC)
- Receiving communication devices (e.g printer, another desktop PC, etc.)
- Supportive communication devices (e.g bridges, repeaters, routers, modems, etc.

Nature and examples of communication devices

a) Transmitter or data source: These are devices with the ability to generates data exchange. They converts data into transmittable signals

b) Receiver or data destination: These are devices which have the ability to accept data and deliver it to the end user.

Most of the **data transmitters** have got the ability to **receive data** and vice versa.

Both transmitters and receivers are also called ***transmission switches***

Nature and examples of data receivers transmitters.

i - Simplex transmitters and receivers: These are transmitters or switches that allow data to flow in one direction only. When they send data they can not receive.

Examples include:

- Radio transmitters and receivers
- Television transmitters and receivers
- *Fire alarms*

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*ii - **HALF DUPLEX** **transmitters and receivers** : These are transmitters or switches that allow data to flow in one direction at a time. When they are sending data, they can not receive and when they are receiving they can not send.

Examples include:

- *Radio calls*
- *Credit card verification systems.*
- *Automatic teller machines*

*iii - **FULL DUPLEX** **transmitters and receivers:** These are transmitters or switches that allow data to flow in both directions at the same time. They can send data as they receive at the same time.

A regular telephone line supports full duplex transmission.

***iv - BASEBAND* transmitter and receiver**. *This is a transmitter which can send only one unit of data or signal at a time.*

***v - BROADBAND* transmitter and receiver**. *This is a transmitter which can transmit multiple signals at the same time. They transmit signals at a much faster speed. Two widespread applications of broadband transmission are;*

- *Digital subscriber lines (DSL)*
- *Cable television networks.*

Nature and examples of communication devices

vi - MODEMS: [Is an acronym for **MO**dulator **DEM**odulator].

Modem is a networking device that prepares or converts signals so that they become suitable for another communication channel. For instance it can interpret signals as they move from bit form to wave form in the air space.

The different types of modems include Dial-up, ISDN and DSL, cable)

vii - REPEATER: A network device used to amplify or strengthen the flow of data signals along a communication line.

The process of loss of signal strength along a communication line is known as **_attenuation_**.

viii - MULTIPLEXER. A communication device that combines many transmission channels into one line of communication.

ix - Concentrator: A device that enables several users to share a single transmission line.

- **BRIDGE**: Is a networking device that interconnects two or more Networks of the same configuration or architecture. (or same protocol). Bus to bus or ring to ring

  It is an interface (go between) that enables similar networks to communicate.

- **GATEWAY.** Is a networking device that interconnects two or more different network configuration or architecture to communicate. (like a LAN and a WAN).

Others include;

- **Network Interface cards** (NIC): A network interface card (NIC) or LAN adapter is an expansion card that enable a computers and their devices to connect to a network. The Ethernet card is the most common type of network card.

- **Hub:** Is a common connection point of devices on a network. It allows packets to change routes as required on the network. It can be;
  - An active/intelligent hub
  - Dormant/passive hub
  - Switching hub

- **Router:** Is a networking device that forwards data packets between computer networks. Routers manage and direct packets between networks

- **Switch**: Is a networking device used to store addresses of every device connected to the network. It conserves network bandwidth and offers generally better speed than a hub.

NB:

1. As a result of system embedment and advancement in technology, most of these devices have been reduced to either **functions** or just simple Apps.

2. Most of these networking devices are a combination of hardware and software (drivers)

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Communication software

Communication software refers to <u>electronic instructions or programs</u> which facilitate creation/initiation, sending and receiving of data across computer networks.

Functions of communications software:

- Network access control
- Transmission control
- Network error detection, reporting and correction
- Provision of network security.
- *Help network* users to establish a connection to other computers or networks
- Manage the transmission of data, instructions, and information
- Provide an interface for users to communicate with one another.

Examples of Communication Software

1. **Network operating system (NOS**): Manages (organizes and coordinates) network activities. They help in the control, planning, coordination, and supervision/monitoring of network devices and programs. Examples of NOSs include:
   - Novell NetWare
   - Microsoft Windows server 2003 and 2008.
   - AppleShare
   - Unix /NFS
   - Sun Solaris

Functions of Network operating system

- *Help* users establish a connection to other computers or networks

- Manage the transmission of data and instructions across the network.

Communication software   …..Cont'd

COMMUNICATION PROTOCOL

Protocols are sets of standards, communication software and devices follow while capturing, transmitting and delivering Information/data.

Common protocols include;

1. TCP/IP=Transmission Control Protocol/ Internet Protocol: Standards which make data movements possible.

2. **HTTP = Hyper Text** Transfer Protocol

3. FTP = File Transfer Protocol

4. SMTP = Simple Mail Transfer Protocol

5. Ethernet =

6. PPP=Point-To-Point Protocol which is data link protocol commonly used in establishing a direct connection between two networked computers.

7. TELNET=TELecommunication NETwork; for remote access between computers

8. IMAP=Internet Message Access Protocol

9. POP = Post Office Protocol

10. IPX/SPX=Internetwork Packet Exchange / Sequenced Packet Exchange: These are networking protocols used primarily on network using the Novell Netware operating systems

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3. Data Communication/ transmission media

There are basically two types;

1. Wired, Physical, or guided transmission media
2. Wireless or unguided transmission media

Wired or Guided transmission media

This is where data is moved though a physical

cable or wire.

Also called **Bounded media**

Bounded media are the physical links through which signals are confined to narrow path. These are also called guide **media**. **Bounded media** are made up o a external conductor (Usually Copper) **bounded** by jacket material.

Types of Network cables or wires

The most common types of network cables are;

1. Twisted Pair cables:

2. Coaxial Cable

3. Fiber Optic Cable

Physical or guided Transmission Media

- It is a tangible media
  - Examples: Twisted-pair cable, coaxial cable, Fiber-optics, etc.

1. Twisted-pair cable:

   This involves one or more twisted wires bundled together in one. These cables can be **Shielded Twisted Pair (STP)** or Unshielded Twisted Pair **(UTP)** Cables

2. Coaxial-Cable:
   - Consists of single copper wire surrounded by three layers of insulating and metal materials
   - Typically used for cable TV.

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3. Fibre-optics:

- These are cables or wires consisting of thin Strands of glass or plastic fibre through which data signals are transmitted.
- Light is launched at one end and a photo-diode translates the light back into digital data at the other end.

Advantages of Fibre Optic cables

- They have Very high capacity of data through put than any other forms of transmission media.
- Less liable to noise and weather conditions
- They are not easily tapped into. Hence being more secure if compared to other channels.
- They are generally smaller and lighter.

Disadvantages of Fiber Optic cables

- They are generally more expensive to buy and install if compared to other wires
- They need a lot of specialized technical skills and knowledge to install and modify.
- More fragile than other wires or cables.

| Advantages	Disadvantages
Can carry signals over a much longer distance without a repeater compared to copper. The more repeaters used the more expensive it is to set up.	Fibre is more expensive than copper cable
Extremely large data capacity	Connecting fibres together ("splicing") is more difficult
Immune to electrical interference	The complex electronics at both ends of the line tends to be more expensive
Immune to corrosion	Needs specialist expertise to lay fibre and many installers are more familiar with copper cable
Can carry many different services over the same line, TV, telephone, data transfer	Fibre cannot carry power as it is made of glass. Copper cable can carry both signal and power at the same time
Can be used in hazardous environments such as petro-chemical refineries	Failure can be more catastrophic than a copper cable because you may have crammed many services over a single cable - they all fail because of a single cable failure.
'Future proofs' your network to cope with the growth in data traffic - plenty of bandwidth	
Excellent security as it is difficult to tap into a glass fibre without detection	
One cable carries many fibres, each fibre can carry 10Gbps or more	
Each fibre could be used for a different service	

Examples of Physical Transmission Media
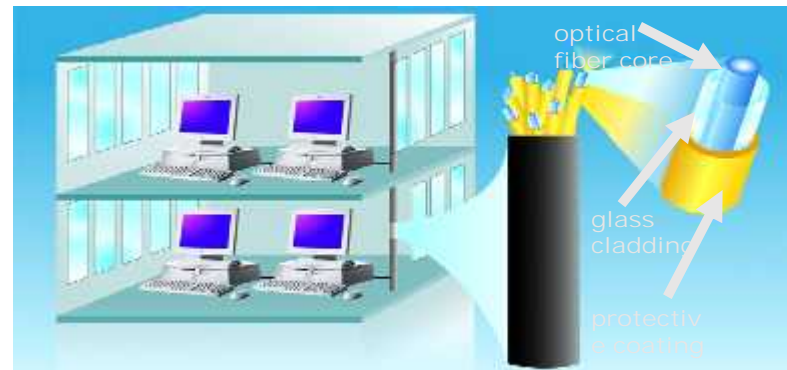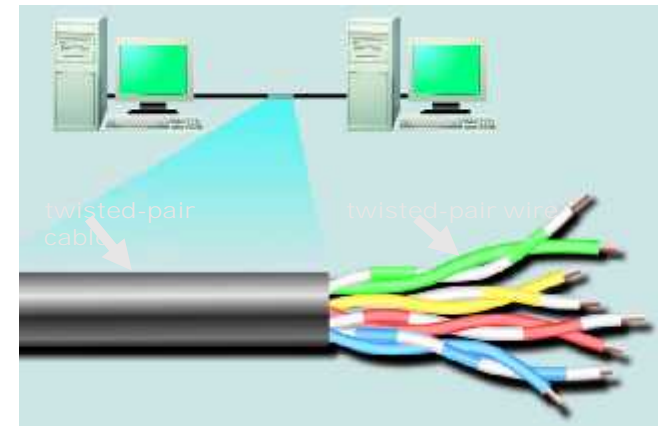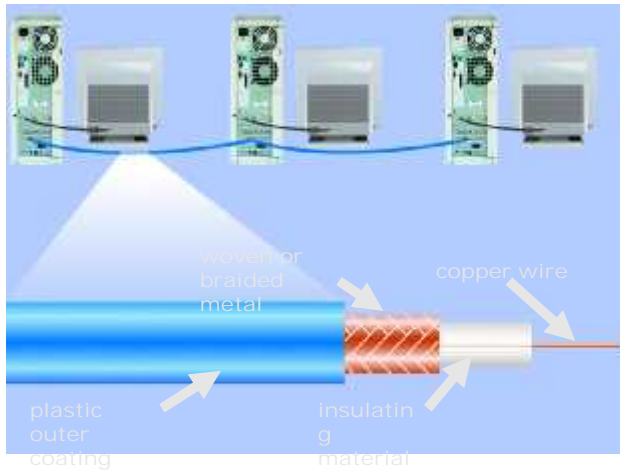
Wireless transmission media

Wireless transmission *media sends communication signals through the air and space.*

- *The common wireless* *transmission* *media are;*

1. *Radio waves:*

- Radio waves are a type of electromagnetic radiations by which data can be transmitted from one communication device to another.

- *Radio waves* have the longest wavelengths in the electromagnetic spectrum.

- Communication devices receive *radio waves* and convert them into mechanical vibrations transmittable into and space.

Forms of radio waves

a) **Broadcast Radio waves– (Up to 2mbps)**

- Distribute signals through the air over long distance using antennas and
Radio Frequency Identification (RFID)
**RFID t**echnology uses radio signals to Communicate with a tag placed in an object

b) **Cellular Radio waves– (9,600bps to 14.4kbps)**

- A form of broadcast radio used by mobile communication devices. They use
High **Frequency** Radio Waves to transmit voice or data. They use **Wireless Applications Protocol (WAP).** This software allows wireless mobile devices to access Internet

  - *(OUT) A wave is a vibration that carries energy with it. The frequency of a wave is the number of waves that pass by each second, and is measured in Hertz (Hz). For example, a sound wave might have a frequency of 450 Hz.*

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Forms of radio waves …………. Cont'd

c) Microwaves

- Radio waves providing very high speed point-to-point transmission with minimal or no obstructions
- Used for satellite communication
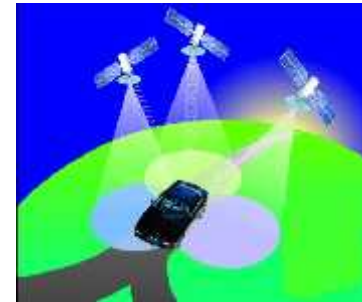
2. Infrared (IR) Transmission media

Infrared is a light beam that moves in air and space to carry data in close-range (**about 10 metres)** distances using '**IrDA**' - **Infrared Digital Association** communication standard.

- The key component of an infrared system is an infrared LED (Light Emitting Diode) to emit the light and a photo-diode in the television or equipment to receive the light.

- IR is generally used in;
    - wire-less communication for remote controls for televisions, dvd players and most other entertainment devices
    - the Mouse, keyboards, joysticks, and gamepads
    - PCs, Laptop, game console
    - etc.

- **IR works only up to but that is fine for the type of applications it is mainly used for. It will only work line-of-sight.**

3. Laser communication or 'free-space':

"A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation." LASER is an acronym for "Light Amplification by Stimulated Emission of Radiation". It uses high power laser beams to transmit light signals. A typical laser uses feedback from a pair of mirrors mounted on both the sides of the gain medium;

Uses:

    a)   Campus wide communication
    b)   Emergency data links (disaster relief etc)
    c)   Outdoor events requiring high speed data feeds
    d)   Building - to - Building communication
    e)   Satellite to Satellite communication
    f)   Backup network in case main cabled network fails

Advantages	Disadvantages
Inexpensive compared to other technologies	Only works in line-of-sight
Works over a moderate bandwidth 115 kbps	Short range - a few metres
Works well over a short distance	Has very Low bandwidth
Offer very fast data transmissions	Highly affected by the weather.

Wi-Fi is a standard that uses **Wireless Access Point (WAP) to interconnect devices without using cables.** WAPs are commonly called **'hotspots'** and can be found in airports, stations, cafes, library and other public spaces. They are the ones needed to handle the ICT Network radio traffic.

Most of the modern ICTs are WiFi enabled

Uses

- Connecting to an organisation's Local Area Network
- Connecting to the Internet through a hotspot
- Smartphones and PDA connecting to the internet
- Wirelessly downloading electronic books into a reader
- Wirelessly streaming music throughout a home
- Wi-Fi enabled printers
- Games consoles to connect to the Internet

Advantages of wireless communication	Disadvantages of wireless communication
No need for physical cables	Slower than cabled networks e.g. 54 Mbps compared to the 1000 Gbps that Gigabit Ethernet offers
The ICT or device can work anywhere within range of a WAP	Requires a Wireless Access Point (WAP) to be present
Can work through walls and on different floors as long as the radio signal is not too weak	Requires encryption to ensure data privacy
Smartphones can roam the Internet through the home network without incurring other expenses	It can only support a limited number of simultaneous connections so not so good as a company-wide LAN
They offer sufficient bandwidth for most Internet use although streaming video is more of a challenge.	Performance depends on the structure of the building and any obstacles there may be weakening the radio signal
Wi-Fi certified devices are guaranteed to be compatible	

4. Bluetooth

- Bluetooth is a type of short range radio communication and networking protocol combined.

- It enables devices close to one another to exchange data.

- By close, we mean within about 10 metres of one another even if there is a wall in-between.

COMMUNICATION SATELITES.

Satellite

- A satellite is a machine placed in space orbit in order to carry out some specific tasks.

- Satellites which orbit the Earth can be used for many jobs, including:
  - Communication
  - Television broadcasting
  - Navigation
  - Mapping
  - Scientific research
  - Military

- The satellite sends and receives signals using transponders.

- Satellites generally are in two kinds of orbit - LEO Low Earth Orbit which is used for rapidly changing requirements such as GPS (Global Positioning System) or Military where fine detail is needed in real time.

- The other is geosynchronous orbit. This is used where it is important that the apparent position in the sky does not change. For example, Sky Television has millions of satellite dishes screwed to the wall of individual houses. So it is vital that the Sky satellites do not move in the sky!

- These receive microwave signals from earth based communications facilities, amplify the signals and retransmit the signals back to the communications facilities.

- The earth based stations use large dish shaped antennas to transmit and receive data from satellites.

- The transmission to the satellites is called **uplink** and the transmission from the satellite is called a **down link**.

Cont'd

- satellite

Cont'd

- Communication satellites are usually placed about 22,300 miles above the earth's equator and moves at the same rate as the earth.

- **Applications of communication satellite**
  - Television.
  - Radio broadcast.
  - Video conferencing.
  - Paging and global positioning systems.

Cont'd

Advantages of Communications satellites

- Lots of data can be sent simultaneously
- Allow high quality broadband communication across continents.
- Covers a large geographical area for data transmission.

Disadvantages of communication satellite

- The fee to launch a satellite is extremely expensive.
- The infrastructure costs needed to access satellite communications is high

Applications/Uses of data communications

- Voice mail
- Fax
- E-mail
- Instant messaging
- Chart rooms
- Newsgroups

- Internet telephony
- Video conferencing
- Groupware
- Telecommunicating
- Global positioning system

Revision exercise - 1

1. **What is the difference between;**
   - a) Computer communication and computer network
   - b) Intranet and extranet technology
   - c) Email and the internet
   - d) Internet and world wide web (WWW)

2. **Briefly describe;**
   - a) Four forms or types of networks
   - b) The three LAN models

3. **State four components of an e-mail message window**

4. **Give three limitations of using e-mails as means of communication**

5. **Explain the following fields used in e-mail accounts:**
   - a) CC
   - b) BCC
   - c) Compose
   - d) Drafts
   - e) starred

6. **State three netiquette guidelines for electronic mail users**

Revision exercise - 1

7. Who is an Internet Service Provider (ISP)

8. Give four examples of ISPs in Uganda.

9. Give five services provided by ISP's in Uganda

10. State five services provided on the internet.

11. State five factors that affect data transmission speeds across networks.

12. Explain the nature of crimes committed by some internet users

13. State how crimes committed by internet users can be averted.

14. Distinguish between the following;
    a) Domain name and an IP address
    b) Analogue from digital signals
    c) Modulation from demodulation
    d) Serial transmission from parallel transmission
    e) Physical from wireless transmission media

15. Give any three factors to consider when choosing transmission media

Revision exercise - 1

16. State four elements of a data transmission model

17. What is data transmission media?

18. With the help of examples give the difference between guided and unguided data transmission media.

19. Outline the advantages and disadvantages of <u>Guided transmission media:</u>

20. State the functions of the following protocols;
    a) TCP
    b) UDP
    c) SMTP

21. Explain the following terms as related to world wide web
    a) Web browser
    b) Search engines
    c) Web server
    d) Home page
    e) Marquee

22. Give three examples of web authoring software