



UNIVERSITY OF SIERRA LEONE

**FACULTY OF INFORMATION SYSTEMS AND TECHNOLOGY**

DEPARTMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY

**INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY**

**ITEC 111**

**INSTITUTE OF PUBLIC ADMINISTRATION AND MANAGEMENT**

**JUNE 2024**



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These Modules were developed with the support of Commonwealth of Learning, Vancouver, Canada. The Commonwealth of Learning (COL) is an intergovernmental organization created by Commonwealth Heads of Government to promote the development and sharing of open learning and distance education knowledge, resources and technologies.

Course Developers

**Mr. Daniel Chaytor**

**Alhaji Y. Kenneh**

## COURSE BLUB

Information and Communications Technology (ICT) is an exciting subject and the concepts are evolving. ICT involves any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form, e.g. personal computers, digital television, email, robots. ICT is a compulsory programme in the university. It is the first part of the four credit unit courses planned for an entire year. This course will be taken during the first semester. It has two Modules sub-divided into four Units.

Credit Units: 4 Units

Course Status: Compulsory

Semester: First

Course Duration: 15 weeks

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## **INTRODUCTION TO INFORMATION AND COMMUNICATIONS TECHNOLOGY FOR ODL**

Information Technology (IT) and Information Communication Technology (ICT) is a growing field and important area of endeavor. The developers of this curriculum have established a set of underlying principles to guide its work. The development of IT and ICT curricular must be sensitive to changes in technology, new developments in pedagogy, and the importance of lifelong learning. In the preparation of this syllabus for HTC, we will concentrate purely on the IT aspect. In a field that evolves as rapidly as Computer Science, educational institutions must adopt explicit strategies for responding to change. These technological educational changes must seek to prepare students for lifelong learning that will enable them to move beyond today's technology to meet the challenges of the future.

### **WHAT YOU WILL LEARN**

This course will enable you to be aware of the range of reasons for using ICT and to critique the strategies for developing ICT over time. You will also analyze the strengths and weakness of different decision-making mechanisms in ICT and become familiar with a wider range of useful tools and resources for integrating ICT.

### **COURSE AIMS**

This course aims to encourage students and other learners to know different categories of ICT tools, their affordances and different criteria to be applied when selecting them. Moreover, the aim is also to be able to analyze the needs for digital content and various strategies on how to get it, share, or develop and to be aware of the potential of ICT to support student's computational thinking, to reflect on the needs, priorities, and future plans for further developing and extending the digital environment.

### **COURSE OBJECTIVES:**

At the end of the lesson students should be able to:  
explain the basics of ICT at university  
Use the internet and email to access and communicate relevant information  
Identify the hardware components and software of the computer

Use the computer properly and manipulate documents using word processing and do mathematical/statistical operations using spreadsheet.

Develop students' ability in the basics of ICT

## **WORKING THROUGH THIS COURSE**

You are required to thoroughly work through all the units in this course. There are three modules in all with sixteen units.

## **COURSE MATERIALS**

The major components of this course are

1. Course Guide
2. Study units
3. Text books
4. Using Internet
5. Tutor assignment
6. E - facilitation

## **STUDY UNITS**

The breakdown of the three modules and study units are as follows: Every unit contains a list of references and further reading. Try as much as you can to get the listed books and further reading materials. You are also expected to approach the internet for further related reading materials. This is to widen as well as deepen the depth of understanding of this course

## **PRESENTATION SCHEDULE**

The presentation schedule which is included in your course materials gives you the important dates for the completion of tutor-marked assignments and for attendance of tutorials. Remember, you are required to submit all your assignments on due dates. You should guard against falling behind in your work.

## **ASSESSMENT**

Your assessment will be based on tutor-marked assignments (TMAs) and a final examination which you will write at the end of the course. You are required to complete four TMAs which will contain 20 multiple choice test items each.

### **TUTOR MARKED ASSIGNMENTS (TMA)**

Every unit contains at least one or two assignments. You are advised to work through all the assignments and submit them for assessment. Your tutor will assess the assignments and select four, which will be marked and the best three will be selected which will constitute 30% of your final grade. The tutor-marked assignments may be presented to you in a separate file. Just know that for every unit there are some tutor-marked assignments for you. It is important you do them and submit for assessment.

### **FINAL EXAMINATION AND GRADING**

At the end of the course, you will write a final examination which will constitute 70% of your final grade. In the examination which shall last for two hours, you will be required to answer 120 objectives questions in multiple choice, Yes/No and fill-in response format.

### **COURSE MARKING SCHEME**

This table shows how the actual course marking is broken down.

Assessment Assignments: Four assignments. Best three marks of the four count as 30% of course marks

**Final Examination:** 70% of overall course marks

**Total :** 100% of course mark

# MODULE ONE: INTRODUCTION TO INFORMATION TECHNOLOGY

Unit 1: General Background of Information Technology

Unit 2: Elements of Information Technology

## Unit 1: General Background of ICT

- 1.1 Introduction
- 1.2 Objectives
- 1.3 Main Content
  - Meaning of ICT
  - What Makes up ICT
  - Importance of ICT
- 1.4 Conclusion
- 1.5 Summary
- 1.6 Self-assessment Exercise
- 1.7 Tutor Marked Assignment
- 1.8 References/Further Readings and Other Resources

### **1.0 GENERAL BACKGROUND OF ICT**

Information and Communications Technology or ICT is a broad subject and the concepts are evolving. It covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form, e.g. personal computers, digital television, email, robots.

#### **1.1 OBJECTIVES**

At the end of this unit, students should be able to:

Define the term Information and Communication Technology

Discuss the basic importance of ICT

List some technologies in ICT

#### **Course general learning outcome**

At the end of the course students will be able to;

1. Comprehend Basic Concepts:

- Explain fundamental concepts of Information and Communication Technology (ICT).
- State the role and significance of ICT in various sectors such as education, business, healthcare, and daily life.

2. Computer Hardware and Software:

- Identify different types of computer hardware components and their functions.
- State the basics of computer software, including operating systems, applications, and utility programs.

3. Data Management:

- State the importance of data, databases, and data management systems.
- Explain basic data entry, storage, retrieval, and management techniques.

4. Networking and Internet:

- Explain the basics of computer networks, including LAN, WAN, and the Internet.
- List the various types of internet connections, networking devices, and protocols.
- Describe online communication tools and their applications.

5. Digital Literacy:

- Develop skills to use basic office productivity software such as word processors, spreadsheets, and presentation tools.
- Describe effective online searching techniques and evaluate the credibility of online information.

6. Security and Ethics:

- Explain the importance of cybersecurity and basic measures to protect personal and organizational data.

- Describe ethical and legal considerations in ICT, including issues related to privacy, intellectual property, and digital citizenship.

7. Problem-Solving and Critical Thinking:

- Develop problem-solving skills using ICT tools.
- Apply critical thinking to analyze and solve real-world problems using technology.

8. Emerging Technologies:

- Explore emerging ICT technologies such as cloud computing, artificial intelligence, and the Internet of Things (IoT).
- Describe the potential impact of these technologies on society and various industries.

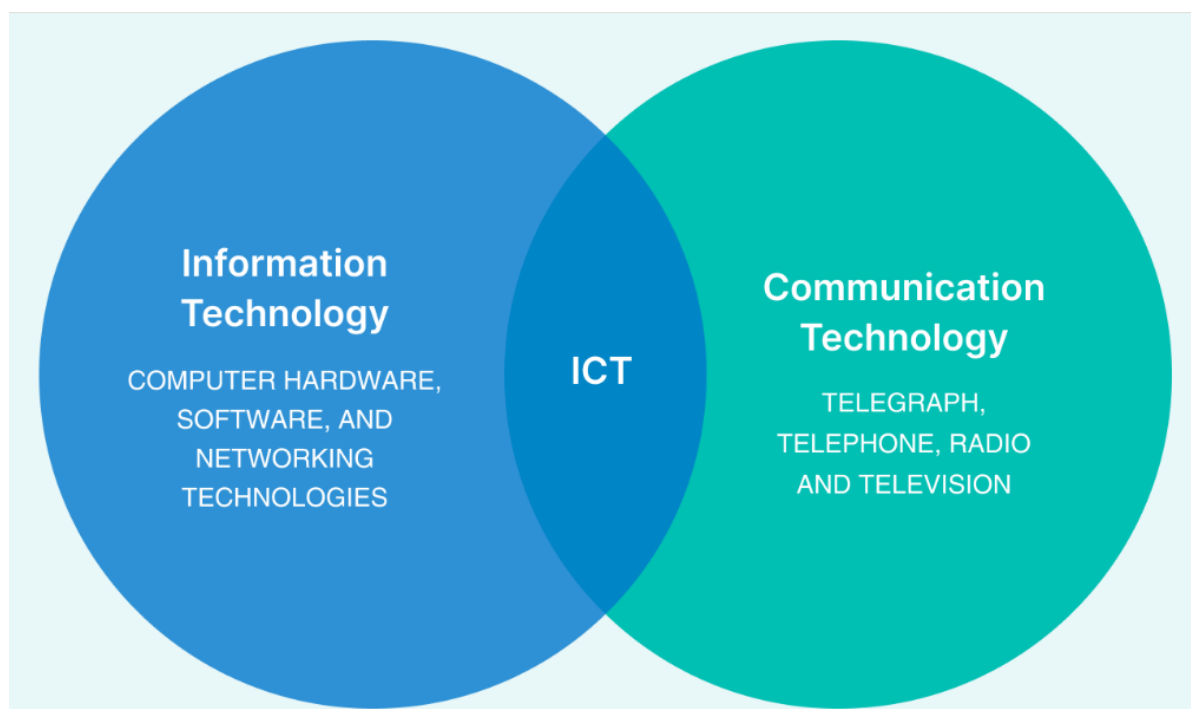
9. Collaboration and Communication:

- Apply the use ICT tools for effective communication and collaboration.
- Describe the role of ICT in enhancing teamwork and productivity in various settings.

These objectives aim to provide a comprehensive foundation in ICT, preparing students to effectively utilize technology in their academic, professional, and personal lives.

## Unit 2. Elements of ICT

Information is a dynamic and unending resource that affects all disciplines and all walks of life. It supports education, research and development. Technology in its broader sense is the main factor determining the development of information. Information and Communication Technology (ICT) is the biggest technological achievement in the evolution of mankind. ICT, is often used as an extended synonym for Information Technology (IT), but is usually a more general term that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to create, access, store, transmit, and manipulate information. ICT has changed rapidly over the past ten years resulting in a significant shift of emphasis in all human activities.



Fig

ure 1.0

ICT, or information and communications technology, is the infrastructure and components that enable modern computing. ICT serve as a tool that enables the way people create, process and share data or information with each other. It also helps people improve their abilities in lots of

areas, including business; education; medicine; real-world problem-solving; and even leisure activities related to sports, music, and movies etc.

The definition of ICT is dynamic because of the evolving nature of the subject. However, the term is generally accepted to mean all devices, networking components and applications. When combined, these help people and organizations interact in the digital world.

### **History and evolution of ICT**

The whole idea of ICT can be traced far back to the 19th century during the era of the development of the telegraph and the telephone. These two inventions revolutionized the way people worked and interacted in the social world by making it possible for one person to communicate with another person in a different location in real or near-real time.

By the middle of the 20th century, the radio and television were invented and the concept of mass communication was introduced by the end of the century at that time the internet had become a mainstream tool for communication, commerce and entertainment. Its use continued to grow rapidly in the following years, revolutionizing the way people work and digitally transforming the way people communicate.

Here are some technological advancements and the years they were developed;

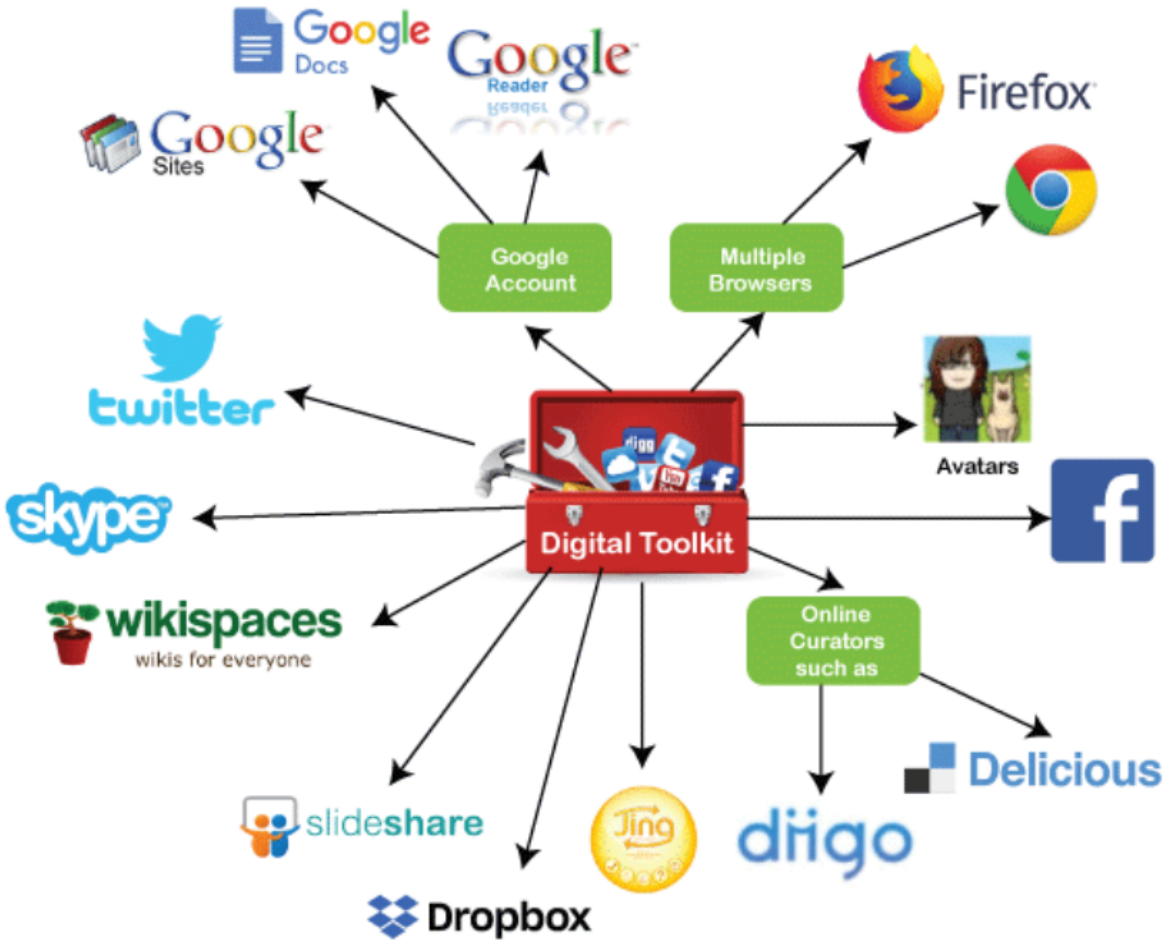
<b>Year</b>	<b>Technological Advancement</b>
1837	Morse code and telegraph
1876	Telephone
1895	Wireless telegraphy
1927	Television
1947	Transistor

1951	UNIVAC I (First commercial computer)
1969	ARPANET (Foundation of the Internet)
1990	World Wide Web
1991	GSM (Global System for Mobile communication)
1994	Netscape Navigator (Widely-used web browser)
1998	Google
2001	Commercial 3G networks
2008	Bitcoin (First blockchain-based cryptocurrency)
2010	4G networks
2016	AlphaGo (AI system defeating world champion Go player)
2020	5G networks

### **Tools used in ICT**

Information and communication tool refers to digital infrastructure such as computers, laptops, printers, scanners, software programs, data projectors, and interactive teaching boxes.

ICT devices encompass the latest tools, concepts, and techniques used for student-to-teacher and student-to-student interaction in the context of information and communication technology. Examples of these devices include clicker devices, mobile applications, and the flipped classroom approach.

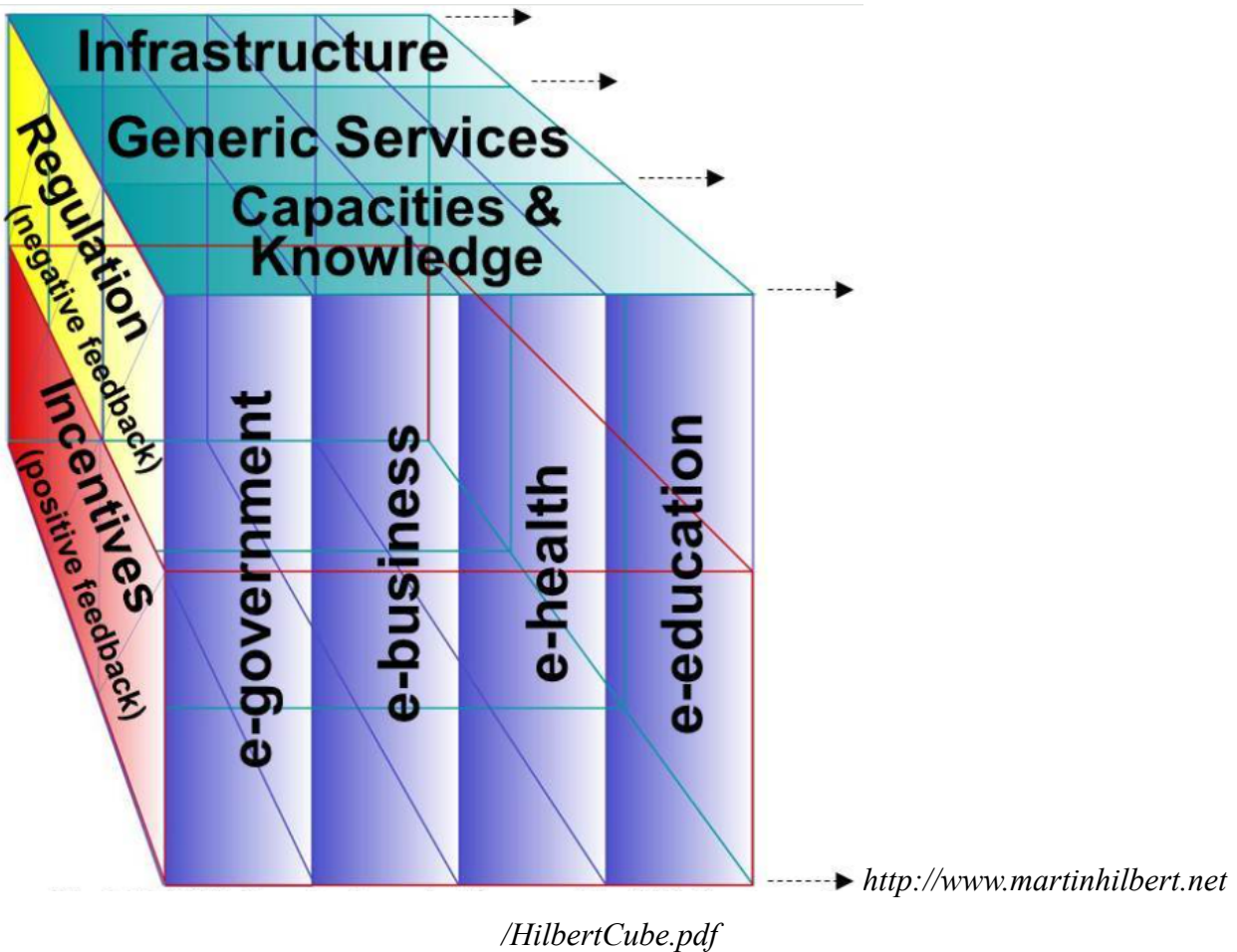


<https://www.javatpoint.com/ict-tools>

To unlock the potential of these technologies the following should be done;

- Determine the initial ICT proficiency of each student and incorporate ongoing assessment into core subjects such as literacy and numeracy.
- Develop a strategy to support the progression of ICT skills within the university curriculum.
- Use evidence-based practices to integrate ICT learning with subject-specific learning.

## Impact of ICT on society and business



Governments and agencies continue to spend huge sum of money in the establishment of Information and Communications Technology (ICT) infrastructures. This investment takes various forms, such as policy initiatives, government funds, and grants or Government investment incentives. The aim is to reap the benefits from the emergence, development, and widespread application, usage, and commercialization of different advanced ICT technologies. However, until recently, the focus has mainly been on particular key horizontal economic issues, such as availability and jobs. There has been an implicit assumption that ICTs would eventually interweave and play a useful role in different business functions, both public and private.

Some of the areas where ICT has impacted severely are as follows;

## **E-Government**

The term electronic government, or e-government, refers to the use of information and communication technologies by the government to exchange information and provide service delivery to its citizens, businesses, and other arms of government. E-Government is directed towards better governance performance, empowering the government and its people, cutting down transaction costs, improving government operations, and making it customer-oriented as well as ensuring public access to and use of information. E-Government supplies all content of government information and services through the Internet. This allows citizens and businesses to access or furnish information given by or received by the government.

## **E-Business**

Many businesses have recognized that electronic commerce and internet-based or activated applications can enhance their efficiency and effectiveness and generate new revenue streams by weaving together their external and internal information systems. The actual payoff from internet solutions is no longer in having the internet or a website. This rather obvious strategy has posed a difficult challenge to their way of luring clients or enabling employees to work together. Business organizations have now started heavy investment in ICT, supportive of a company's strategic objectives. A mere website or connectivity of your company network from a home PC is not what the deal is, they opine. This likely time saver and cost cutter is nothing less than a revolution in managing the business perspective.

## **E-Commerce**

Nowadays, just about any company from various industries has business activities on the web, and e-commerce has emerged as a relevant communication and distribution channel. With its global reach and increasing number of internet users around the world, it has become a significant contributor not merely to the company's growth in sales and profitability but also to assisting in extending the companies' territories to position as effective and efficient retailing and service companies. The expansive and exponential growth of e-commerce has experienced significant technological advances over the past forty years, but most significantly, tremendous acceleration in transforming traditional retailing to electronic retailing over the past decade. This

change has set online commerce as having gone from the era when it would be hurting brick-and-mortar stores and the consumer, who would be scared about giving personal and credit card information over the internet, to the era when brick-and-mortar stores would start to complement their physical stores by establishing an online presence. Consumers would begin to love e-commerce and appreciate the convenience and cost savings in product prices that e-commerce offers. Consequently, in recent years, there has been a massive growth in broadband penetration worldwide, in internet users, and in the number and average spending of consumers who eventually used their country's Visa or Mastercard to purchase online from businesses across the globe.

### **E-Health**

ICT supports a new model of patient-centered medicine - a goal that professionals and politicians, public and private organizations, and regulatory entities are yet far from reaching. The remarkable growth of electronic devices, increasing the degree of immediacy of care while not harming patient healthcare, enhances the investment in these technologies. This means that not only the volume of information is most relevant but also the speed of data dispersion, making vital the interconnection of all user's devices. With access to the internet, it is possible to obtain a broad range of information about symptoms and diseases, take the diagnosis or the treatment in several browsers with applications that look like additional doctor pairs, make an appointment in a hospital, or online prescribe, and purchase medication, appending health status with the ability to restrain generate pressure and stress, among other physical and psychological states.

### **E-Education**

When looking at the actual use of ICT in education, and also at the actual enhancement of student performances by ICT, education is still in the early digital age. Several countries have now been able to introduce ICT in some parts of their education systems, in many cases with development cooperation. Development has moved from a phase in which ICT in education was seen as a sort of background enabler of what and how to allow integration of ICT, through a phase of technology-enhanced learning or knowledge transmission and reception enabled by advances in technology, into the phase of technology-supported learning for social and economic

development, using ICT for socio-community interaction and preparation for the knowledge society.

### **E-Learning**

When ICT is used as an alternative or additional method of teaching, there are various terms used to describe this approach, with e-learning being the most commonly used term. However, some prefer to use the term 'computer-aided learning' (CAL) as an alternative. It is important to note that CAL should be distinguished from other terms such as 'computer-based training' (CBT) or 'web-based learning' (WBL), as these can be seen as specific implementations of CAL. CAL is typically used to refer to recognized applications of e-learning within an educational course. In other words, while all CAL can be considered as e-learning, not all e-learning can be considered as CAL.

### **Further reading materials and references**

- Fundamentals of Information Technology: Textbook – English
- Internet

### **SELF-ASSESSMENT TESTS**

- i. List the technological advancements and the years they were developed
- ii. Name the tools used in ICT

### **TUTOR MARKED ASSESSMENT**

- i. What is e-government and its purpose as described in the text?
- ii. List and discuss four tools that are used in ICT
- iii. Discuss any four (4) areas that ICT has created major impact in our society

### **REFERENCES**

O'Byrne, S. (2003). *Information and Communication Technology*. London: Letts Educational  
Shortis, T. *The language of Information and Communication Technology*: London: Routledge.

## **MODULE 2.0: COMPUTER FUNDAMENTALS**

Unit 1: Types of Computers

Unit 2: The components of a computer system

Unit 3: Computer Operating Systems and Networks

Unit 4: Application of computers in business

### **Learning Objectives**

**After completing this module, students should be able to:**

- Identify the main types of computer like desktops, laptops, tablets, as well as other computing devices such as smartphones, media players and digital cameras
- Identify the main components of a computer system
- Describe different types of data storage devices and their suitability for different tasks
- Distinguish between software and hardware and between the different types and uses of software
- Explain the need for computer networks and describe the different options available to connect computer systems together
- Describe the functions of operating systems and identify the different operating systems available for computers and computing devices.

### **UNIT 1.0: Types of Computers OBJECTIVES**

By the end of the unit students should be able to:

- Explain what a computer system is.
- Identify the different types of computers and their uses
- Determine the right type of computer for specific situations.

### **INTRODUCTION**

This unit introduces the common types of computers and provides an overview of the parts of a typical computer. This will allow you to compare computers with different specifications and make the right choices when selecting a computer for a specific task.

A computer is a machine or device that performs processes, calculations and operations on data based on instructions encoded in software. A computer is made up of multiple parts that facilitate user functionality.

## MAIN CONTENT

### 1.1 Types of a Computer

A computer is an electronic device that takes **input data** such as numbers, text, sound, images, video, **processes** it, and converts it into meaningful **information** as **output**.

Input data and information produced as output may also be stored on storage devices internal to the computer system.

Almost all computers you have used so far are likely to fall in the category of **microcomputers**. A microcomputer is a small, standalone computer designed to be used by one person at a time. Microcomputers are also known as **Personal Computers (PCs)** and are typically used for personal tasks such as writing **emails**, searching for information on the **web**, creating documents, making presentations, updating **spreadsheets**, watching movies, listening to music, and playing computer games.

The most common types of microcomputer are desktop computers, laptops, tablets, mobile phones, and smartwatches on your wrist.

Modern microcomputers can talk to each other and share information. When you snap a photo using your phone, it can become immediately visible on your desktop. Similarly, when you get a phone call or a message on your phone, it can pop up on your desktop, smartwatch, and phone simultaneously. We begin by taking a brief look at each type of microcomputer.

#### Desktop Computer

A desktop computer is a microcomputer primarily designed to meet the computational needs of a single user at a fixed location. If you have a comfortable desk where you do most of your work and would like a computer to use on the desk without moving it around, a desktop computer may be ideal for you.



Figure: A typical desktop computer

Desktop computers are generally cheaper than smaller portable computers with similar specifications, since the components in a desktop do not have to be optimized for size, weight, or power consumption. Also, since desktops don't have to be light, small, or portable, they can be configured with multiple storage devices, and include **extra ports** to support multiple peripherals like external storage, external speakers, microphones, and cameras.

For their economy as well as setup convenience, desktop computers are very common in organizations, particularly for office staff who do not need portable computers to deliver presentations or take notes in meetings. Desktops are also popular for **gaming** because they can simultaneously support the most powerful computing units, video graphics cards, and highest resolution monitors without the need to worry about battery performance.

One additional benefit of owning a desktop computer is the ease of upgrade. Desktops are enclosed in cases that are usually easy to open. Desktops typically offer **expansion slots** that you can use to add additional memory and Graphic Processing Units (GPUs) over time for a better video gaming experience.

## **Laptop**

Laptops, small enough to fit in your lap, has a screen on the top half and an integrated keyboard and trackpad on the bottom. The great advantage of a laptop is its portability which allows you to work from anywhere—school, home, and coffee shops. In the post-Covid world, with most offices offering hybrid work models, a laptop has become an indispensable possession for some, offering the ability to work from wherever you want. As laptop prices drop, colleges are increasingly requiring students to own a personal laptop for use in class.



Figure: A typical laptop computer

Manufacturers aim to design laptops that are as light as possible and work all day without the need for an external power source. To optimize for portability, the components inside a typical laptop focus on power efficiency, and compromise on performance metrics such as speed to keep the unit light. For these reasons, a laptop may not be as powerful as your desktop CPU. Laptop keyboards can also lack features common in full-sized keyboards such as a dedicated numbers keypad.

However, the benefits of being able to sit at a park bench, airport, or meeting room, pull out your laptop and work or be entertained far outweigh the performance compromises of laptops for most users. As laptops come with a built-in rechargeable lithium-ion battery, you won't need to find a charging source for several hours, even with continuous use. To address some of the limitations of laptops, you can carry a mouse and headphones or wireless earbuds. Some people keep a full-sized monitor, keyboard, and mousepad connected to a docking station at their home or office, so the laptop easily converts into a full-fledged desktop when they work for long hours.

### **Tablet**

A tablet computer (known simply as a tablet) is a microcomputer designed for portability and media consumption. They have screen sizes comparable to that of a laptop, but lack the input/output capabilities of a laptop such as keyboards and mice. Instead, they use touchscreens for input and output, much like a smartphone. Tablets have the same components as other microcomputers—RAM, CPU, storage, microphone, camera, and speakers, and they connect to the Internet through Wi-Fi, just like most other portable devices. Some tablet models also support Internet connectivity over a cellular network.



Figure: A typical tablet computer

The motivation behind tablets is to have a basic computer that is inexpensive, can be carried easily and be turned on quickly to consume media in a convenient way. If you want to watch cooking shows in your kitchen, read books in subway stations, or attend web conferences from airport lounges, a tablet may be the optimal device for you.

### Smartphone

Smartphones are portable computers that connect to the internet using cellular telephone networks. Apple kickstarted the smartphone era when it launched the iPhone in 2007. While mobile phones with rudimentary internet capabilities (e.g., messages and text-based web browsers) existed prior to iPhones, Apple managed to package almost all the capabilities of microcomputers into an easy-to-use device that you could use not only to make calls and send text but also to run most microcomputer applications such as email, word processors, and spreadsheets. Other manufacturers soon followed suit.

Prior to smartphones, we had featurephones that had a non-touch display, press-button based inputs, and a set of built-in features. However, the smartphone is dynamic. You can add new **apps**, remove old apps, and play a newly released game by buying it on an **app store**.

Smartphones have almost removed the need to carry around many other electronic devices. People have stopped carrying basic cameras and camcorders, can use their phones as a flashlight, alarm clock, radio, compass and even a measuring device.

### Smartwatch

Smartwatches are the newest entrants to the microcomputer line-up. They can perform their own processing or pair with phones to connect to **networks**. Because of their size limitations, they obviously don't have a keyboard and mouse, but they make up for that shortcoming in other ways, primarily by leveraging their seamless connectivity with smartphones.

**Streaming services** make it easy for you to save music on your watch. Because smartwatches can connect with peripherals, you can put your ear buds on and go for a walk, while listening to

your favourite songs streaming out of your watch. You can also make phone calls and send/receive messages while you are exercising and don't have access to your phone.

The main unique selling proposition (USP) of smartwatches is that they help users improve their health. As microcomputers closest to users and wrapped around wrists, smartwatches have the potential to accurately sense many health parameters. Current technologies already allow smartwatches to monitor heart rates, blood oxygen levels, body temperature, step count, and sleep cycles. Some smartwatches can detect a fall and automatically notify nearby emergency services. Other smartwatches can detect irregular heartbeats and remind you to get yourself checked.

## **1.2 SUMMARY**

Computer, is a programmable machine that can store, retrieve, and process data. Microcomputers are the most commonly used type of computer, and they include desktops, laptops, smartphones, tablets and smart watches.

### **SELF-ASSESSMENT TESTS**

- i. Name type of computers
- ii. What part of the computer is known as the brain?

### **TUTOR-MARKED ASSIGNMENT**

- a. What is a computer?
- b. Why is the device called computer?
- c. What are the elements of a computer?

## **1.3 REFERENCES/FURTHER READING**

Yazcayir, Nevriye and Sewik (2015). "ICT competencies of class teachers."International Journal of Innovative Research in Education. 3(1).

Richard, Parsons and Harber, S. C. eds. (2004). GCSE ICT: the revision guide. Kirkby in Furness: Coordination Group Publications

## UNIT 2.0: The Components of a Computer System

### OBJECTIVES

By the end of this unit students should be able to:

- Identify and describe the various parts of a computer.
- Determine the appropriate specification of memory, storage and processor speed to acquire according to type of use.

### 2.1 ARCHITECTURE OF THE COMPUTER

A computer comprises both **hardware** and **software**. Computers take signals from input devices, process these inputs using instructions loaded in their memory, and send the output to an output device. The input devices, processor and output devices constitute the hardware, and the instructions used to perform the flow and processing of data constitute the software.

This general architecture of a computer is known in the industry as the Von Neumann architecture, shown in the figure below, and the flow of input and output signals is almost unchanged since the original 1945 specification.

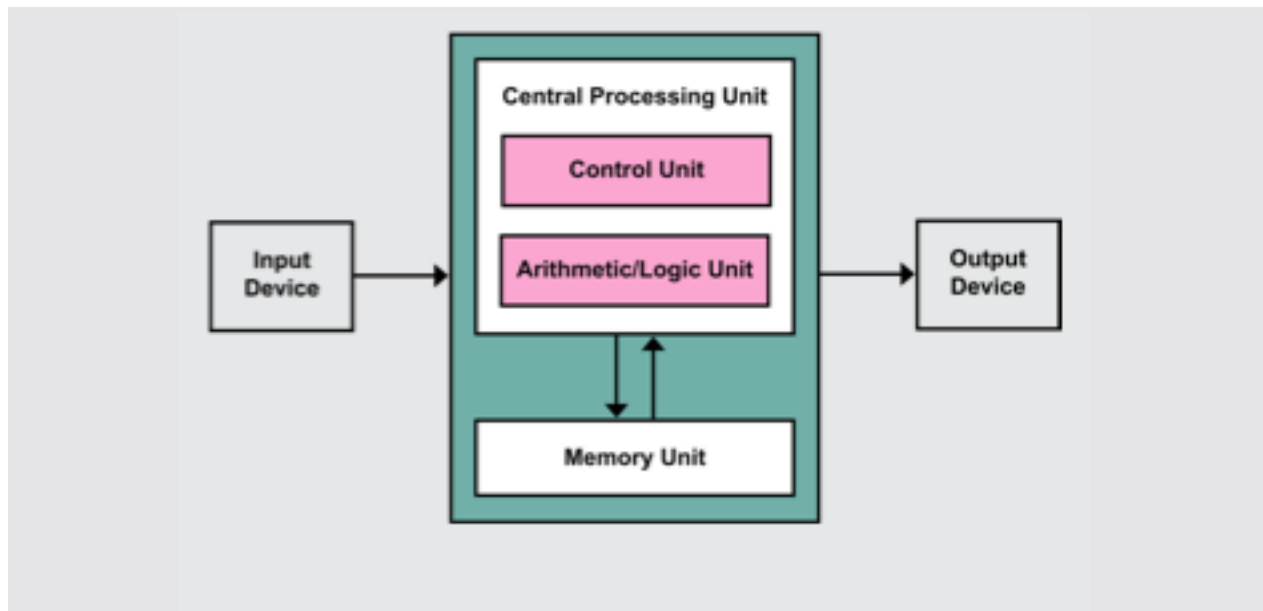


Figure: The Von Neumann architecture of a computer

We will now look at basic hardware components of the computer—the physical parts of a computer you can touch and feel – and then examine the core parts of computer software—the instructions that tell a computer what to do.

## Motherboard

The motherboard is a large circuit board that holds the wiring that connects all the components of a computer. The motherboard of a computer is analogous to the layout of a city or town. The layouts of most towns and cities have well- designed roads connecting homes, schools, parks, libraries, and office complexes. When a city or town is planned, the designers anticipate user needs and come up with an architecture to connect the different parts of the town and facilitate the quick movement of people and goods.

The motherboard does for a computer what the layout does for a city. The motherboard is a plan to place various computer parts (processor, memory, storage, input and output devices) in the right locations and connect them to each other, so all the parts get the necessary power and are able to communicate with each other at their rated speeds. A typical motherboard is shown in the Figure below.

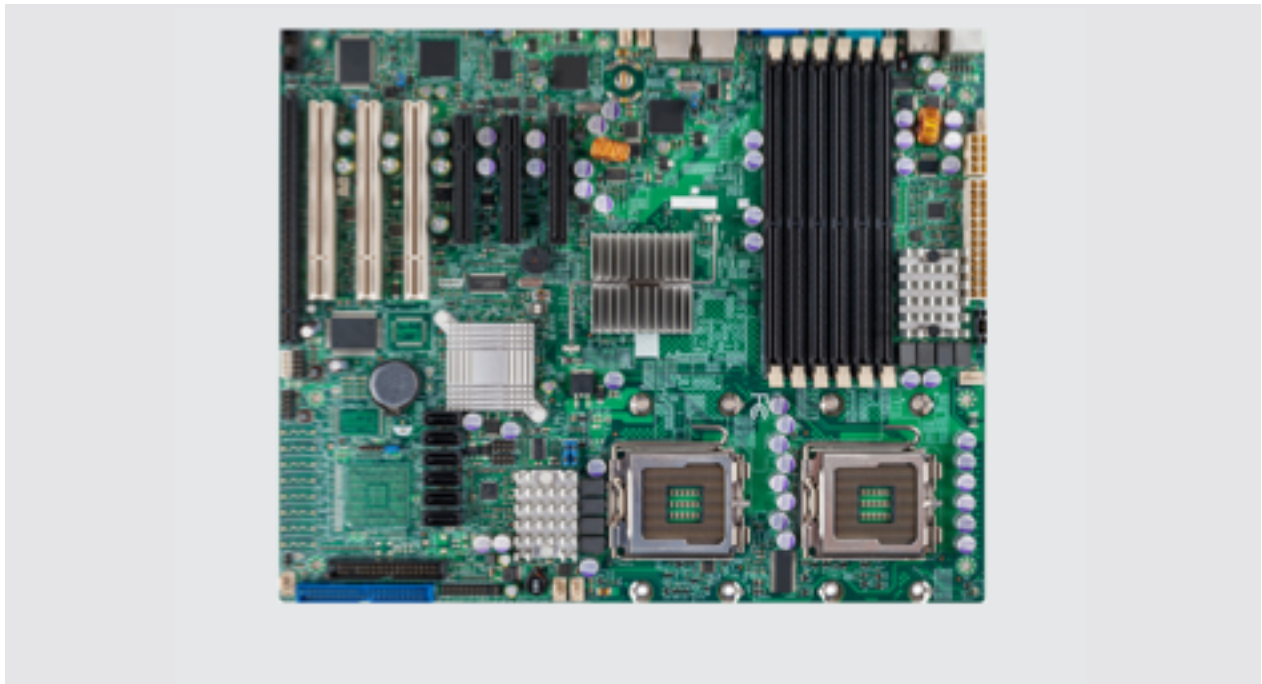


Figure: The motherboard of a computer

A motherboard has designated slots for the other core computer components and also distributes the right amount of power to each component. To dissipate the heat generated by high performance processors, motherboards also have mechanisms to attach heat sinks and fans. The motherboard also has data paths called a bus to move data at high speeds between the components. The motherboard may also have expansion slots for you to add additional memory and GPUs (Graphical Processing Units) to allow the computer to scale if needed.

### Central Processing Unit (CPU)

The Central Processing Unit (CPU) is the brain of the computer and performs all the computations necessary to execute the user's command. Modern CPUs implement the Von

Neumann architecture shown previously. The core technological marvel that enables CPU capabilities is the **transistor**. A transistor is an electronic device that amplifies a signal. To create the binary behaviour necessary for computer operation, the transistors used in computers are highly sensitive and effectively act as switches. When the input is low, these transistors block the connection (interpreted as 0) and when the input is high, the transistors enable the connection (interpreted as 1). By rapidly switching between 0 and 1 as directed by the software instructions, transistors help CPUs perform the necessary computations for the user. Modern CPUs have many transistors to do complex data processing. CPUs in popular computers today can have over 100 billion transistors.

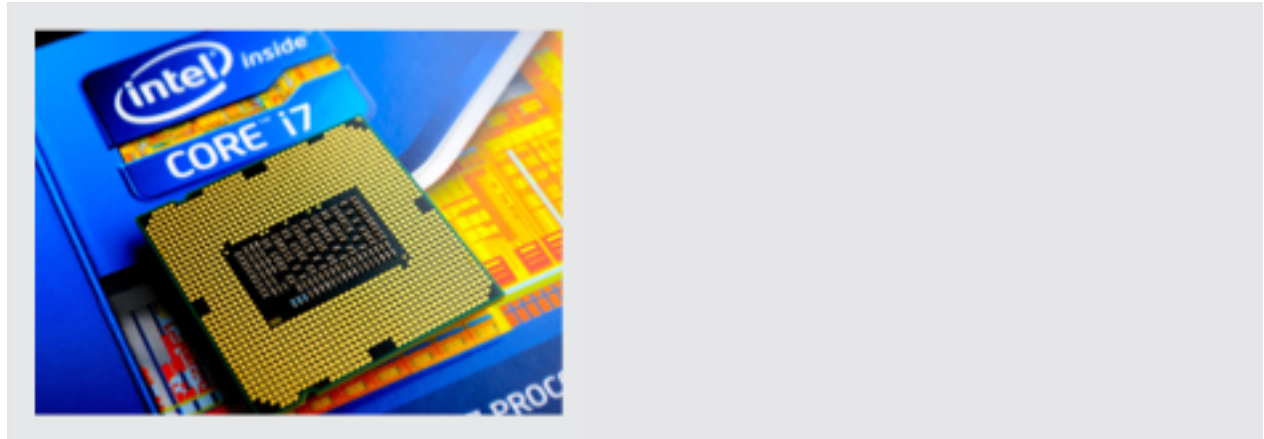
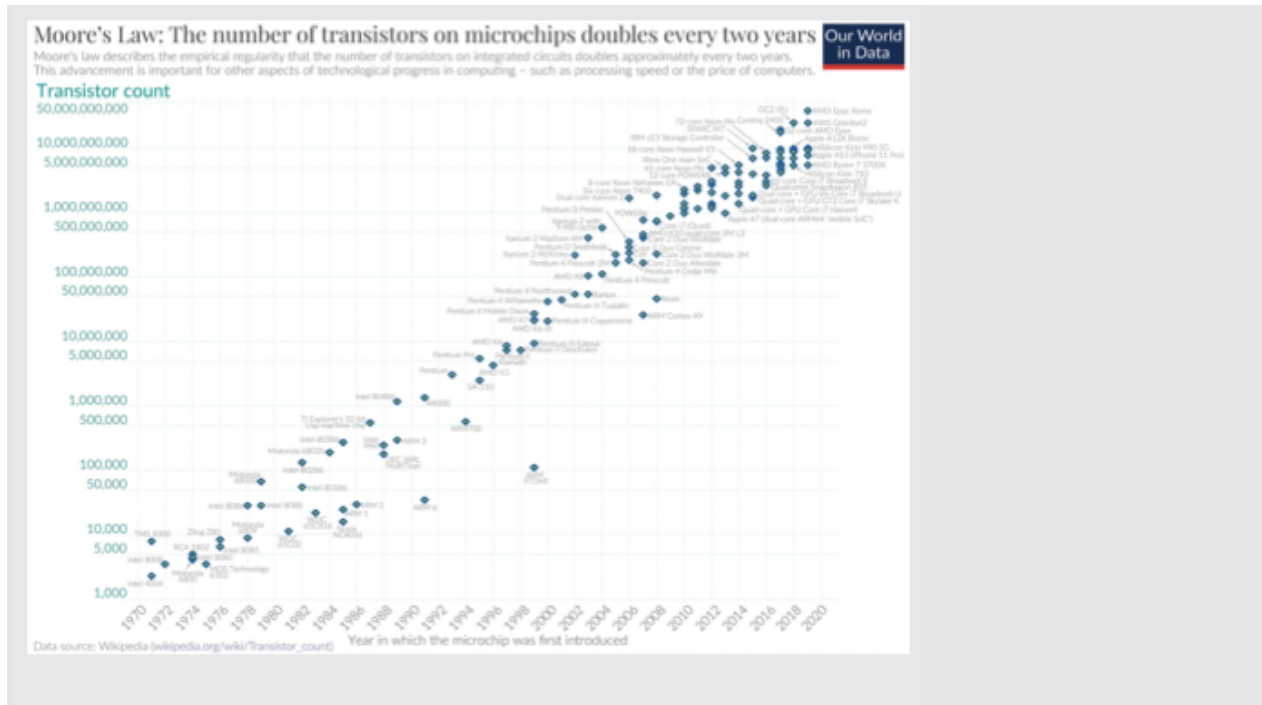


Figure: The Intel i7 CPU

Transistors are one of the world's most sustained innovations. In 1971, Intel's first CPU, the Intel 400441 had 2,300 transistors and cost \$200, for a cost of \$0.10/ transistor. The transistors in the Intel 4004 were able to switch between 0 and 1 about 740,000 times per second. Performing each instruction took about 8 switches, and the Intel 4004 was able to complete about 92,000 instructions per second. In 2022, the AMD Epyc 7773X45 chip has 26 billion transistors, and sells for ~\$9,000, for a cost of \$0.0000003 per transistor. While instructions are now considered a simplistic metric, this chip is likely to perform the equivalent of 1.8 trillion instructions per second. So, while the cost per transistor has fallen by a factor of 250,000 between 1971 and 2022, the capabilities have gone up by a factor of almost 20 million. This revolution in costs and capabilities is the key enabler of digitally driven changes in our economy.

CPUs tend to follow Moore's law, the observation made by Gordon Moore (founder and CEO of Intel) in 1965 that the number of transistors on a microchip doubles approximately every two years. This is seen in the graph below, the growth in the number of transistors on microchips for 50 years since 1970.



This exponential growth has not only given us faster computers but has also made them smaller, cheaper, and less power hungry. This has enabled form factors such as smartwatches and enabled even low-income people in developing countries to own computers and smartphones and communicate over the World Wide Web.

Before you decide to buy a computer with the latest, most powerful CPU, you should keep in mind that the CPU is also typically the most expensive part of your computer. You may never utilize the power of the CPU if you plan to use the computer just to create Word documents, PowerPoints, write emails, and browse the web.

### **Random Access Memory (RAM)**

Random Access Memory (RAM) is the main memory (primary storage) of the computer system. It is used to temporarily store computer instructions that need to be accessed frequently, along with the data processed by these instructions. For example, when you launch the Chrome browser, the CPU needs a place to temporarily store the Chrome program as well as the webpages you are viewing and track all the changes you are making.

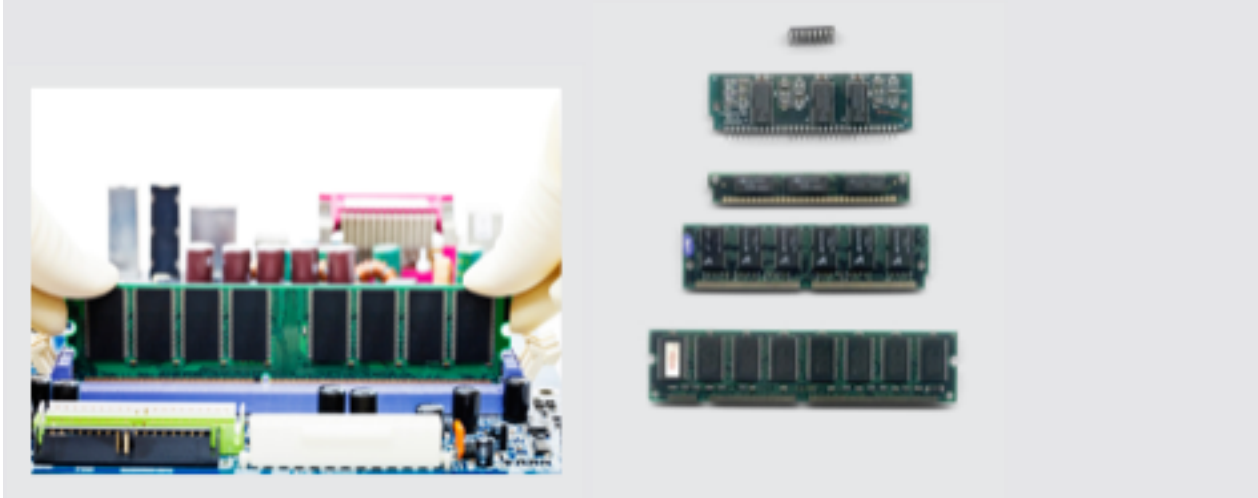


Figure: Computer Memory (RAM)

RAM is only operational when it is powered. Even a momentary power loss clears up the contents in RAM.

Memory comes in many types. In addition to RAM, modern CPUs also have extra-fast memory within the processor chip called the **cache**. The cache is designed for instructions and data to be readily available within the CPU for instant access.

As of 2020, the cache memory within the processor chip is 10–100 times faster than RAM memory. It takes 1–4 nanoseconds to retrieve data from the cache, and about 100 nanoseconds to retrieve data from RAM.

If you end up consuming all available RAM in your computer, for example by opening many tabs on your browser, your browser can become slow and might even crash. Computers try to augment RAM by using space on the hard drive as an extension of the computer's RAM. This additional space is called the **page file**, or **virtual memory**. Since the hard drive is usually many times slower than RAM, your computer's performance could get noticeably slower as the page file use increases.

### Measuring Memory and Storage Capacity

RAM size is typically measured in gigabytes (approximately 1 billion bytes). One byte is equal to 8 bits. A bit, the unit of computer information, is a binary digit and takes a value of either a 1 or a 0. All information, whether in text, photo, audio, or video format, is converted into binary format and represented as bytes. Once this translation happens the computer can store it in RAM and process it in the CPU.

RAM is one of the most critical components to speed up a computer. Your RAM requirement is one of the key decisions you'll need to make before purchasing a computer.

### How Much RAM Do You Need?

Generally, 8GB of RAM is recommended for casual computer usage and Internet browsing, 16GB for spreadsheets and other office programs, and at least 32GB for gamers and multimedia

creators. How you use your computer influences how much RAM you need, so the following can be used as a guideline.

Type of User	Recommended RAM
<b>Casual User</b> <b>Internet browsing, email, listening to music, or watching videos</b>	At least 8GB
<b>Intermediate User</b> <b>Internet browsing, email, Word Processing, spreadsheets, running simple graphics programs, flash games, music, videos or multitasking</b>	At least 16GB
<b>Professional User/Gamer/Graphic Designer</b> <b>High performance gaming, multimedia editing, high-definition video, graphic design/3D modelling, intensive multitasking</b>	At least 32GB

## Storage

Computer storage is the technology that stores the software (e.g., operating system and applications) and data on the computer. Storage is also popularly known as hard drives. A critical feature of storage technology that differentiates it from RAM is that applications and data are retained in storage even after the power is turned off. This ability to retain data for long periods without power or external connectivity allows you to store software and relevant data (e.g., documents, games, songs, and movies) in your computer throughout your school years and beyond. When the computer is powered on, the computer loads the operating system from storage into memory. Since RAM cannot store data unless the computer is on, every computer comes with in-built secondary storage to keep your content safe when it is powered off.

Modern storage devices have reasonably large capacities and can store all the data and applications most users need. If your storage needs exceed the capacity of the built-in storage device, you have a few options. Most users connect external storage devices to augment the storage capacity of their computers. External storage is typically connected to your computer using a USB cable.



Disk drives in a typical desktop computer



External storage devices

Cloud storage services such as DropBox, Box, OneDrive, iCloud, and Google Drive are also options to store personal data for a fee. Cloud services eliminate the risk of data loss. Cloud services like Backblaze52 offer even more comprehensive backup capabilities, saving all the files on a computer. Both external drives and cloud services can also be used to back up your data and move it between computers.

Your storage needs depend upon the kind of information you work with. If you work mostly with text, your typical Word document will be a few kilobytes (1 kilobyte = 1,000 bytes) in size. Photos are usually larger, about 4–5 megabytes (1 megabyte = 1,000 kilobytes or 1 million bytes) in size. Higher resolution photos can be even larger. Audio files are comparable in size to photos, with each song typically taking up about 5MB (in compressed formats like MP3) and about 50MB in CD quality uncompressed formats. 4k videos in current smartphones take up about 1 gigabyte (1 gigabyte = 1,000 MB or 1,000,000 bytes) per minute. The table below shows the common prefixes for file sizes.

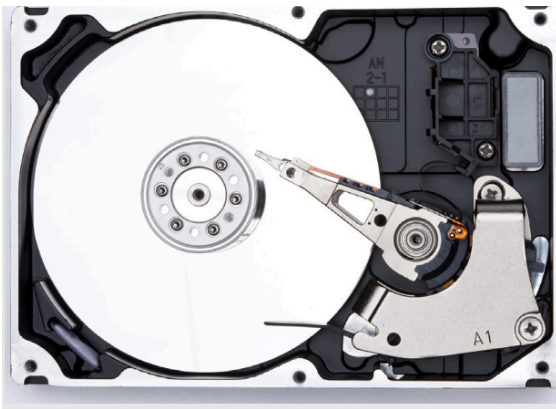
Memory unit	Description
Kilobyte	1 KB = 1024 Bytes
Megabyte	1 MB = 1024 KB
Gigabyte	1 GB = 1024 MB
Terabyte	1 TB = 1024 GB
Petabyte	1 PB = 1024 TB
Exabyte	1 EB = 1024 PB
Zettabyte	1 ZB = 1024 EB
Yottabyte	1 YB = 1024 ZB
Brontobyte	1 Bronto Byte = 1024 YB
Geobyte	1 Geo Byte = 1024 Bronto Bytes

### HDD vs SSD vs Portable Flash Drives

There are two popular storage technologies currently in use—magnetic disks and solid-state disks. Magnetic disks store data as changes in magnetization on tracks on a disk. Solid state disks

(SSD) store data as the charge state of a transistor. Let's take a quick look at each type of storage.

Magnetic disks, also called hard disk drives (HDDs), are a legacy technology that store digital data on glass platters coated with magnetic material. Data is stored as the direction of magnetism of the material. HDDs have a reader head that can magnetize portions of the disk during the writing process and read the direction of magnetization during the read process. The disks in an HDD spin as fast as possible, while the head writes or reads data on the disk. The weight of the rotating platter makes hard disks heavy, slow, noisy, and hungry for power. However, at the current time, HDDs are cheaper than SSDs and can store significantly more data than SSDs. So, if you plan to store a lot of media files (songs, movies, and games), hard disk drives may be a good secondary storage option for you.



A hard-disk drive (HDD)



Solid-state drives (SSD)

Solid-state drives (SSDs) are a newer type of storage devices that use transistors to store data. The transistors used in SSDs can save a charge even when not connected to power, enabling them to save data over long periods. SSDs do not have any moving parts, unlike HDDs. Not having any moving mechanical parts allows SSDs to be faster, longer lasting, and power efficient. Most newer computers come installed with SSDs as the primary internal storage.

As of 2020, it takes 16,000 nano seconds (16 microseconds) to read data from an SSD and 2,000,000 nano seconds (2 milli seconds) to read data from a hard disk drive. Thus, RAM is 25 times slower than L2 cache, SSD is 160 times slower than RAM and magnetic disks are 125 times slower than solid state disks.



Flash drives are also called USB sticks or thumb drives

A popular small version of an SSD is called a portable flash drive (also known as a USB stick). These devices are designed to be compact and often given out as company swag for marketing purposes. If you plug the flash drive or USB stick into your computer, the system will automatically detect the USB key as a storage device and the contents of the key become available in your File Explorer. You can treat the USB key like a storage device into which you can add or remove files. USB sticks are useful when you want to move content from one computer to another.

## **Bus**

The bus in a computer is a communication system that transfers data between a set of components. As we have seen, the components on a computer operate at vastly different speeds. Buses allow the CPU to operate at the highest speeds possible, without getting slowed down by the slowest components. The buses in the earliest computers were simply a set of wires connecting components. Developments in bus technologies have enabled CPUs to become significantly faster even as peripherals like printers and keyboards (and human users) have not evolved at a comparable pace. Modern micro-computers have several buses, each operating at its own speeds.

## **GPU**

A graphics processing unit (GPU) is a computing technology designed to run several small programs simultaneously. While modern CPUs have multiple cores and threads and can run tens of multiple programs in parallel, GPUs can run thousands of programs in parallel. The overall size of the processor chip is about the same in both CPUs and GPUs. While CPUs are organized as a small number of highly capable processors, GPUs are organized as many relatively simple processors with relatively limited capabilities. For most tasks, the complexity of CPUs is sufficient. However, for a small subset of tasks, mostly in image processing and machine learning (ML), there is a need to perform many simple operations in parallel. As image processing becomes popular for gaming and machine learning becomes popular for artificial intelligence, GPUs have become increasingly popular. This is also reflected in the market caps of the principal CPU manufacturer, Intel (\$120bn) and the principal GPU manufacturer, Nvidia (\$400bn).

A lot of young people use personal computers primarily to play video games. Over time, the games have become hyper-realistic and take place in a fantasy world where artificially created characters interact with each other. Complex lighting and shadow patterns on high resolution monitors with fast refresh rates can make these games very realistic. For a while, CPUs were stretched thin dealing with complex gaming algorithms and high-resolution images designed to simulate a true-to-life experience.

The computing industry addressed the problem by introducing chips dedicated to processing graphics and rendering video content on the screen. These chips, known as GPUs work in tandem with the CPU of the computer. The CPU handles the user input and does all the computations (e.g., Did two objects collide? What is the location of objects on the screen). So, the CPU is still the overall boss, but it can send video gaming/image processing workloads to the

GPU, which does the computations needed to render each pixel (e.g., colour, shading, brightness) in the frame. Modern high-resolution gaming monitors can have over 8 million pixels (3,840 x 2,160) and with frames refreshed 60 times a second (refresh rates), about 500 million computations are needed each second to just display the images on the screen. While this is a lot of computations, all the computations are similar and simple. These are a perfect fit for GPUs, and therefore CPUs delegate these computations to GPUs for optimal performance.



Intel's integrated GPU



Intel's discrete GPU

GPUs themselves come in two formats: Integrated GPU and Discrete GPU. Integrated GPUs look like just another chip on the motherboard and cannot be upgraded by the end user. On the other hand, Discrete GPUs can be purchased, replaced, and upgraded by the end user. It connects to the motherboard through an expansion slot on the PCIe bus and comes with its own cooling fans. Typically, Discrete GPUs are far more powerful than Integrated GPUs.

### GPUs for Video Content Creation

Because GPUs were originally designed to handle fast/high resolution video rendering, they have become the go-to choice for video content creators, too. If you like to capture videos, edit them, splice them with additional audio/video content, then a powerful GPU on your PC will make your video editing program much faster. Whether you are an anime creator, an Adobe Photoshop user, or a producer of content for educational purposes, you may consider buying a computer with a powerful GPU or adding one to your current system.

### GPUs for Machine Learning

Even though GPUs were designed primarily for graphics and video rendering, data scientists working on machine learning (ML) models also found GPUs useful. The job of going through all photos uploaded by users to Facebook and removing objectionable content is a difficult and expensive task for humans. Facebook users upload more than 350 million photos per day. To manually view each one and determine if it is suitable for consumption can be daunting. Machine learning algorithms are an effective and cheap way to do the job. As most machine learning algorithms involve a lot of identical operations (addition and multiplication), GPUs are great ML use cases.

## Input Devices

As computers are designed to interact with humans, they need a mechanism to take our commands and return responses. An input device is a medium through which we can provide actionable tasks for computers. Let's look at some common input devices to understand them better.

### Keyboard

A keyboard is the primary input mechanism of a computer. Keyboard commands get translated into emails, chat messages, clicks on a browser screen, video game movements, or others depending on the program receiving the input. As the standard English keyboard has the letters Q, W, E, R, T, and Y on the top row, it is known as QWERTY. See Figure below. This arrangement, designed for typewriters, was intended to avoid jamming typebars striking on paper and is, unfortunately, not the most efficient layout for modern computers.



A standard English keyboard, also known as QWERTY

For touch typists (those who type without looking at keys), the letters F and J have a small, raised dot. The dots are meant to help you place your forefingers on the keyboard before you begin typing. You can connect any new keyboard to your desktop or laptop through USB or Bluetooth.

### Mouse and Trackpad

If you look closely at your computer screen, you will see a small arrow. This arrow tells the computer where to focus. You can use your mouse/trackpad to shift the point of focus any time. Your mouse/trackpad typically has two buttons, left and right. We use the left button to click and select objects, and the right button is used to open contextual menus that change based on your location. The mouse also has a wheel to scroll through multiple pages easily. If you have a wireless mouse, you can connect it to your device via Bluetooth software.



A typical mouse

The trackpad of a laptop

The mouse is popular with desktop computers and office areas with sufficient desktop space to move the mouse. Since laptops are often used in tight spaces (e.g., airport seats) with no room to place a mouse, most modern laptops come with touchpads to replace the mouse as a tactile input device. Touchpads or trackpads use a specialized surface to translate the position of a user's fingers on the device to a location on the screen. The screens of modern smartphones also serve as touchpads.

### **Camera and Microphone**

With the popularity of remote work in the post-Covid world, many employees use Zoom, Webex, GoTo, Teams, or Google Hangouts daily to join meetings and conferences. Often, you'll be required to keep your video and audio on to participate and have the feeling of being in a room with other participants. All these programs depend on the camera and microphone on your computer to share your video and audio with other meeting participants.



A webcam

As online meetings become increasingly important for school and work, the quality of the camera and microphone are becoming increasingly important differentiators of laptops. If these devices are not satisfactory, you can buy and connect an external high-resolution camera and a high-fidelity microphone to your computer to improve your remote-working experience.

### **Output Devices**

After a computer accomplishes your tasks, the output devices will communicate the outcome of the actions. A monitor is the primary output medium that you will interact with all the time, whether you watch a movie on Netflix, type an email to a friend, or work on a spreadsheet.

Since you will spend most of your time on the computer looking at the monitor, the monitor has a significant impact on your end-user experience. Fortunately, most modern monitors provide excellent performance at an affordable price. Some extra monitor features may come at a price. For example, touch screens are interesting, but they also consume more power and add weight to the laptop cover. Similarly, large screens are useful during work, but reduce portability. It is therefore useful to carefully assess your needs before you select a monitor.

### **Speakers**

Most Laptops and PCs come with built-in speakers to play audio. Most laptops today have very good sound output, including some models which use four speakers to produce rich, realistic sound. It is also becoming increasingly common for users to use earbuds or headphones to

minimize disturbance to nearby users. Further, to improve the quality of sound, particularly if you watch videos on YouTube or listen to music on Spotify, you may attach your own high-fidelity speaker through the USB ports or use Bluetooth to connect to wireless earbuds.



## **SUMMARY**

Computer, is a programmable machine that can store, retrieve, and process data. Microcomputers are the most commonly used type of computer, and they include desktops, laptops, smartphones, tablets and smart watches.

## **SELF-ASSESSMENT TESTS**

- i. List 5 input devices
- ii. List 5 output devices

## **2.2 TUTOR-MARKED ASSIGNMENT**

- a. What is a computer?
- b. Why is the device called computer?
- c. What are the elements of a computer?

## **2.3 REFERENCES/FURTHER READING**

Williams, B.K & Sawyer S. (2005). Using Information Technology: A practical introduction to computers and communications. Boston, Massachusetts: Mc Graw Hill Technology.

## UNIT 3.0: Computer Operating Systems and Networks

### OBJECTIVES

By the end of this unit students should be able to:

- Identify and describe the various operating systems used in computing devices.
- Describe the different types of computer networks
- Determine the appropriate specification of memory, storage and processor speed to acquire according to type of use.

### 3.1 Introduction

In order for the hardware components of a computer to work in a coordinated manner, software must be installed that tells these hardware components what to do. An **operating system** is the primary software that manages all the hardware, as well as other software on a computer. The operating system, also known as an "**OS**," interfaces with the computer's hardware and provides services that **applications** can use.

While the operating system is the main software acting as the brain of the computer, you'll generally need to install many other end-user applications (e.g., Chrome, Instagram, DropBox, Spotify, and others) to turn the computer into a versatile assistant.

#### What Does an Operating System Do?

The operating system sits in between the applications you run and the hardware, using the hardware **drivers** as the interface between the two. For example, when some other software application wants to print something, it hands that task off to the operating system. The operating system sends the instructions to the printer, using the printer's driver to send the correct signals. The application that's printing doesn't have to care about what printer you have or understand how it works. The OS handles the details.

Any software program is a collection of instructions to the CPU to perform a task. These instructions are expressed in binary code for the CPU to perform the required operations. Afterward, the output is conveyed to us through the correct output device, which translates the 1s and 0s into images, sounds, and text.

### 3.2 What is Computer Network?

A computer network is a set of devices connected through links. A node can be computer, printer, or any other device capable of sending or receiving the data. The links connecting the nodes are known as communication channels.

#### Computer Network Types

Below are the most common computer network types that are frequently used these days:

- LAN [Local Area Network}
- WLAN [Wireless local area network]
- CAN [Campus Area Network]
- MAN [Metropolitan Area Network]
- PAN [Personal Area Network]
- SAN [Storage Area Network]
- VPN [Virtual Private Network]
- WAN [ Wide Area Network]

## 1. LAN



LAN or Local Area Network is a group of devices connecting the computers and other devices such as switches, servers, printers, etc., over a short distance such as office, home. The commonly used LAN is Ethernet LAN. This network is used as it allows the user to transfer or share data, files, and resources.

## 2. WLAN

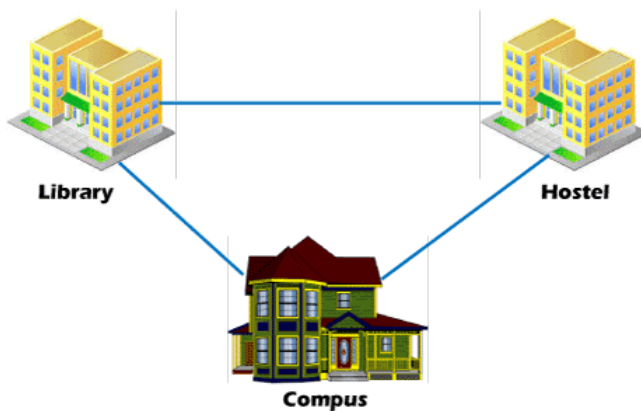
### **WLAN ( Wireless Local Area Network)**



WLAN or Wireless local area network is similar to LAN with the difference that it uses wireless communication between devices instead of wired connections. WLAN typically involves a Wi-Fi router or wireless access point for devices, unlike smartphones, laptops, desktops, etc.

### **3. CAN**

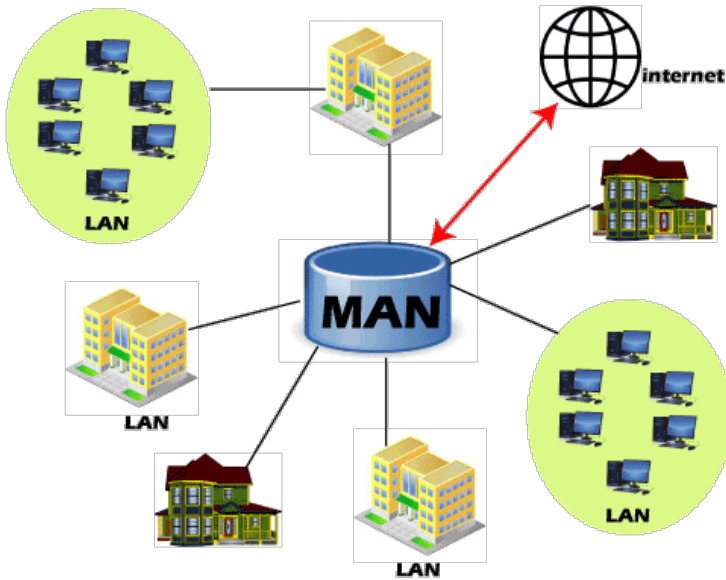
#### **CAN ( Campus Area Network)**



CAN or Campus Area Network is a closed corporate communication network. A CAN is a mobile network that may contain a private or public part. CANs are widely used colleges, academies, and corporate sites.

### **4. MAN**

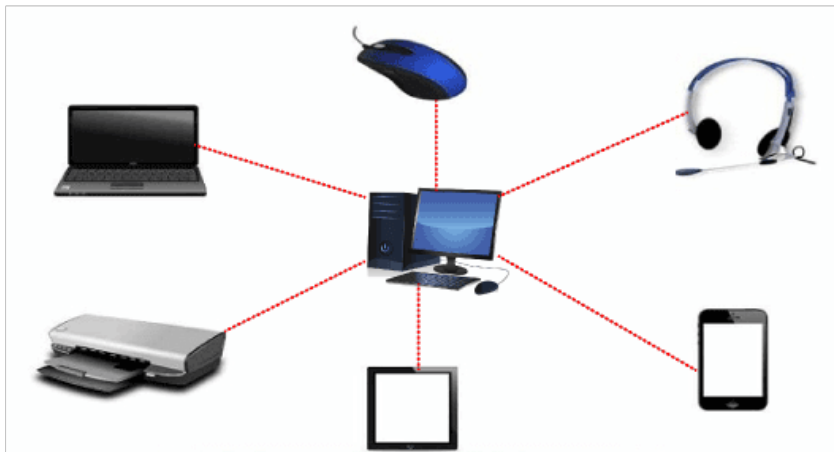
## MAN ( Metropolitan Area Network )



MAN or Metropolitan Area Network is typically a more extensive network when compared to LANs but is smaller than WANs. This network ranges between several buildings in the same city. Man networks are connected via fiber optic cable (usually high-speed connection). Cities and government bodies usually manage MANs.

## 5. PAN

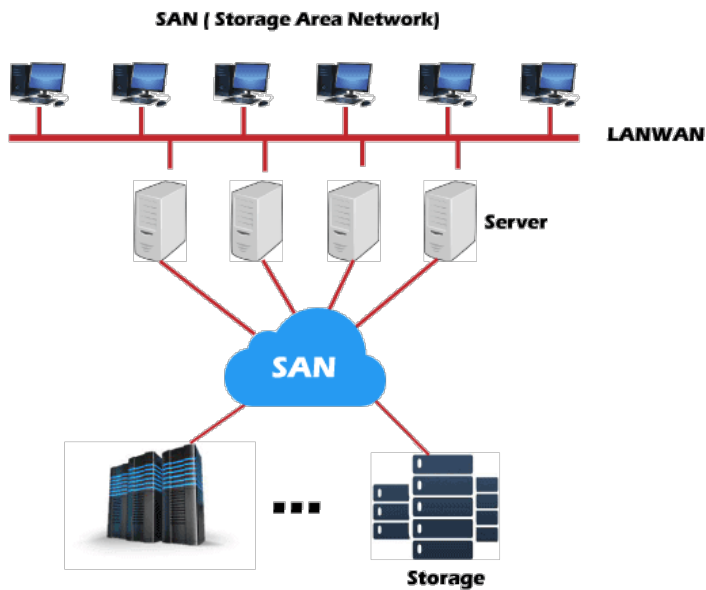
### PAN ( Personal Area Network )



PAN or Personal Area Network is a type of network used personally and usually serves one person. This network usually connects devices unlike your smartphones, laptop, or desktop to

sync content and share small files, unlike songs, photos, videos, calendars, etc. These devices connect via wireless networks such as Wi-Fi, Bluetooth, Infrared, etc.

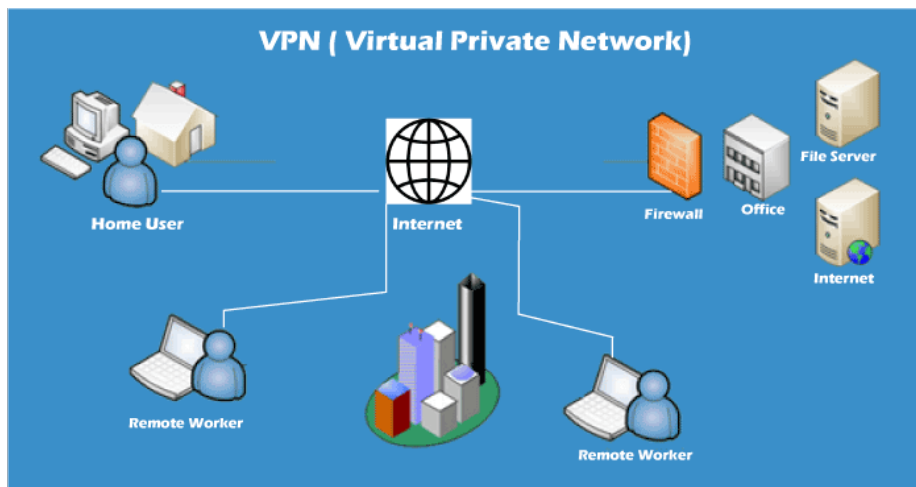
## 6. SAN



**SAN or Storage Area Network** is a specialized high-speed network that stores and provides access to block-level storage. It is a dedicated shared network that is used for cloud data storage that appears and works like a storage drive.

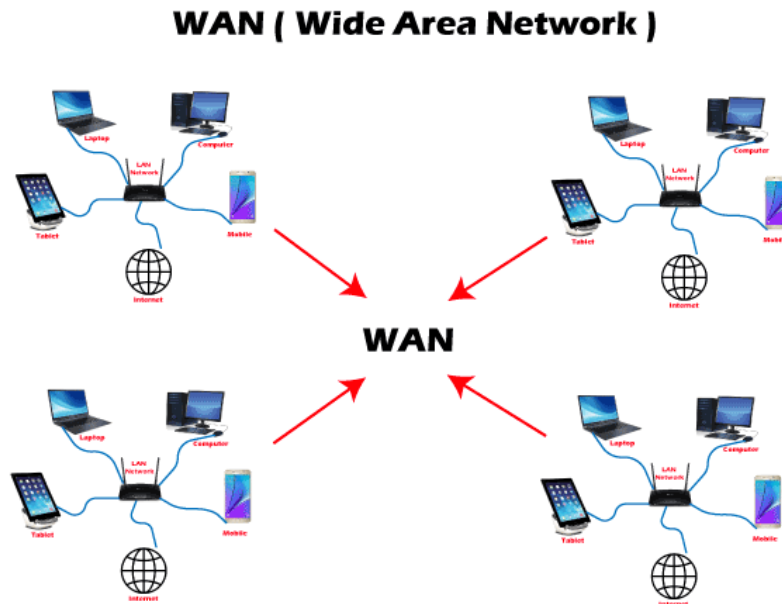
SAN consists of various switches, servers, and disks array. One of the advantages of SAN is that it is fault-tolerant, which means if any switch or server goes down, the data can still be accessed.

## 7. VPN



**VPN or Virtual Private Network** is a secure tool that encrypts point-to-point Internet connection and hides the user's IP address and virtual location. It determines an encrypted network to boost user's online privacy so as their identity and data are inaccessible to hackers.

## 8. WAN



**WAN or Wide Area Network** is the most significant network type connecting computers over a wide geographical area, such as a country, continent. WAN includes several LANs, MANs, and CANs. An example of WAN is the Internet, which connects billions of computers globally.

### Unit 4: Application of computers in business

Computers play a critical role in modern businesses, enhancing efficiency, productivity, and communication across various departments and functions. Here are some uses of Computer in Business or Role of computer in business or Application of computer in business:

#### 1. Data Management and Storage

Computers are used to store and manage large volumes of business data, including customer information, financial records, inventory data, and more. Databases and file management systems help organize and retrieve this information efficiently.

#### 2. Communication

Computers facilitate communication within and outside the organization. Emails, instant messaging, video conferencing, and collaboration tools enable seamless communication among employees, teams, and clients regardless of their physical locations.

### **3. Accounting and Financial Management**

Computers are essential for accounting tasks, including bookkeeping, financial analysis, budgeting, and payroll processing. Accounting software helps streamline financial operations and ensure accurate record-keeping.

### **4. Sales and Marketing**

Computers are used for customer relationship management (CRM) systems, sales tracking, and marketing automation. These tools help businesses manage leads, track customer interactions, and create targeted marketing campaigns.

### **5. Inventory Management**

Computers assist in tracking inventory levels, monitoring stock movement, and automating reordering processes. This helps prevent stock outs and overstocking while optimizing supply chain efficiency.

### **6. E-commerce**

Computers enable online selling through e-commerce platforms. Businesses can set up online stores, manage product listings, process orders, and handle payment transactions electronically.

### **7. Business Analytics**

Computers are used to analyze data and generate insights from various sources. Business intelligence tools help in making informed decisions by visualizing and interpreting data trends.

### **8. Human Resources Management**

Computers are used for employee records, recruitment, performance evaluations, training programs, and payroll processing. Human resources information systems (HRIS) streamline HR operations.

## **9. Document Management**

Computers help in creating, editing, and sharing documents digitally. Document management systems ensure version control, access permissions, and efficient collaboration on documents.

## **10. Project Management**

Computers support project planning, scheduling, and tracking. Project management software helps teams coordinate tasks, allocate resources, and monitor project progress.

## **11. Customer Support**

Computers assist in providing customer support through online chat, ticketing systems, and knowledge bases. Businesses can address customer inquiries and issues promptly using these tools.

## **12. Supply Chain Management**

Computers help optimize the supply chain by tracking inventory, orders, shipments, and suppliers. This enhances supply chain visibility and reduces operational inefficiencies.

## **13. Data Analysis and Reporting**

Computers process and analyze business data to generate reports and insights that guide strategic decisions. Data visualization tools make it easier to understand complex information.

## **14. Remote Work and Telecommuting**

Computers enable remote work arrangements by providing employees access to company resources, applications, and data from their home or other remote locations.

## **15. Security and Cybersecurity**

Computers are used to implement security measures, including firewalls, encryption, and authentication protocols, to safeguard business data and systems from cyber threats.

## **SELF-ASSESSMENT TESTS**

- i.** What is an operating system?
- ii.** Which category of computer network does the internet belong to ?

## **TUTOR-MARKED ASSIGNMENT**

1. What is a computer network?
2. Name the different types of computer networks
3. Discuss four uses of computers in business

## **REFERENCES/FURTHER READING**

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Williams, B and Sawyer S. (2005). introduction to Computers and Information Technology: by emergent learning. Boston, Massachusetts: Mac Graw Hill Technology