UNIVERSITY OF ILORIN
FACULTY OF COMMUNICATION AND INFORMATION SCIENCES
DEPARTMENT OF COMPUTER SCIENCE

COURSE CODE: MAC 251
COURSE TITLE: Fundamentals of Communication and Information Sciences
Prepared By: Dr. A. L. Azeez; Dr. S.A. Olarongbe; Mr. H.A. Mojeed; Mr. I.A. Sikiru; & Mr. Q.R. Adebowale.

Pre-print Edition

STUDY GUIDE
MAC 251 FUNDAMENTALS OF COMMUNICATION AND INFORMATION SCIENCES

Introduction
Fundamental of Communication and Information Sciences is a Faculty course that is designed to expose the students of the Faculty of Communication and Information Sciences to the fundamentals of communication and information which are common and which bind the five programmes or departments in the Faculty. It is a harmattan semester course, which all 200 level students of the Faculty must take and pass. An essential, and most significant part of the course, is its extensive dwell on the various career opportunities in the information and communication industry, particularly as they are unique and specific to each of the five programmes in the Faculty. Therefore, the course entails the specific fundamentals that are unique and common to all information and communication processes either through the mass media, computer technology, telecommunication technology or the library. It also emphasizes entrepreneurship endeavours, whereby students are made to present a business plan for establishing and operating any information and communication enterprise that is related to any of the five programmes in the Faculty. It is, though, housed in the Department of Mass Communication, it is co-taught by other lecturers from other Departments in the Faculty.

Course Goal
The primary goal of this course is expose students of the Faculty to the fundamentals of information and communication process in mass media, computer technology, telecommunication technology and library with the purpose of initiating the students to career opportunities in the communication process or industry which they might develop as a future career.
Related courses: MAC 101: Introduction to Mass Communication & other introductory courses in other Departments.

Prerequisite: *–*

Needed for: *–*

Learning Outcomes
At the end of this course you should be able to:

I. Identify the fundamentals of communication and information process that are common or unique to Mass Communication, Computer Science, Telecommunication Science, Library Science and Information Science
II. Identify a career opportunity that can be built on from any of the communication and information process inherent in mass communication, library science, computer science, telecommunication science or information science

Course Contents
Module 1 Fundamentals of Communication
Unit 1 Introduction to Communication
Unit 2 Communication Technologies
Unit 3 Mass Communication and its Career Opportunities

Pre-print Edition

Module 2 Information System Planning and Development

Unit 1 Introduction to Systems
Unit 2 Information Systems
Unit 3 System Development Life Cycle Models
Unit 4 Information System Professionals

Module 3 ICT Application in Libraries and Information Centres

Unit 1 Automation of Library and Information Centres
Unit 2 Retrospective Conversion of Bibliographical Information of Library Holdings
Unit 3 Entrepreneurship in Library and Information Profession

Module 4 Information and Communication Technology: An embodiment of mass communication

Unit 1 Communication and ICT infrastructure
Unit 2 ICT and ICT Policy
Unit 3 Current Trends on ICTs for Next Generation Enterprise Information Systems (NG-EISs)

Module 5 Introduction to networking, internet and Network Architecture

Unit 1 Introduction to network and internet
Unit 2 Computer Networking
Unit 3 Network Architecture
Unit 4 Introduction to OSI model/ the OSI and TCP/IP Model
Unit 5 Introduction to Network topologies/ Different types of Network topologies

References

Ad-hoc Networks: Fundamental Properties and Network Topologies: Ramin Hekma: Springer, Year: 2006

Aina, L. O. (2004). Library and information science text for Africa. Ibadan: World and Information Services. 322-330.

Avgerou C. (2011). Information systems development and management The London School of Economics and Political Science. IS2062, 2790062.

Azeez, A. L. (2018): Technological Determinism in Traditional and New Media of Mass Communication, In Traditional and New Media of Mass Communication. Eserinune McCarty MOJAYE (ed.) Abraka: Published by the University of Ibadan Press.

Bittner, J.R. (1997) Mass Communication: Introduction. New Jersey: Prentice Hall.

Building Successful Information Systems – a Key for Successful Organization. Annals of Dunarea de Jos" University of Galati Fascicle I – (2010). Economics and Applied Informatics. - ISSN 1584-0409

Burstein, F. (2002). Systems development in information systems research. In K. Williamson (Ed.), Research methods for students and professionals: Information management and systems (Vol. 2nd edition, pp. 147–158). Wagga Wagga, Australia: Centre for Information Studies, Charles Sturt University.

Capena A. (2010), Integrating ICT into Sustainable Local Policies. ISBN 9781615209293

CCNA INTRO: Introduction to Cisco Networking Technologies Study Guide: Exam 640-821: Sybex, 2006, 9780470068502

Communications and Networking: An Introduction (Computer Communications and Networks) Author(s): John Cowley: Springer, Year: 2007

Drucker, P. (1985). Innovation and Entrepreneurship. London: William Heinemann.

El Kadiri, S., Grabot, B., Thoben, K., Hribenik, K., Emmanouilidis, C., and von Cieminski, G. and Kiritsis, D. (2016). Current trends on ICT technologies for enterprise information systems. Computers in Industry, 79, 14-33.

Fiske, J. (1982). Introduction to Communication Studies. New York: Routledge.

https://www.ict4cart.eu/technologies/ict-infrastructure-architecture#:

Hasan, S. (2014) Mass Communication: Principles and Concepts. New Dehli: CBS Publishers.

Igwe, K. N., Sadiku, S. A. & Edam-Agbor, I. B. (2019). Themes and trends in information science, Lagos: Zeh Communication Limited.145-180.

Preprint Edition

Igwe, K. N. & Uzuegbu, C. P. (2013). Automation of libraries and information centres. Lagos: Waltodany Visual Concepts. 1-21.
Introduction to Computer Networking, Author(s): Thomas G. Robertazzi: Springer International Publishing, Year: 2017
Introduction to networking: Author: Saravanan A.M researchgate.net/publications.2018
Introduction to computer networking Varna Free University "Chernorizec Hrabar" Institute of Technology, Author: Prof. T. Bakardjieva
Introduction to Distributed Computer Systems : Principles and Features: Ludwik Czaja : Lecture Notes in Networks and Systems: Springer International 2018
Kundishora, S. M (2012), The Role of Information and Communication Technology ICT) in Enhancing Local Economic Development and Poverty Reduction
Massey, V., & Satao, K. (2012). Comparing various SDLC models and the new proposed model on the basis of available methodology. International Journal of Advanced Research in Computer Science and Software Engineering, 2(4), 170–177.
Powers G.K. (2003). Information processes and technologies. Heinemann, A division of Reed International Books Ltd, Australia.
Ralph M. Stair (2010). Principles of Information Systems A Managerial Approach Ninth Edition , Florida State University, Course Technology, Cengage Learning.
Texas Project Delivery Framework, U.S. Department of Information Resources (2008). System development Life Cycle guide. Texas Department of Information Resources. Retrieved from http://www.dir.texas.gov/SiteCollectionDocuments/IT%20Leadership/Framework/Framework%20Extensions/SDLC/SDLC_guide.pdf
Vira Viktorivna Shendryk and Andrii Boiko. (2015). Stages of Information System Development in the Process Approach. Science Direct. doi: 10.1016/j.procs.2015.12.365

Requirements

- Registered students for this course will be provided with login details at the point of registration.
- Download and read through the unit of instruction stated for each week before scheduled time of interaction with the course tutor/ facilitator. You can also download and watch the relevant video and listen to the podcast so that you will understand and follow the course facilitator
- At scheduled time, you are expected to login to the classroom for interaction
- Self-assessment component of the courseware are available as exercises to help you learn and master the content you have gone through. [either ***components*** or ***is***]
- You are to answer the TMA for each unit and submit for your assessment
- Students[Every student] will be assigned to a group which will identify and present a business plan for an enterprise in the information and communication industry related to any of the programmes in the Faculty [inadequate punctuation masking the ideas being conveyed]

Assignments and Grading

Beyond the regular classroom attendance weight will be given to assignments and final examination as follows:
Tutor Marked Assessment 20%
Continuous Assessment 20%
Final Examination 60%
Total 100%

Pre-Print Edition

MODULE 1: FUNDAMENTALS OF COMMUNICATION

UNIT 1: Introduction to Communication

1.0 Introduction

This unit introduces you to the fundamentals of communication in general. Therefore, in this unit, you will learn about the importance, meaning or definitions of communication, elements of communication and process through which human beings communicate. Furthermore, you will be exposed to the classical models that describe the general process of communication.

2.0 Learning Outcomes

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

i. appreciate the importance of communication in social organisations;
ii. define and quote at least two definitions of communication;
iii. identify elements of communication;
iv. describe process of communication; and
v. identify and illustrate two basic models that describe the process of communication.

3.0 Main Content

3.1 Meaning or Definition of Communication

Pre-print Edition

Communication is the process of sharing meaning, ideas, information and expression of thoughts. In other word, communication is expression of thought through symbols that are shared by group of people.

It is the essential element and mechanism for sustaining relationship and interaction among human being. Therefore, it is a mechanism that keeps the society going because it sustains the interaction that keeps human system.

Without communication, human system cannot be sustained because there will be no interaction and the network of relationship that keeps human system will not have been established.

To this end, Emery, Ault & Agnes (1963) defined communication among human beings as the "art of transmitting information, ideas and attitudes from one person to another". In order to expand this definition, Berelson & Steiner (164) defined communication as "the transmission of information, ideas, emotions, skills etc. by the use of symbols- words, pictures, figures, graphs etc. It is the act or process of transmission that is usually called communication".

The main purpose of communication is to influence target audience's cognitive, affective and behavioural status. To this end, communication is also defined as the "process by which an individual (communicator) transmits stimuli (verbal or written) to modify the behaviour of other individual (the audience)" (Hovland, Janis and Kelly, 1953). In the same vein, Oliver, Zelko & Holtman (1962) defined communication as "fundamentally, the stimulation in the minds of others of essentially your awareness, understanding, and sense of importance of the event, feeling, fact, opinion, or situation you are attempting to depict".

3.2 Process of Communication

Communication is a process and a process means a series of activities geared or moved towards a purpose. Therefore, communication involves a series of activities that are carried out by a number of actors. The activities in communication process include:

1- Encoding
2- Decoding

Encoding: is the activity in communication process that entails transforming or transformation of meanings, thoughts, feelings into codes or signals that are shared by the target audience. By codes, it means a system of symbol that carries meanings that are shared by members of culture or sub-culture or a community. Encoding can also be considered as a transforming or changing meaning into signals that can be carried by a particular medium or channel.

Process of communication or mass communication begins from encoding. It is one of the major activities in communication.

Decoding: it is the activity in communication process that entails the deconstruction of the symbols and codes that are received in order to make meaning out of the message that are passed. There is effective deconstruction or decoding when the codes or signals that are received are shared by the receiver. This means there is effective deconstruction if the meaning intended by the encoder is shared by the decoder. This is otherwise known as effective communication.

3.3 Elements of Communication

Elements of communication refer to actors and paraphilia or instruments involved in the process of communication. They include:

1- Source/Encoder/Sender: The individual or the group of individuals that encodes and sends a particular message/information;
2- Message: It is the content or the information encoded and sent by the source;
3- Channel/Medium: It means the channels through which a message or information is sent to the audience;
4- Receiver/Decoder: It is the individual or the group of individuals that receives and deconstructs the sent message or information; and
5- Feedback: It is the transmission of the receivers' reaction back to the source as a means of readjusting the message from the source to the aspiration of the receivers.

Preprint Edition

3.4 Basic Models of Communication

Models are the graphical descriptions of the process of communication. They show the relationship among the elements of communication.

Just like theories, models also perform the function of explaining and predicting the relationship among the elements of a structure or a phenomenon. The basic models of communication that describe the general process of communication include:

LASWELL MODEL

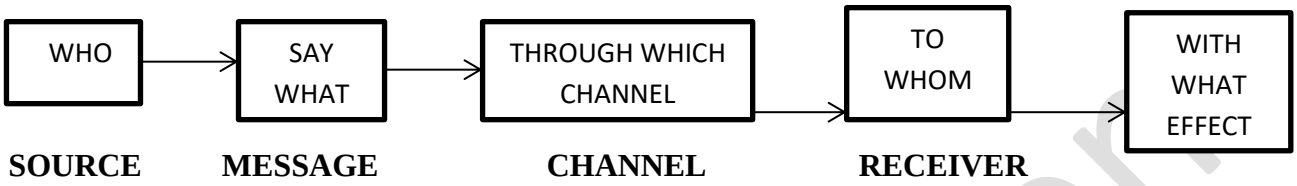


Figure 1.1.1: Laswell Model

Laswell was the first scholar to make an attempt to describe the process of communication. He put his model description in the form of a question that: "who says what, in which channel, to whom and with what effect''.

From the model, certain elements or actors in the communication process are identified. These elements include:

Source: that answers the question: "Who?". The source is then the communicator or the source of the information or the sender or the encoder. In mass communication, the source can be a journalist, editor, columnist, broadcaster, media organization.

Message: that answers the question: What? In this regard, it means the information or messages that are being disseminated. Specifically in mass communication, it refers to the content like the news stories, articles, editorials etc.

Channel: that answers the question: through which channel?. It means the medium through which the message is transmitted or disseminated. Specifically, in mass communication, it refers to Radio, Television, Internet, Cinema, Newspaper etc.

Receiver is another element that answers the question: "To whom?". By receiver, it means the decoder, the individual or the group of individuals that receives and deconstructs the message that is transmitted.

Effect that answers the question: "With what effect?". By effect, it means the desired response by the source; it means doing what the source wants the receiver to do.

This model stimulated many other models of communication and theories of communication that explain the effect of communication or mass media on their audience. However, it has been criticized for many reasons.

1. It is transitional, meaning that it does not give room for negotiation between the encoder and decoder. Therefore, the receivers do what the source wants. There is no negotiation because there is no provision for feedback.
2. It is linear- this means that it does not have any form of loop that provides opportunity for feedback.
3. It is too simple.
4. It considers communicator as a purposeful one that has an intention of achieving certain objectives

Braddov however added two other dimension to Lasswell model to make it a complete model- He added two dimensions before the question of "with what effect''. To this end, the new model, as improved by Braddov, reads thus – Who say what '', ''in which channel'', ''to whom'', ''in what circumstances'', ''for what purpose'', ''with what effect''.

Pre-print Edition

SHANNON AND WEAVER

MESSAGE SIGNAL Receiver message MESSAGE

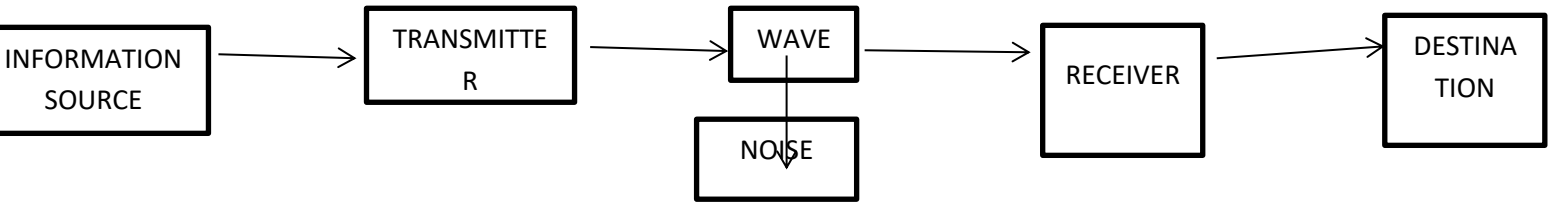


Figure 1.1.2: Shannon and Weaver Model

It was developed by Shannon and Weaver to explain the technicality involved in communication. Therefore, it is all about the technical importance or dimension of communication. The model essentially identifies two basic functions namely transmitting and receiving. Transmission is done at the end of the sender, while receiving is performed at the destination end.

The model describes the process of communication as beginning from the source that transmits a particular message through a signal to the receiver who deconstructs the message at his or her destination. Essentially the model identifies these following major elements:

Source: The source encodes a particular message out of many alternatives available to him. Encoding in this sense means the transformation of messages into a set of signals;

Transmitter: It is the technical apparatus that changes the message into signals. Along with this transmitter is the channel which is the technical apparatus or medium that transmits message to receiver;

Receiver: The receiver decodes or deconstructs the message to get meaning out of the message; and

Noise: What is more important in this model is the emphasis on what we call **Noise**. The model describes the process of communication as a process of transmitting message that is transmitted/converted into signals that are carried through a particular medium to the receiver. And in the process of transmitting the signals, there are always some technical problems that could hinder the process of decoding the signal accurately. Therefore, noise is anything that is added to the signals being transmitted and received, but which is not originally added by the source.

Noise is any signal received by the receiver but which is not intended by the source. It can be in form of semantic not necessarily technical. Semantic noise is nothing but distortion of meaning occurring in the communication process.

Shannon and Weaver see noise as a problem of communication. Types of noise include:

Technical Noise: This occurs in electronic media when there is something like snows on television screen or when there is something like thunder noise on radio;

Semantic Noise: Complex diction and words that make it difficult to get meaning out of a message.

Other types of noise are: Psychological noise, Physiological noise, and Physical noise.

Shannon and Weaver model also raises some issues about certain concepts that relate to the noise that can hamper the process of decoding the message accurately. Such concepts include entropy and redundancy. Information, to the Shannon and Weaver model, means the various available choices that are available to the sender while encoding his message.

Entropy refers to the concept of unpredictability or randomness of choice available to the sender. In summary, Entropy means unconventional or hard to understand. Therefore, if we encode a message that is unconventional, that does not strictly follow certain predictive rules, then we say the message is entrophic.

On the other hand, redundancy means conventional, easy to understand. Redundancy is the concept that is used in communication to make message easily understood by repeating the message several times.

Pre-print Edition

This model also makes us to understand that there is a difference between the receivers and destination. The receivers are the point at which decoding is carried out and therefore does not means the destination or the person encoding the message.

4.0 Summary

In this unit, you have learnt that:

- Communication is an essential element of human organisation through which human beings interact, and without which human beings can subsist; it sustains the interaction that keeps human system;
- Communication is essentially the process of sharing meaning, ideas, information and expression of thoughts in a human system. It is the transmission of information, ideas, emotions, skills etc. by the use of symbols- words, pictures, figures, graphs etc.- for the main purpose of influencing cognition, affection and behaviours;
- Communication is a process, and as a process, it consists of a series of activities that essentially include encoding and decoding;
- As a process, it involves some actors and instruments, which are known as elements. Elements of communication, therefore, include source (sender), message (content), channel (medium), receiver (decoder);
- There are various models (graphical descriptions) of the process of communication. They show the relationship among the elements of communication. Two of such models that describe the general process of communication are Laswell Model and Shannon and Weaver Model;
- Laswell model describes the process of communication as involving encoding of certain messages by a source which he passes to an audience or a group of receivers through a channel with the main purpose of achieving a particular cognitive, affective or behavioural effect on the receivers; and
- Shannon and Weavers describes the process of communication as involving a source who encodes a particular message that is transformed into signals which is transmitted through a channel to a set of receivers that re-transform the signals into meaningful messages for the target audience. In the process of transmission of the signals, noise can occur; and noise is anything that is added to the signals while on transmission.

5.0 Self-Assessment

A. Quote two definitions of communication as given by two scholars.
B. Identify the activities involved in the process of communication.
C. Identify the major elements of communication.
D. What is a model?
E. What are the major roles of communication models?
F. Identify two main models of communication and how they describe the general process of communication.

6.0 Tutor-Marked Assignment

A. Define communication in your own words.
B. Describe the process of communication that can take place between you and your father through mobile phone on your preparation for an approaching examination using Shannon and Weaver Model to illustrate the description.
C. Identify and explain with illustrations the various kinds of noise that can hamper your communication with a friend through an e-mail.

7.0 References

Fiske, J. (1982). *Introduction to Communication Studies*. New York: Routledge.

8.0 Further Reading

Pre-print Edition

Cortner, J. and Hawrthorn, J. (eds) (1980). *Communication Studies*. London: Arnold.
Lin, N. (1983). *The Study of Human Communication*. New York: Bobbs Merrill.

UNIT 2: Communication Technologies

1.0 Introduction

In this unit, you will learn about the evolution of communication technologies and how each of the technologies of communication impacted ways human beings communicate as each of them evolved. To this end, you will be introduced to the advancement of communication technologies from the traditional technologies to the new technologies by looking at the four critical stages of development of communication technologies. We will also look at the features that differentiate traditional communication technologies from the new communication technologies. We will enhance the understanding of the impact of communication technologies as they evolved by looking at the theory of technological determinism.

2.0 Learning Outcomes

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

i. identify the four stages of the development of communication technology;
ii. assess the defining characteristics of each of the stages and how they affected how we communicate;
iii. identify the main traditional media technologies and the order in which they evolved;
iv. narrate how the new media began and how it continuously improved to bring about what we call the global village; and
v. explain the propositions and assumptions of the theory of technological determinism.

3.0 Main Content

3.1 Evolution of Communication Technologies

The trajectory of the advancement of communication technologies over the last nine centuries had followed the four critical periods of time or stages in human history that McLuhan identified. And according to McLuhan, the transition from one era to another is brought on by a new mode of communication, which caused some sort of significant changes in society. The media technology that evolved at one stage extended human senses further than the one that came before it. This is why McLuhan said that the content of any new, current media is always the format of the medium that came before it.

So, the four critical periods or stages of the development of media technology, as identified by McLuhan, are:

Pre-print Edition

- Tribal age;
- Literate age;
- Print age; and
- Electronic age.

These stages translated into the invention of the phonetic alphabet, printing and telegraphy. McLuhan noted that phonetic alphabet catapulted the human race into an age of literacy while printing launched the Industrial Revolution, and telegraphy moved human race to the global village.

At the tribal age, communication depended on sound and ear where communication within physical presence was prioritized.

At the literate age, phonetic alphabets were invented and this extended and depended on ears and eyes. As McLuhan observed, literacy jarred people out of collective tribal involvement into a "civilized" private detachment.

At the printing stage, when Gutenberg invented the printing press, the literate age was brought to an end and visual dependence was made more widespread through mass production of identical products.

With the electronic age and the invention of telegraph, re-tribalizing of human race occurred. Instant communication became the new cultural and communication behaviour, and this returned people to a pre-alphabet oral tradition where sound and touch were more important than sight. Electronic age brought people to the global village where they were in touch with one another, everywhere, all-at-once, all-the-time, and instantaneously.

3.2 Traditional Media of Communication

Mass communication era began with the invention of printing press by Johannes Gutenberg in 1450, forming the prototype for mass production and the first traditional medium of communication. Precursor to this landmark development was the invention of alphabets in, development of paper by the Chinese from papyrus in the year 105 A.D. and movable type in the year 1000. Through the printing press, Gutenberg produced the first so-called modern books, including two hundred copies of a Latin Bible (Campbell, Martins and Fabos, 2005). This was developed further into Linotype and Offset Lithography by 1880. It was the printing press that brought about not only book publishing but newspapers and magazines as powerful media of mass communication with the London's Daily Courant debuting as the first daily newspaper in 1702 and the Review unveiling in London as the first magazine in 1704. By 1833, mass circulation of newspapers (the New York Sun of Benjamin Day), supported by increased literacy and breakthroughs that replaced steam-power presses with mechanical presses, had brought about what we called penny press and yellow journalism. .

The social and cultural transformation ushered in by the invention and spread of printing presses, books, newspapers and magazines was highly significant. As Eisenstein (1979) noted, the technology of printing presses permitted information and knowledge to spread outside local jurisdiction. "Individuals had access to ideas far beyond their isolated experience, and this permitted them to challenge the traditional wisdom and customs of their tribes and leaders" (Campbell, Martins and Fabos, 2005, p. 344). So, "the printing presses shaped the course of human affairs than any other product of the human mind because they were the carriers of ideas and it was ideas that changed the world" (Tebbel, 1974). The printing press reconfigured power and people (Lule 2011, p,54). It weakened the fear of disapproval, a sense of isolation, the force of local community sanctions, the habit of respectful submission to traditional authority (Eisenstein, 1979).

With the invention of telegraph in 1840s, electronic age was ushered in. Samuel Morse developed the first practical system, sending electrical impulses from a transmitter through a cable to a reception point. By 1844, Morse set up the first telegraph line between Washington D.C., and Battimore, Maryland.. By 1866, the first transatlantic cable ran between Newfoundland and Ireland along the ocean floor. This cable was the forerunner of today's global communication technologies, including the internet, faxes and satellite transmission. And by 1876, first telephone message was sent by Alexandra Graham Bell.

In the meantime, Thomas Edison developed the phonography in 1877, and by 1887, phonograph records were introduced. In furtherance of the development of sound technology, long-playing (LP)

Pre-Print Edition

33-1/3 rpm record was launched by Columbia Records and became the recording industry standard for over 30 years.

Another significant ground-breaking development in the trajectory of the evolution of the media technologies is the invention of cinematograph in 1895 by Auguste and Louis Lumiere, which Thomas Edison had tried to do as far back as the late 1800s. Thus, Auguste and Louis Lumiere's efforts led to the invention of moving pictures. They developed a projection system so that more than one person at a time could see the moving images on a nine-by six –foot projection screen. Earlier, Hannibal Goodwin developed a transparent and pliable film called celluloid that could hold a coating or film of chemicals sensitive to light. Eastman Kodak bought Goodwin's patents in 1890s, improved the ideas, and manufactured the first film used for motion pictures. The consistent development of this medium of communication over a century led to the emergence of various electronic media such as videocassette recorders (VCRs) in 1970s and digital video disk (DVD) precisely in 1997. Each of these developments changed the communication experience of the world as a whole. Cinematograph popularized the culture of movie-going with a viewing audience in a particular public location. While the videocassette recorders enabled people to purchase or rent movies to watch in their homes instead of going to cinema, the digital video disk marked the shift of film experiences to digital formats.

Although revolutionary, the telegraph and telephone were limited by their dependence on wires. Thus, there was the need to invent technology for wireless communication and the key development for this came from James Maxwell, a Scottish physicist, who in the mid- 1860s elaborated on ideas about electricity and magnetism with his theorization that there existed electromagnetic waves. Heinrich Hertz, a German physicist, proved Maxwell's theory in 1880s by creating a crude device that permitted an electrical spark to leap across a small gap between two steel balls to mark the first recorded transmission and reception of a radio wave. Meanwhile, it was Guglielmo Marconi, a 20 year old Italian engineer, who made wireless technology practical by transmitting radio messages through a point-to-point communication system in 1895. And with Reginald Fessendein's improvement over Morse code, the first voice broadcasting through one-to-many mass media technology was made in 1906 and the real radio broadcasting technology was consummated. This drastically transformed communication and society.

With the consummation of radio technology for broadcasting to a large widely dispersed audience in 1920, it became the veritable means of representing and defining areas of culture that are not readily acknowledged in mainstream newspapers. Negatively, radio had brought about various upheavals of globalization during the 21st century – the radio broadcast that riveted audiences during World War II, the propaganda services that did battle worldwide during the Cold War, the so-called death radio that helped drive the genocide of Tutsi in Rwanda and many others (Frere, 2009).

Although television achieved mass media status in the 1950s, inventors from a number of nations had been toying with the idea of televised images for nearly a hundred years. In the late 1800s, for instance, the invention of the cathode ray tube, which is the forerunner of the TV picture tube, combined principles of the camera and electricity. Other inventors such as Paul Nipkow, a German, who in 1880s, developed scanning disk that could separate pictures into pinpoints of transmittable as a series of electronic lines; Boris Rosing, a Russian physicist, who improved the mechanical scanning devise and Philo Farnsworth, who independently pioneered an electronic TV system, were all credited with the invention of what we know today as television medium of mass communication.

Television brought together the visual and aural of film with the accessibility of radio. People sat in their living rooms and kitchens to view pictures and stories from across the globe. The world was brought into the home. The amount, range, and intensity of communication with other lands and cultures occurred in ways simply not possible before.

Unlike radio and broadcast television, cable television's earliest technical breakthroughs came from a fairly anonymous and practical group of people. Originating in rural and small-town communities in the late 1940s, cable sprang from obstacles that appliance- store owners faced in selling TV sets to people who lived in remote areas. To remove the obstacles of blockage of signals by hills and mountains, they built antenna relay towers and then strung wire from utility poles for running cables from the towers into individual homes (Campbell, Martins and Fabos, 2005). Although today's

Pre-print Edition

technology is more advanced, cable TV continues to operate in pretty the same way. It is the advancement in cable technology that led to the birth of Ted Turner's 24 hour news network (Cable News Network -CNN), which premiered in June 1980, and had grown to revolutionize the news business.

Pre-print Edition

3.3 New Media of Communication

The development of the new media of communication began with the innovation of the internet, resulting from the advancements in computer technology. As a matter of fact, the advent of the internet displayed the typical push and pull of military, scientific, commercial and countercultural innovation (Hafner and Markoff, 1991). Specifically, the invention of the internet began with the funding by the Advanced Research Projects Agency of the investigation of techniques and technologies for networking computer networks of various kinds for the purpose of developing a communication network which would facilitate the exchange of information between various research centers involved in ARPA projects. Therefore, the creation of the so called ARPANET in 1969 became widely recognized as the origin and advent of the internet. By 1968 when ARPA awarded the contract to build the ARPANET to Bolt, Beranek and Newsman, a consulting firm in Cambridge, Massachusetts, specializing in information system, and when it was launched by the end of 1969, we had entered into a technological age in which people could interact with richness of living information. Within sixteen months after its launch, ARPANET was connecting more than ten sites with an estimated 2000 users and at least two routes between any two sites for the transmission of information packets. A public demonstration of ARPANET was held during the first International Conference on Computer Communications in Washington DC in October 1972. And in 1973, the first international connections were set up with Norway and Great Britain at a conference held in Brighton when data was sent by satellite to Goonhilly Downs in Cornwall (Slevin, 2000).

Of course, the emergence of the internet was not only the outcome of the efforts of the military and the ARPA, the invention of the modern and the development of the Xmodern protocol in the late 1970s by two Chicago students allowed for the transfer of information between computers over the regular telephone system (Slevin, (2000). According to Slevin's account, with the invention of modern technology, "computer network which had so far been excluded from connecting to ARPANET, or other backbone systems, were then able to communicate with each other" (Slevin, 2000, p. 32).

Since its invention, the internet technology is being developed with a variety of applications that have changed human communication behaviours, culture, values and social system from the primitive nature of the oral age to a very sophisticated system of the digital age. The latest and probably most baffling internet application developed is the social media. Social media is a group of Internet-based applications that builds on the ideological and technological foundations of Web 2.0, and that allows the creation and exchange of User Generated Content (Kaplan & Haenlein, 2010). It has various dimensions such as collaborative projects, virtual worlds, blogs, content communities (Flickr, for photos, and YouTube, for video), and social networking (Facebook, Twitter, Istagram, WhatApp, You Tube etc).

Technological impact of the new media, which is built around the internet, answers the question on the transformative and interactional impact of the new media. Indeed, the new media are creating new form of action and interaction different from the action and interaction engendered by the traditional/old media of communication. They are even reordering the way in which individuals interpret and respond to social world. In fact, the new media are fundamentally "contributing to the transformation of the spatial and temporal organization of social life which began with the advent of telecommunication". Furthermore, "the new media, in a way that is fundamentally different from the old media, have enabled individuals and organizations to interact with distant others on an unprecedented scale, creating new modes of exercising power and new modes of underwriting the legitimate use of that power" (Slevin, 2000, p.7). The new media are affecting the mediazation of tradition by endowing it with a new life as well as by exposing it to new sources of critique. They present our new social organization with a range of new options along with new burdens (Thompson,) By and large, the new media, as Slevin (2000) who drew from Thompson's cultural transmission perspective concluded, are really reorganizing social relations in our modern world. The new media have brought about new forms of publicness and, therefore, intensifying global interactions beyond our local territory, thereby making social interaction operative within what Giddens (1991) called *place as phantasmagoric*. The new media have brought about what Giddens (1991) again called

Pre-print Edition

collage effect, meaning that new media have technical capacity to present and share information that is timely and consequential. Slevin (2000, p.54-65) reinterpreted collage effect as "a consequence of the intensity with which and the scale at which the internet acts as a disembedding mechanism, prizing information and other symbolic content free from the hold of specific locales and allowing for its recombination across wide time-space distance". Although this effect is enabled by the technical capacity of new media, it can still not be explained or understood outside the social context that facilitates the collages of assembled and reassembled information through the active participation of the users of the media.

So, as McLuhan predicted that electronic media would evolve to a point when they would abolish space and time, new media have revolutionalized the way we communicate. He established, with audacious conviction and optimism that, through electronic media, and then new media humans around the world would see one another and speak with one another as if they are in the same space at the same time. With the world made smaller by electronic media and free from restrictions of space and time, McLuhan said "the human family would exist under conditions of a global village". To him, "the new electronic interdependence would recreate the world in the image of a global village" (Lule 2011, p.70).

McLuhan was farsighted to have foreseen globalized world being brought about and shaped by the new media, a time in human history when there is an intensification of consciousness of the world as a whole or intensification of worldwide social relations (Giddens, 1990)), although he sounded too eccentric in his divination that the media would allow human to recover the unity they lost at Babel. McLuhan noted that electronic media, and then new media would bring human beings together again, and they would think the same, speak the same language and understand one another with a striking result that there would be unity and peace in the world. Thus, to him, technological development in communication technologies would bring about "a Pentecostal condition of universal understanding and unity" (McLuhan 1964, p.25). Notwithstanding, his prediction of global village is today a reality, but his utopian vision is a mirage.

3.4 Technological Determinism

Technological determinism, as a social theory, presumes that technologies in modern societies drive social changes in the societies as well as the development of social and cultural values of the societies. In specific relation to the media or communication technologies, technological determinism links the dynamism in the way people in modern societies behave and perceive their world with the evolution of the technologies of communication.

The concept of the 'medium is the message' by McLuhan explains the assumption of technological determinism. The concept means that as new forms of media technology evolved, peoples' experiences and perceptions of their world transformed in line with the structures and features of each forms of communication technology. Thus, it is the form of media technologies that influenced peoples' perception and the way they lived their lives, and not the content disseminated through the media technologies. To put it in another way, McLuhan believed that each form of communication technologies, as they evolved, was an extension of man – each of them extended man's senses in different ways or degrees (radio exploiting our hearing senses much more than television that extended our sight).

So, the meaning in the idea of technological determinism is that 'as we shape our tools, they in turn shape us'. Invariably, media technologies, as they evolved, shape how we, as individuals in a society, think, feel, act, and how our society operates as we move from one technological age to another.

4.0 Summary

- The trajectory of the advancement of communication technologies over the last nine centuries had followed the four critical periods of time or stages in human history which are:Tribal age; Literate age; Print age; and Electronic age.
- The stages translated into the invention of the phonetic alphabet, printing and telegraphy.

Pre-Print Edition

- Traditional media of communication included books, newspapers, photography, cinema, radio and television; and they evolved in the order that they have been listed.
- The development of the new media of communication began with the innovation of the internet, resulting from the advancements in computer technology.
- The invention of the internet began with the funding by the Advanced Research Projects Agency of the investigation of techniques and technologies for networking computer networks of various kinds for the purpose of developing a communication network which would facilitate the exchange of information between various research centers involved in ARPA projects. Therefore, the creation of the so called ARPANET in 1969 became widely recognized as the origin and advent of the internet.
- Since its invention, the internet technology is being developed with a variety of applications that have changed human communication behaviours, culture, values and social system from the primitive nature of the oral age to a very sophisticated system of the digital age. The latest and probably most baffling internet application developed is the social media.
- Social media is a group of Internet-based applications that builds on the ideological and technological foundations of Web 2.0, and that allows the creation and exchange of User Generated Content.
- The new media, in a way that is fundamentally different from the old media, have enabled individuals and organizations to interact with distant others on an unprecedented scale, creating new modes of exercising power and new modes of underwriting the legitimate use of that power.
- The new media have brought about new forms of publicness and, therefore, intensifying global interactions beyond our local territory, thereby making social interaction operative within what Giddens (1991) called *place as phantasmagoric*. The new media have brought about what Giddens (1991) again called *collage effect*, meaning that new media have technical capacity to present and share information that is timely and consequential.
- Although McLuhan's prediction of global village is today a reality, his utopian vision is a mirage.
- Technological determinism, as a social theory, presumes that technologies in modern societies drive social changes in the societies as well as the development of social and cultural values of the societies.
- The concept of the 'medium is the message' by McLuhan explains the assumption of technological determinism, and the concept means that as new forms of media technology evolved, peoples' experiences and perceptions of their world transformed in line with the structures and features of each forms of communication technology.

5.0 Self-Assessment

A. Mention the four stages of the evolution of communication technologies
B. What are the main traditional media of communication?
C. In which order did the traditional media of communication evolve?
D. Identify the main new media of communication
E. Differentiate between the traditional media and new media of communication
F. What do we mean by global village, and how have we achieved it?
G. What does the McLuhan's concept of the medium is the message means?

6.0 Tutor-Marked Assignment

A. Identify all the social media and explain how they have impacted the modern society with respect to the production and dissemination of information, using the theory of technological determinism to illustrate your explanation
B. Explain the concept of the medium is the message with a reference to the effectiveness of dissemination or flow of information through the affordances of the new media in our contemporary society.

Pre-Print Edition

7.0 Reference

Azeez, A, L. **(2018):** Technological Determinism in Traditional and New Media of Mass Communication, In ***Traditional and New Media of Mass Communication***. Eserinune McCarty MOJAYE **(ed.)** Abraka: Published by the University of Ibadan Press.

8.0 Further Reading

Carey, J. (1992) "Technology and ideology: The case of the telegraph" in *Communication as Culture: Essays on Media and Society*. New York: Routledge.
Croteau, D. & Hoynes, W. (2000) *Media Society: Industries, Images, and Audiences* (2nd Edition). London: Pine Forge Press.
Cambell, R., Martin, C.R., & Fabos, B. (2005) *Media and Culture: An Introduction to Mass Communication*. New York: Bedford/ST. Martins.
McLuhan, M. (1964) *Understanding Media: The Extension of Man*. New York: McGraw Hill.
McLuhan, M. (1962) *The Gutenberg Galaxy: The Making of Typographic Man*. London: Routledge.
McLuhan, M. & Quetin, F. (1967) *The Medium Is the Message: An Inventory of Effect*s. New York: Bantain Books.

Pre-print Edition

UNIT 3 : Mass Communication and its Career Opportunities

1.0 Introduction

This Unit introduces you to mass communication as an important integral part of human communication. It therefore covers the definition of mass communication, characteristics of mass communication, media or technologies of mass communication, functions of mass communication, sequences of mass communication and career opportunity in mass communication.

2.0 Learning Outcomes

At this end of this Unit, you should be able to:

i. define mass communication
ii. identify the characteristics of mass communication
iii. identify media of mass communication
iv. explain the sequences of mass communication
v. identify career opportunities in each of the sequences of mass communication

3.1 What is Mass Communication?

It may look very unnecessary to define Mass Communication because we know what it means even as laymen. However, there is the need for a better conceptualization of Mass Communication in order to appreciate its significance in our modern world.

Mass Communication is both a steam of study and a career. As a stream of study that emerged in the earlier 19th century, it is the study of the process and techniques by which specialized groups employ technological devices to disseminate symbolic content to large heterogeneous and widely dispersed individuals (Bittner, 1989). The phrase 'specialized group' in this definition indicates that Mass Communication is as well a career. And Mass Communication, as a career, means the profession or craft that specializes in using the mass media to communicate to a large group of individuals that are diverse and dispersed in society. Traditionally, the mass media professional mass communicators use

Preprint Edition

to communicate to their audience include radio, television, newspapers, magazines and films. But, today, the world has witnessed a phenomenal and unprecedented explosion in communication technology and media. All boundaries have been transcended, and the entire global community seems to have been brought together into one unified whole. And it is here that mass-communication, as a stream of study, and as a career, becomes so important and enviable.

3.2 Characteristics of Mass communication

- It is institutionally based: It means mass communication is an institution. It is a mechanism which the society uses to achieve certain objectives. It is an institution also because it is regulated; it is not at the whims & caprices of an individual or absolute control of an individual. Rather, other societal institutions have control on how it should be carried out. This is the reason why we talk about media system.
- It is technological based: Mass communication is mediated through technologies of communication which had evolved over the years. These technologies include radio, magazines, internet etc. In this sense, it is impersonal. This means it is not one on one and neither face to face. The participants in mass communication do not usually see one another and so the communication is not inter-personal.
- Until recently, mass communication is characterized by delayed feedback. This means that it does not give room for interaction between participants (source and receiver). This characteristic is not very important today because of the advancement in technology such as the internet.
- Heterogeneous and larger Audience: It involves large audience that is widely scattered and characterized by different tastes, attitudes and aspirations. In other words, the audiences of mass communication are groups of people that are not only widely dispersed, but that are also diverse in their personalities. This is usually a challenge for mass communication because as a mass communicator you are expected to communicate to different people with different tastes and values.
- Simultaneity of Delivery: This means that mass communication messages are delivered to large audience at the same time.

3.3 Functions of Mass Communication

- Surveillance of the Environment
- Correlation of the part of the society in response to the environment
- Transmission of cultural heritage from one generation to another.
- Entertainment:

3.4 Sequences of Mass Communication

- Journalism/Print Sequence
- Broadcast Sequence
- Public Relation/Advertising Sequence
- Cinematography/Film Studies

3.5 Career Opportunities in Mass Communication

To a great extent, Mass Communication is a modern reality which covers all aspects of human life. To this end, there are many areas and opportunities in Mass Communication, which are, of course, expanding by the day. This is more so because the media of mass communication are evolving, and media technologies are increasingly transcending the physical limits and boundaries of human communication. Therefore, Mass Communication, as a stream of study, is usually broken into concentrations or sequences that essentially include **Journalism, Public Relations, Advertising, Cinematography**, and these sequences provide specialized and unlimited career opportunities for people that study Mass Communication if they acquire the necessary skills. These branches of Mass

Pre-print Edition

Communication are closely related so that professionals in each field often interact with each other in their work. And this is why it is possible for some professionals to switch careers within mass communications, jumping from one branch to a different one, such as a reporter becoming a public information officer. The Senior Special Assistant to the outgoing President of Nigeria on Media and Publicity, Dr. Reuben Abati, was formerly a columnist and journalist, before switching to the senior Public Relations Officer of the Government.

3.5.1 Journalism

It is a major branch of Mass Communication that specializes in gathering, processing and selection of news and current affairs for the press, radio, television, film, cable, internet etc. In other words, journalism is a discipline and a career involving the collection, analysis, verification, and presentation of news regarding current events, trends, issues and people. So journalism is a career that is concerned itself with the reporting of events through the media, particularly radio, television, newspapers, magazine and, most recently, the internet. Thus, as a journalist, you have a social role to report things that would have otherwise be private.

Journalism careers encompass work at television radio stations and print and online publications. By and large, Journalists include reporters, columnists, editors and photographers at print and online media outlets, such as newspapers, magazines and news websites and blogs, and reporters, anchors, producers and videographers at broadcast media like television and radio. Meanwhile, if you have the appropriate skills, you could pursue a career as a journalist without necessarily working for anybody. You could start your own online reporting, you could be a freelance columnist, you could be an independent reviewer and son on.

3.5.2 Public Relations

Public Relations as a career option came into existence as a result of the need of many private and government companies and institutions to market their products, services and ideas. Public image has become so important to all organizations and prominent personalities, and this has resulted into the popularity of Public Relations as a career. So the role of a Public Relation Specialist becomes pertinent in crisis situations when the correct and timely dissemination of information can help save the face of the organization.

So, in terms of career opportunities, PR offers diverse areas of specialization that include PR for product publicity, PR for Government institutions, publishing newsletters of organizations, Speech Writing etc. And you could do all these as an entrepreneur without working waiting endlessly for a formal employment.

3.5.3 Advertising

Advertising is the art, craft or profession of disseminating paid information and persuasive sale messages through the non-personal media of communication to a large audience of anonymous individuals by an identified sponsor to promote products, services or ideas.

Careers in advertising include positions on both the creative side and the business side. Professionals on the creative side focus on the development and production of advertising campaigns for print, online and broadcast distribution. On the business side, career opportunities exist with agencies and media outlets. At agencies, advertising professionals manage accounts, working with both agency clients and the creative professionals developing campaigns, and they also create media buying plans. Advertising professionals at media outlets manage the sale of advertising time or space to organizations and individuals.

3.5.4 Cinematography

This is another professional branch of mass communication that deals with the production and distribution of films. It is the profession of film making which involves a number of tasks including story writing, casting, shooting, editing, screening or promotion that may result in film release, documentary film making, animation, graphic design, digital printing services etc.

Pre-print Edition

3.5.5 Book Publishing

It is also considered as a professional branch of mass communication and it is concerned with the production of books.

So, from the brief identification of the major sequences in Mass Communication, we can see that, as a graduate of Mass Communication, there are many lucrative career options you can pursue and many job opportunities on a self-employment basis. In other words, a professional course in mass communication opens doors for a career and job opportunities in films & TV, publishing, public relations, journalism, editing, direction, filmmaking, scriptwriting, production, etc. In nutshell, Mass Communication widens up the horizon of career and job options for a person. Depending upon personal interest and inclination, a mass communication professional can choose a job and start a business from diverse options. Attractive and high paying jobs as journalist, actor, director, editor, screenwriter, RJ, producer are available to the talented and trained individuals. In fact, your imagination is the only limitation you can have. And this is why I make bold to say that mass communication graduates have no business complaining of unemployment. There is a need and continuous need for mass communicators, and the need will even continue in Heaven when there will be a need for people in the Northern hemisphere of Heaven to communicate to the people in the Southern Hemisphere.

A snippet of careers and jobs you can do as Mass Communication graduates under various industries is as follows:

3.5.6 Components of Media/Journalism

Reporter
Technical writer
Newspaper editor
Rewrite editor
Critic
News director
Sports director
Proofreader
Columnist
News analyst
Copyright specialist
Historian
Assignment editor
Radio/TV reporter
Videographer
Editor
Biographer
Print coordinator
Video journalist#
Anchors
Producers
Script Writer
TV Correspondent
Producer
Radio Jockey/ RJ
Screenwriter
Sound Engineer
Sound Mixer and Sound Recordist
Special Correspondent
Video Jockey
Film Director

3.5.7 Components of Public Relations

Lobbyist
Mediator
Copyright specialist
Administrative assistant
Press secretary
Media specialist/analyst

3.5.8 Components of Publishing

Booking agent
Literary agent
Editor
Writer/Contributor

3.5.9 Components of Advertising/Marketing

Media buyer/broker

Pre-print Edition

Designer
Publicity director
Information specialist
Marketing communications trainee
Account management
Graphics & production specialist
Promotion representative
Event manager

Business/Industry

Research analyst
Media Consultant (for business organisations)
Information Analyst
Information specialist
Customer service representative
Content Marketing Specialist

Education

Educational writer
Teacher/Lecturer
Media specialist
Media librarian
Author/Writer

It must be emphasized at this juncture that careers and job opportunities in Mass Communication can be high paying and ewarding but also bring in a great deal of job satisfaction and expression of creativity.

3.6 Preparing and Developing a Career in Mass Communication

To prepare yourself for a career and job opportunities in any of the above identified career opportunities, you need a thorough training and acquisition of necessary transferable skills as well as critical education that prepare you to think critically and creatively. So having a degree certificate in mass communication is not the meal ticket you need to make your mass communication a panacea for unemployment. Instead the most essential thing is that you are required to possess certain skills or interests which can help you get or start a job. Those of you who are interested to get into news media should have keen interest and sound knowledge of news and current affairs. Global perspective on various issues helps in obtaining the position of reporter or journalist. Similarly, those who are interested in electronic media are required to have practical knowledge on video editing. Invariably, you need to put yourself more in learning and practicing the practical elements of the profession

To develop a career or start a gainfully job in mass communication, you require commitment, dedication and sacrifice of personal time for the sake of staying on front or top, particularly in news industry. A journalist may have to work day in and day out to get breaking news. Similarly, media professionals who are in entertainment or film making need to work with passion which may come at the cost of their personal life. However, ultimately, mass communication as a career provides job satisfaction, name and fame and a challenge to live with.

3.7 General Requirements for Career Development

I will want to encapsulate the general requirements for career development and job opportunities in Mass Communication in what I call the 6 Cs. These are the requirements you need to rise as far as you wish in your career. They are as follows:

Competence: whether we are seeking a career or want to start a gainful job in Journalism, public relations or online media, there is a need for mastery in basic skills of writing. The writing skills include

Verbal/written communication ability

Pre-Print Edition

Persuasive/Negotiation skills
Idea Evaluation
Accuracy and Attention to details (these days a little mistake can be amplified by the viral effect of mass media)
Research skills
Analytical skills

Courage: There is a need to develop high level of courage to grow and develop in any career in Mass Communication. You need courage to write good stories as a journalists as you need courage to present an advertising proposal at a pitching.
Confidence: Confidence is related to courage
Creativity: You must have ability to create old or existing things in a way that that will make it new and unprecedented.
Commitment: This is highly required if you want to develop in any career in Mass Communication. It is a sense of sacrifice and dedication.
Curiosity: To be creative, you must be curious. You must have the motivation to learn and know every bit of everything.
Courtesy: You must be honest and high regard for the interest of others. As a journalist, for example, you are to serve the public interest.

3.0 Summary

- Mass Communication is both a steam of study and a career. As a stream of study that emerged in the earlier 19th century, it is the study of the process and techniques by which specialized groups employ technological devices to disseminate symbolic content to large heterogeneous and widely dispersed individuals;
- It is different from any other form of communication because it is institutional based, mediated by technologies, target a large heterogeneous audience, and its messages are delivered simultaneously;
- As an institution of the society, it serves the functions of telling us what is going around us, explaining and contextualizing the events around, socialize us into the cultural milieu of our society and provide us entertainment for our relaxation;
- The sequences under mass communication include journalism/print, broadcast, advertising, public relations, cinematography/film;
- Each of the sequences under mass communication provide a series of career opportunities that are lucrative and attractive;
- To prepare yourself for a career and job opportunities in any of the career opportunities in mass communication, you need a thorough training and acquisition of necessary transferable skills as well as critical education that prepare you to think critically and creatively;
- To develop a career or start a gainfully job in mass communication, you also require commitment, dedication and sacrifice of personal time for the sake of staying on front or top, particularly in news industry; and
- To be successful in any of the careers in mass communication, you need competence, courage, confidence, creativity, commitment, curiosity and courtesy.

5.0 Self- Assessment

A. Define Mass Communication
B. Mention and explain the main characteristics of mass communication that differentiate it from other forms of communication
C. What are the main functions of mass communication in a society?
D. What are the main sequences in mass communication?
E. Mention at least two career opportunities you can find in each of the sequences of mass communication
F. What is the basic requirement you need to start any career in mass communication?

Pre-Print Edition

G. What is the basic requirement you must have to be successful in any of the careers in mass communication?

6.0 Tutor-Marked Assignment

A. Why is Mass Communication an institution of society?
B. Explain in details the roles of mass communication in our modern society
C. To start a career in Mass Communication is different from being successful in the chosen career. Discuss.

7.0 References

Bittner, J.R. (1997) *Mass Communication: Introduction*. New Jersey: Prentice Hall.
Drucker, P. (1985). *Innovation and Entrepreneurship*. London: William Heinemann.
Hasan, S. (2014) *Mass Communication: Principles and Concepts*. New Dehli: CBS Publishers.

8.0 Further Reading

Kent, D.W. and Mushi, P.S.D. (1996). *The education and training of artisan for the informal sector in Tanzania*. A report prepared for the Overseas Development Administration. UK Serial No. 18.
Musari, A. (2009). Youth and the National Youth Employment Action Plan, Abuja, *Guardian Newspapers*, March 19
Oladele, P.O., Akeke, N.I. and Oladunjoye, O. (2011). Entrepreneurship Development: A Panacea for Unemployment Reduction in Nigeria. *Journal of Emerging Trends in Economics and Management Sciences* 2(4), 251 – 256.

Pre-print Edition

MODULE 2: INFORMATION SYSTEMS PLANNING AND DEVELOPMENT

UNIT 1: Introduction to Systems

1.0 Introduction

This unit introduces to you the concept system as a term in information systems development. It discusses in details the properties, elements and different types of system.

2.0 Learning Outcomes

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

I. Define a system
II. State the properties of a system
III. Identify the elements of a system
IV. Highlight the types of system

3.0 Main Content

3.1 The Concept of a System

The word System is derived from Greek word Systema, which means an organized relationship between any set of components to achieve some common cause or objective. A system is "an orderly grouping of interdependent components linked together according to a plan to achieve a specific goal." In business, a system is an interrelated set of business procedures used within one business unit working together for a purpose. A system exists within an environment. A boundary separates a system from its environment. Examples of system are: traffic management system, payroll system, automatic library system, human resources information system

3.2 Properties of System

A system has the following properties –

Organization: Organization implies structure and order. It is the arrangement of components that helps to achieve predetermined objectives.

Interaction: It is defined by the manner in which the components operate with each other. For example, in an organization, purchasing department must interact with production department and payroll with personnel department.

Interdependence: Interdependence means how the components of a system depend on one another. For proper functioning, the components are coordinated and linked together according to a specified plan. The output of one subsystem is the required by other subsystem as input.

Integration: Integration is concerned with how system components are connected together. It means that the parts of the system work together within the system even if each part performs a unique function.

Pre-Print Edition

Central Objective: The objective of system must be central. It may be real or stated. It is not uncommon for an organization to state an objective and operate to achieve another. The users must know the main objective of a computer application early in the analysis for a successful design and conversion.

3.3 Elements of a System

A system within the context of information technology is composed of six distinct and interrelated components. The components are Input/Output, Processor, Control, Feedback, Environment and Boundaries/Interface. Figure 2.1.1 presents the relationship and organization of these elements of a system.

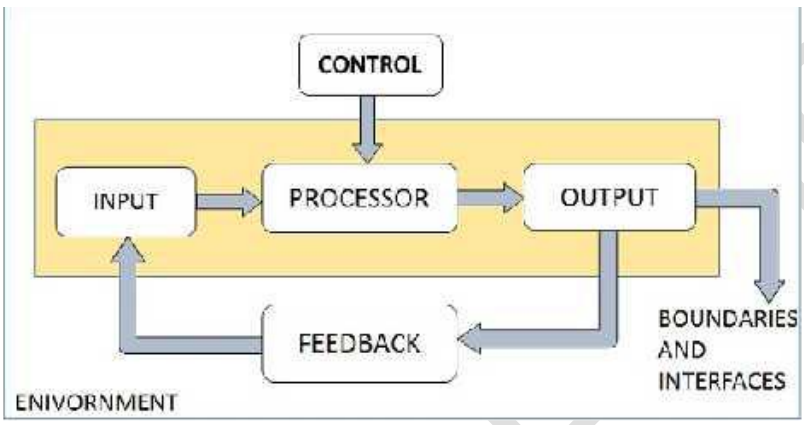


Figure 2.1.1: Elements of a System

i. Inputs and Outputs

- The main aim of a system is to produce an output which is useful for its user.
- Inputs are the information that enters into the system for processing.
- Output is the outcome of processing.

ii. Processor(s)

- The processor is the element of a system that involves the actual transformation of input into output.
- It is the operational component of a system. Processors may modify the input either totally or partially, depending on the output specification.
- As the output specifications change, so does the processing. In some cases, input is also modified to enable the processor for handling the transformation.

iii. Control

- The control element guides the system.
- It is the decision–making subsystem that controls the pattern of activities governing
- input, processing, and output.
- The behavior of a computer System is controlled by the Operating System and software. In order to keep system in balance, what and how much input is needed is determined by Output Specifications.

iv. Feedback

- Feedback provides the control in a dynamic system.
- Positive feedback is routine in nature that encourages the performance of the system.

Pre-print Edition

- Negative feedback is informational in nature that provides the controller with information for action.

v. Environment

- The environment is the "supersystem" within which an organization operates.
- It is the source of external elements that strike on the system.
- It determines how a system must function. For example, vendors and competitors of organization's environment, may provide constraints that affect the actual performance of the business

vi. Boundaries and Interface

- A system should be defined by its boundaries. Boundaries are the limits that identify its components, processes, and interrelationship when it interfaces with another system.
- Each system has boundaries that determine its sphere of influence and control.
- The knowledge of the boundaries of a given system is crucial in determining the nature of its interface with other systems for successful design..

3.4 Types of System

Systems can be divided into the following categories of types:

a. Physical or Abstract Systems

- Physical systems are **tangible entities**. We can touch and feel them. Physical System may be **static or dynamic in nature**. For example, desks and chairs are the physical parts of computer center which are static. A programmed computer is a dynamic system in which programs, data, and applications can change according to the user's needs.
- Abstract systems are **non-physical entities or conceptual that may be formulas, representation or model of a real system.**

b. Open or Closed Systems

- An **open system must interact with its environment**. It receives inputs from and delivers outputs to the outside of the system. For example, an information system which must adapt to the changing environmental conditions.
- A **closed system does not interact with its environment**. It is isolated from environmental influences. A completely closed system is rare in reality.

c. Adaptive and Non-Adaptive System

- **Adaptive System responds to the change in the environment** in a way to improve their performance and to survive. For example, human beings, animals.
- **Non-Adaptive System does not respond to the environment**. For example, machines.

d. Permanent or Temporary System

- **Permanent System persists for long time.** For example, Network work stations.
- **Temporary System is made for specified time** and after that they are demolished. For example, A Mobile multimedia system is set up for a program and it is dissembled after the program.

e. Natural and Manufactured System

- **Natural systems are created by the nature**. For example, Solar system, seasonal system.
- **Manufactured System is the man-made system**. For example, Rockets, dams, trains.

f. Deterministic or Probabilistic System

- **Deterministic system operates in a predictable manner** and the interaction between system components is known with certainty. Radio broadcasting system.
- **Probabilistic System shows uncertain behavior**. The exact output is not known. For example, Weather forecasting, mail delivery systems.

Pre-print Edition

g. Social, Human-Machine, Machine System

- **Social System is made up of people**. For example, social clubs, societies.
- **In Human-Machine System, both human and machines are involved** to perform a particular task. For example, Computer programming.
- **Machine System is where human interference is neglected**. All the tasks are performed by the machine. For example, an autonomous robot.

h. Man–Made Information Systems

- It is an interconnected set of information resources to manage data for particular organization, under Direct Management Control (DMC).
- This system includes hardware, software, communication, data, and application for producing information according to the need of an organization. Man-made information systems are divided into three types –
    1. **Formal Information System** − It is based on the flow of information in the form of memos, instructions, etc., from top level to lower levels of management.
    2. **Informal Information System** − This is employee-based system which solves the day to day work related problems.
    3. **Computer-Based System** − This system is directly dependent on the computer for managing business applications. For example, automatic library system, railway reservation system, banking system, etc.

4.0 Summary

In this unit, you have learnt that:

- A system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific goal
- The properties of a system are: Organization, interaction, interdependence, integration and central objectives
- A system is composed of six (6) elements: Input/Output, Processor, Control, Feedback, Environment and Boundaries/Interface
- System can be categorized into the following types:
    a. Physical or Abstract Systems
    b. Open or Closed Systems
    c. Adaptive and Non-Adaptive System
    d. Permanent or Temporary System
    e. Natural and Manufactured System
    f. Deterministic or Probabilistic System
    g. Social, Human-Machine, Machine System
    h. Man–Made Information Systems

5.0 Self-Assessment

A. Define a System
B. Highlight the properties of a system
C. List the elements of system
D. Enumerate five (5) distinct categories of the type of a system

6.0 Tutor-Marked Assignment

A. With a suitable well labeled diagram, describe the relationship between the components of a system.
B. Differentiate succinctly between the following types of system:
    1. Deterministic and Probabilistic system
    2. Open and Closed system
    3. Physical and Abstract system

Pre-Print Edition

4. Adaptive and Non-Adaptive system

7.0 References

Avgerou C. (2011). Information systems development and management The London School of Economics and Political Science. IS2062, 2790062.

Ralph M. Stair (2010). Principles of Information Systems A Managerial Approach Ninth Edition , Florida State University, Course Technology, Cengage Learning.

8.0 Further Reading

https://ecomputernotes.com/mis/structure-and-classification/explain-the-different-types-of-systems
https://padakuu.com/article/2-system-definition-and-concepts-characteristics-and-types-of-system

Pre-print Edition

UNIT 2: Information Systems

1.0 Introduction

This unit exposes you to the concept of Information System as the core system of any information technology driven organization. It lays more emphasis on its structure, elements and processes. It also explains different techniques for modeling an information system. In addition to that, you will also learn information system development life cycle as a procedure to follow in developing information systems.

2.0 Learning Outcomes

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

I. Define information system
II. State the components of an information system
III. Describe the six information processes carried out by an information system in order to process data
IV. Highlight four information system modeling techniques
V. Describe in steps the phases of information system development life cycle

3.0 Main Content

3.1 Introduction to Information System

An **information system** performs a set of information processes requiring users, data/information and information technology. It performs the information processes of **collecting, organising, analysing, storing/retrieving, processing, transmitting/receiving and displaying information**. Information systems are created for a **purpose** and operate in a particular **environment**.

The structure of an information system is presented in Figure 2.2.1. The relationships between the components of an information system are also depicted. The links between the elements are represented using two-headed arrows. This emphasizes that the components influence each other—a change in one can affect the others. For example, the availability of new technology could change the information processes, which in turn might affect the type of skills required by the participants.

Discussion on each of the components is presented in the following:

Pre-Print Edition

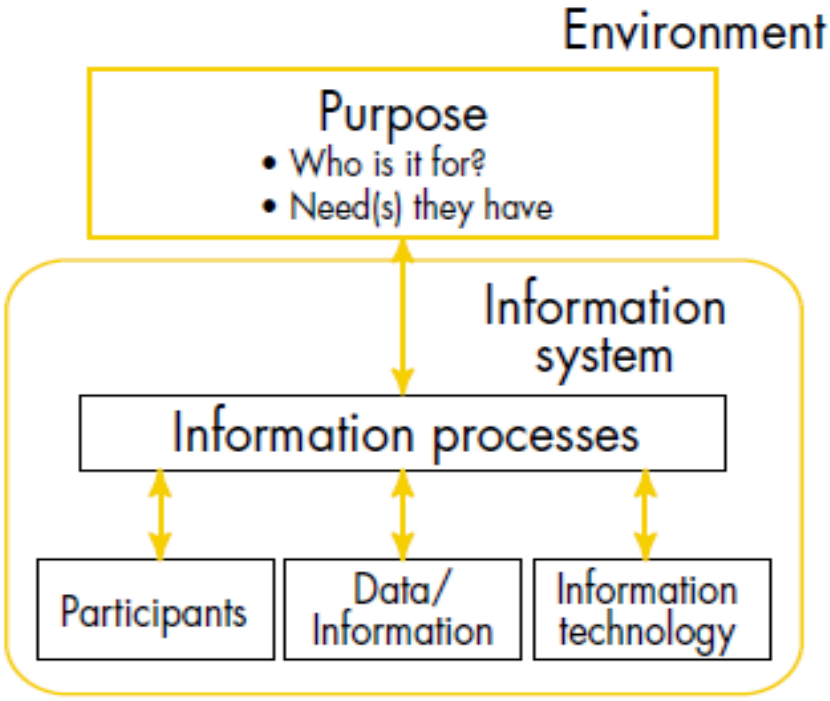


Figure 2.2.1: Structure of an information system

Purpose

The system's **purpose** is the reason for its existence and it is used to measure its success. Information systems are created to solve a problem and provide benefits to an organization or individual. There are many different reasons for existence of an information system.

Individuals may require an information system whose purpose is:

- to keep track of income and expenses
- to design a multimedia presentation for the next staff meeting. etc.

Organizations may require an information system whose purpose is:

- to provide stock inventory, sales, payroll, share market, commodity prices or interest rates information
- to assist decision-making by summarising and comparing data
- to share data and information between individuals and offices in different locations
- to store and organise information on consumer trends, competition products or labour costs. etc.

Environment

The **environment** is everything that influences or is influenced by an information system and its purpose. For example, the environment of the local library is not only the building, but also factors outside the building, such as its location, electrical power, air-conditioning, communications, and funding from the government. The environment of a system is constantly changing. One of the main reasons for the environment to change is the progress in information technology. Twenty years ago, organizations were largely restricted by geographical boundaries. Today, the environment of many organizations is the world.

Information Technologies (IT)

IT technologies are the set of tools used by an information system or its participants to perform work—it is the **hardware and software artifacts** used by information systems. It is important to understand that information technology has no effect unless it is used within an information process. To be effective, the information technology must be able to support the information process.

Hardware is the physical equipment involved in processing information, such as a computer, network cables and data storage devices. Computers often form the basic hardware of an information system.

Pre-print Edition

Computers are electronic devices that can process data according to stored sequences of instructions. They have five basic functions: input, processing, storage, control and output.

- **Input** involve devices designed to assist in the entry of data is called an input device. Input devices include the keyboard, mouse, scanner, digital camera, video camera and microphone.
- **Processing** manipulates data to produce information by following a series of instructions. Processing is performed by the computer's central processing unit (CPU). The CPU is the 'brain' of the computer. It takes the data from an input device, changes it to produce information and sends it to an output device to be displayed to the user.
- **Storage** involves retaining data over a period of time. Before, during and after processing, data and programs are held temporarily in memory. To retain data more permanently, storage devices such as magnetic disks, magnetic tape, optical disks and flash memory are used.
- **Control** coordinates the operations of input, processing, output and storage. The control unit is part of the CPU. The control unit is the 'organizer' that directs the flow of data in the computer in the same way as traffic lights control the flow of cars at an intersection.
- **Output** involves the presentation or display of information to a person, or the transfer of data to another computer. Common output devices are the computer screen and the printer. The information presented is the result of a participant's work

Software is the detailed instructions (computer programs) used to direct the hardware to perform a particular task. A computer needs software to tell it what to do and it needs hardware to carry out the actual work. There are two main types of software: application software and system software.

- **Application software** is a computer program used for a specific task. It allows the computer to achieve the task for which it was designed. Application software includes word processors, databases, graphics programs and spreadsheets.
- **System software** manages and controls the hardware so the application software can perform the required task. It determines the way the participant interacts with the information system. System software includes operating systems and utility software.

Data and information

Data is the raw material entered into an information system. This raw material could be in the form of images, audio, video, text or numbers, and is entered using an input device. A key role for an information system is to process data into information

Information is data that has been ordered and given some meaning by people. It is created or modified by the information processes. The form and content of information must be appropriate for a particular use. It is used within the information system or is the result of the information system.

Participants

Participants are the personnel who carry out the information processes within the information system. Participants need to know what to do, how to do it and when to do it. All information systems have participants—even the most automated systems rely on people if the system fails. Participants have an essential role in an information system, and the success or failure of the system depends on their skills, interests and commitment. Participants are often referred to as **direct users**.

Information Processes

Information processing refers to the creation of information by processing data using information technology. **This changing of data into information involves seven steps called information processes**. These processes describe the procedures that an information system performs to process data into information. The information processes include:

I. **Data Collection**: Collecting is the information process that involves deciding what to collect, locating it and collecting it. A range of hardware devices such as **keyboard, clicker, PDA, Webcam, microphone, sound recorder and scanner** are used to collect different types of data. Software such as **operating system, forms, electronic survey, social network applications** are also used to collect data.

Pre-print Edition

II. **Data Organization**: Organizing is the process that arranges, represents and formats data for use by other information processes. Data is digitized using a hardware device called **modem**. There is a range of application software for organizing data in a variety of formats. These applications include **word processor, desktop publishing, multimedia software, spreadsheet and Database management system.**

III. **Data analysis:** Analyzing is the interpretation of the data. It involves examining a set of data and extract salient meaning or hidden pattern from it. After data is analyzed, it becomes information. The hardware requirements for analyzing data depend on the type of analysis and amount of data. There is a range of software applications to analyze data of different types and format. These include **sorter, modelling and simulation tools, SPSS, Stata, R, WEKA and Nesstar**

IV. **Storing and retrieval**: The process of storing data is called **writing** and retrieving data is called **reading.** There is a range of different hardware devices such as **magnetic disks, magnetic tape, optical disks and flash memory** are used for storing and retrieving. Software such as **File management system, DBMS, internet browser, and search engines** are used for storing and retrieval

V. **Processing:** Processing is the manipulation of data by editing and updating it. The major hardware for data processing is **computer's CPU and the RAM**. Software application packages such as **Microsoft office, Coreldraw, Photoshop, Flash micoedia, Cinema4D, Matlab** etc. are also used to manipulate different kinds of data.

VI. **Transmittion:** Transmitting and receiving is the transfer of data and information within and between information systems. The hardware includes **modems and networks devices such as switches, routers, bridges and hubs** as well as the internal components of the computer. Software is used to direct the use of the hardware, store and provide information to be shared by several users.

These steps are not necessarily separate and sequential. Several steps may occur at the same time, and they may occur in almost any order.

3.2 Information System Modeling

Information System Modeling involves the use of virtual representations (called models) to conceptualize and construct system for managing processes in an organization. There exist several system models, including:

I. Schematic Models

- A schematic model is a 2-D chart that shows system elements and their linkages.
- Different arrows are used to show information flow, material flow, and information feedback.

II. Flow System Models

- A flow system model shows the orderly flow of the material, energy, and information that hold the system together.
- Program Evaluation and Review Technique (PERT), for example, is used to abstract a real-world system in model form.

III. Static System Models

- They represent one pair of relationships such as activity–time or cost–quantity.
- The **Gantt chart**, for example, gives a static picture of an activity-time relationship.

IV. Dynamic System Models

- It shows an ongoing, constantly changing status of the system. It consists of −
    a. Inputs that enter the system
    b. The processor through which transformation takes place

Pre-print Edition

c. The program(s) required for processing
d. The output(s) that result from processing.

3.3 Information System Development Life Cycle (SDLC)

In essence, information system development consists of the process of creating an information system, with all the variables that it entails and which usually need to be taken into account: such variables include among others;

- *its ability to be user-friendly*
- *its ability to function well*
- *its ability to meet the needs of the organization into which it will be integrated.*

System Development Life Cycle (SDLC) is a conceptual model which includes policies and procedures for developing or altering systems throughout their life time.

An effective System Development Life Cycle (SDLC) should result in a high-quality system that meets customer expectations, reaches completion within time and cost evaluations, and works effectively and efficiently in the current and planned Information Technology infrastructure.

3.3.1 Phases of System Development Life Cycle (SDLC)

Systems Development Life Cycle is a systematic approach which explicitly breaks down the work into phases that are required to implement either new or modified Information System. The specific phases of SDLC depicted in Figure 2.2.2.

I. Feasibility Study or Planning

- Define the problem and scope of existing system.
- Overview the new system and determine its objectives.
- Confirm project feasibility and produce the project Schedule.
- A feasibility report for the entire project is created at the end of this phase.

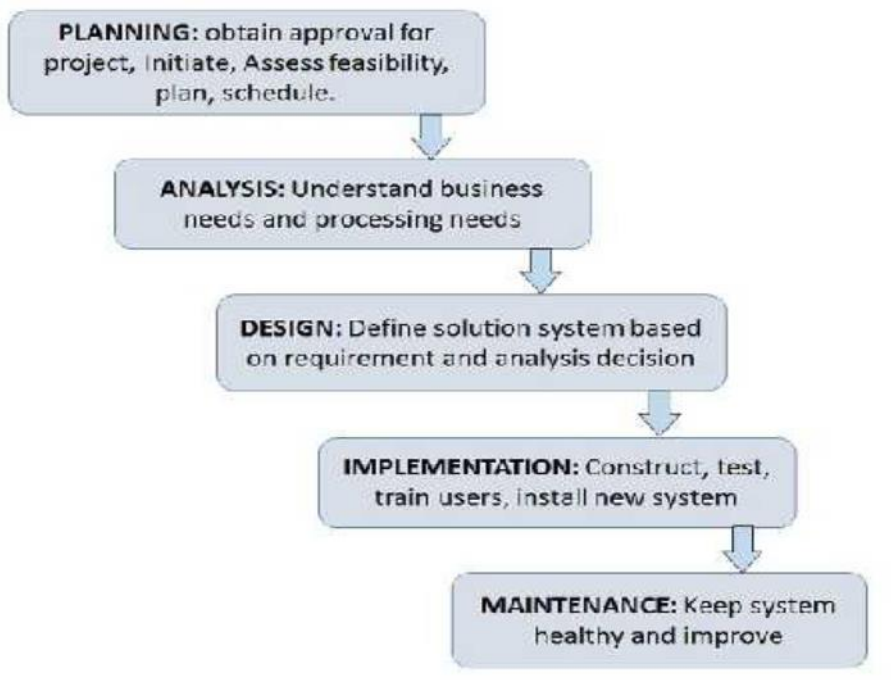


Figure 2.2.2: *Phases of SDLC*

Print Edition

II. Analysis and Specification

- Gather, analyze, and validate the information.
- Define the requirements and prototypes for new system.
- Examine the information needs of end-user and enhances the system goal.
- A Software Requirement Specification (SRS) document, which specifies the software, hardware, functional, and network requirements of the system is prepared at the end of this phase.

III. System Design

- Includes the design of application, network, databases, user interfaces, and system interfaces.
- Transform the SRS document into logical structure, which contains detailed and complete set of specifications that can be implemented in a programming language.
- Create a contingency, training, maintenance, and operation plan.
- Finally, prepare a design document which will be used during next phases.

IV. Implementation

- Implement the design into source code through coding.
- Combine all the modules together into training environment that detects errors and defects.
- A test report which contains errors is prepared through test plan that includes test related tasks such as test case generation, testing criteria, and resource allocation for testing.
- Integrate the information system into its environment and install the new system.

V. Maintenance/Support

- Include all the activities such as mobile or physical on-site support for users that is required once the system is installing.
- Implement the changes that software might undergo over a period of time, or implement any new requirements after the software is deployed at the customer location.
- Maintenance and support may be needed for a longer time for large systems and for a short time for smaller systems.

Note: SDLC was developed for large and structured information system projects. Therefore, development projects using SDLC can sometimes take months or years to complete.

4.0 Summary

In this unit, you have learnt that:

- An **information system** performs a set of information processes requiring users, data/information and information technology.
- The components of information system are: Purpose, Participants, Data & Information, Information Technology, Information processes and Environment.
- Information system performs the information processes of **collecting, organizing, analysing, storing/retrieving, processing, transmitting/receiving and displaying information**.
- Information System Modeling involves the use of virtual representations referred to as models to conceptualize and construct system for managing processes in an organization.
- Information system modeling techniques include: Schematic model, Flow system model, Static model and Dynamic model.

Pre-print Edition

- The phases of information system development life cycle are : feasibility study/Planning, Analysis & specification, System design, Implementation and Maintenance/Support.

5.0 Self-Assessment

A. What is information system?
B. State the six (6) components of an information system
C. Processing data within an information system requires several information processes, state the six information processes employed by any information system
D. Enumerate the four information system modeling techniques
E. Describe the phases of information system development life cycle in order of their implementation

6.0 Tutor-Marked Assignment

A. What do you understand by the term "Information Technology"?
B. Mention at least two (one hardware and one software) technologies employed in each of the six information processes carried out by any information system

7.0 References

Avgerou C. (2011). Information systems development and management The London School of Economics and Political Science. IS2062, 2790062.

Powers G.K. (2003). Information processes and technologies. Heinemann, A division of Reed International Books Ltd, Australia.

Texas Project Delivery Framework, U.S. Department of Information Resources (2008). System development Life Cycle guide. Texas Department of Information Resources. Retrieved from http://www.dir.texas.gov/SiteCollectionDocuments/IT%20Leadership/Framework/Framework%20Extensions/SDLC/SDLC_guide.pdf

Vira Viktorivna Shendryk and Andrii Boiko. (2015). Stages of Information System Development in the Process Approach. Science Direct. doi: 10.1016/j.procs.2015.12.365

8.0 Further Reading

https://opentextbook.site/informationsystems2019/chapter/chapter-1-what-is-an-information-system-information-systems-introduction/
https://www.tutorialspoint.com/system_analysis_and_design/system_analysis_and_design_development_life_cycle.htm
https://www.tutorialspoint.com/system_analysis_and_design/system_analysis_and_design_development_life_cycle.htm

Pre-print Edition

UNIT 3: System Development Life Cycle Models

1.0 Introduction

The methodology for information system development involves a great variety of approaches, is known as models of system development life cycle**.** This unit exposes you to the various methodological models for developing information systems from feasibility study to maintenance. It is crucial to educate you with an overview of these development life cycle models, for you to further understand which one of them would be more appropriate for a specific information system project.

2.0 Learning Outcomes

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

I. Describe at least 5 system development life cycle models
II. Explain the skills required by information system professional
III. List at least five information professional and their roles within the information system.

3.0 Main Content

3.1 The Waterfall Model

The waterfall model is a step-by-step sequential description of the product's life cycle that spans 5 key stages. The model is depicted in Figure 2.3.1.

- Each of its stages must be entirely concluded before the next can begin.
- Thus, analysis of requirements must be thorough and final before design begins, and testing can only be efficiently carried out once coding is entirely complete.
- Each stage is regarded as a static component, a rigid step in the process.
- Subsequent changes in previous steps (e.g., awareness of new requirements) cannot be taken into account.

Pre-print Edition

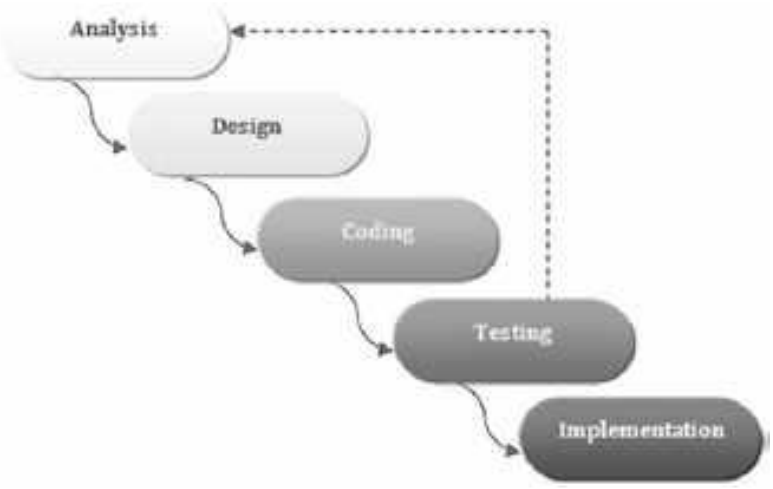


Figure 2.3.1: waterfall life cycle model

The waterfall model suffers an important setback with the increasing speed of technological evolution and the subsequent need to swiftly deliver new software systems and products.

- Viewing each stage as a single, "frozen" step of evolution can **greatly delay the implementation stage because errors will only be detected very late in the process**, during the testing phase, which is preceded by extensive designing and coding.
- The communication of objectives between developers and clients is also greatly hindered because **if the client changes the requirements of the system, the development process needs to completely restart** for those changes to be taken into account.

Note: This model is an idealized and greatly simplified concept of SDLC. It is not very flexible, but it is still popular as a conceptual basis for other frameworks or models.

3.2 Incremental Model

The incremental model is a particular evolution of the waterfall model that attempts to address its more prominent shortcoming, which is the slowness of the cycle. It also aims at outlining a more flexible process that requires less extensive planning up-front. The model is depicted in Figure 2.3.2. According to this approach:

- instead of dividing the SDLC into static, isolated steps, the whole process can, instead, be designed, tested, and implemented, one fraction at a time, in successive stages, so that with each stage (or increment), there can be at least some feedback from the client.
- This feedback will provide valuable assistance in the next increment of the process and so forth.
- With each ongoing increment, the product is extensively tested and improved, according to objectives and expectations from the client, which facilitates its eventual success.

Pre-print Edition

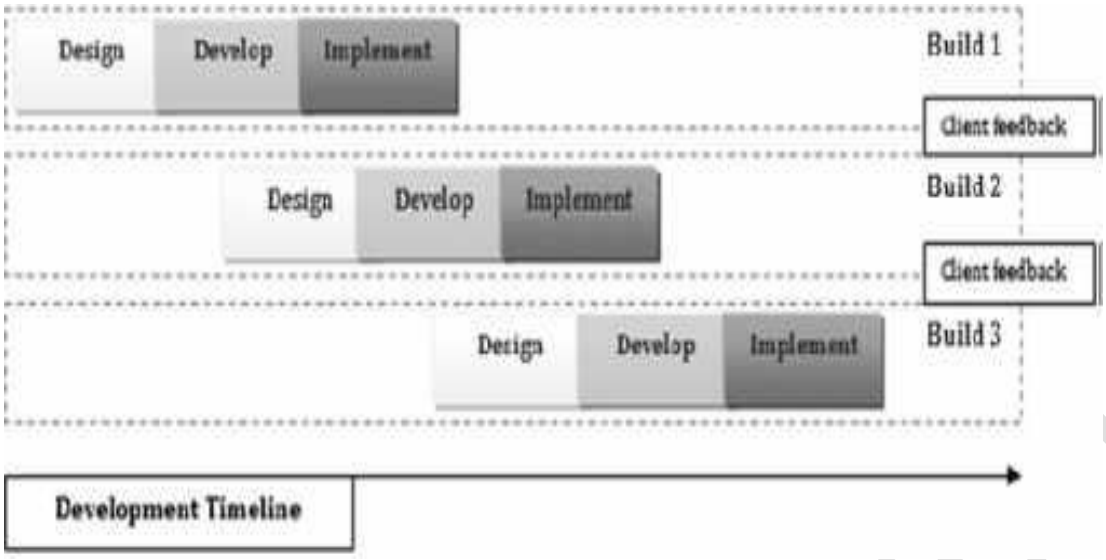


Figure 2.3.2: Incremental Life Cycle Model

3.3 The V Life Cycle Model

The V-Model is a variation over the waterfall model that attempted to emphasize the existing connection between each of the stages of the development process and its respective stage of tests. By focusing on this relationship, it ensures that adequate quality measurements and testing are constantly resorted to, throughout the life cycle. This is depicted in figure 2.3.3.

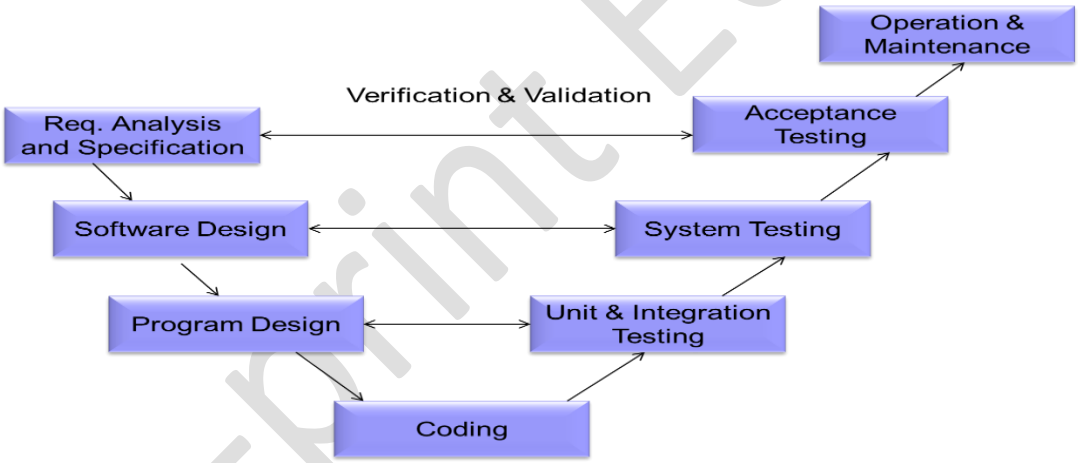


Figure 2.3.3: The V Life Cycle Model

The model has the following attributes:

- The V-Model starts off with a very similar premise to the classic waterfall models. In successive steps, the project goes from analysis of requirements and specifications, to architectural and detailed design, to coding.
- However, instead of continuing this downward ladder, there is a parallel structure that moves upward from the coding stage, giving the model its distinct V shape.
- The upward ladder describes each of the testing steps that follows coding, starting with unit testing and ending with acceptance testing, the final step before final release.
- In that sense, the **V-Model describes three successive layers of system development that can be described as requirements (overall system), high-level design (software design), and low-level design (Program design).**
- To each of these layers, there is a corresponding layer of verification and testing.

The core objective of the V life cycle model is to illustrate the importance of the relationship between development and testing tasks.

Pre-print Edition

Note: Since the V-Model addresses its errors shortly after they are identified, it becomes less expensive to resolve them, which is perhaps the greatest advantage of using this model. However, this model is very rigid and there is little room for flexible adaptation, particularly because any alteration in the requirements will render all existing testing obsolete.

Since the V model requires a great deal of resources, it only works well for small projects where requirements are easily understood.

.

3.4 The Prototyping Model

The prototyping model is based on the idea of creating the entirety or part of a system in a pilot version, called the prototype. The goal is ultimately to build in various versions and consistently refine those versions until a final product is reached. The emphasis is placed on the creation of the software, with less attention to documentation. It is also a user-centric approach, because user feedback is fundamental to develop subsequent prototypes and, eventually, the final product. The model is depicted in figure 2.3.4.

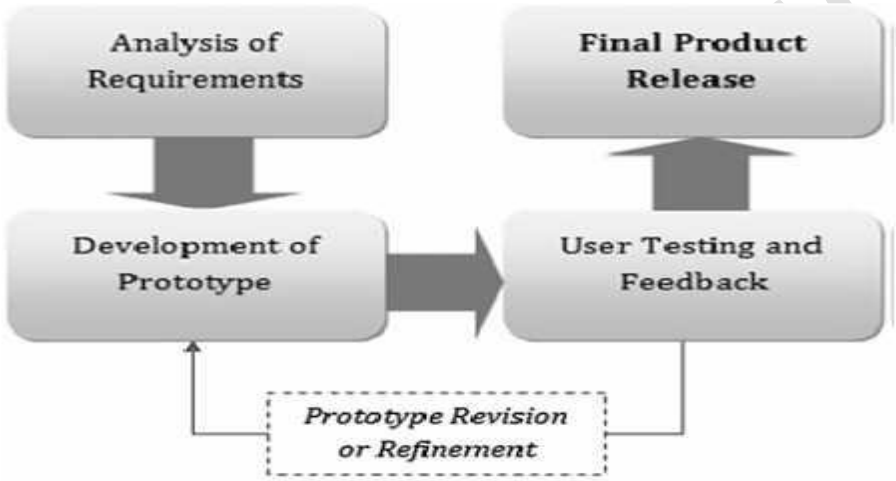


Figure 2.3.4: The Prototyping Life Cycle Model

A prototyping model essentially entails **four different stages**:

1. User's **requirements and needs are analyzed** and identified.
2. The team **develops a working prototype of the product**, which is then implemented.
3. The **users test it and provide real-time feedback** and experience. If improvements and changes are found necessary, the prototype is revised and refined
4. A **new prototype is released** and implemented for testing. This sub-cycle will go on until the product is generally accepted by the users and the final version is released.

There are three types of prototyping, according to specific needs of the project. These are: exploration, experimentation, and evolution.

- The exploratory approach is centered on the premise that requirements are thoroughly explored with each iteration. Under this category, we find rapid throwaway prototyping, essentially a method of delivering fast releases of the product with each iteration.
- The experimental approach entails that a solution to the user's needs is first proposed and then evaluated through experimental use. The use of simulation programs and skeleton programming falls under this category. It is the most common form of prototyping.
- The evolutionary approach essentially describes development in successive versions and is closest to incremental and iterative life cycle models, in that its main goal is to accommodate the eventual changes in requirements and needs.

By using a form of the prototyping model, a development project can easily adapt to changing requirements, because there is constant feedback.

Preprint version

Note: Prototyping models are weak on analysis and design planning. While requirements are assessed as the product is developed in successive versions, there is little control over costs and resources, which can dramatically increase the financial cost of the project. Therefore, we can conclude that prototyping is ideal for larger projects and particularly for user-centric ones.

3.5. The Spiral Life Cycle Model

The spiral model introduces something that other models did not take into account, which is risk analysis. In essence, the spiral model attempts to bring together key aspects of some other prominent models (namely the waterfall, incremental, and evolutionary prototyping).
According to this SDLC model:

- The process of developing a system consists of a series of cycles or iterations.
- Each cycle begins with the identification of objectives and requirements of the current stage, as well as an analysis of alternatives and constraints.
- This process will highlight areas of uncertainty (risk), which will be taken into account during the next step.
- The outlining of a strategy or plan, through prototyping and other simulation methods. This process involves constant improvement of the prototype as risks are decreased (while others may arise).
- Once the prototype becomes sufficiently robust, and risk is reduced to acceptable levels, the next step develops the system in accordance with the basic waterfall approach, through a succession of stages: concept, requirements, design, and implementation.
- Once this cycle is concluded, another cycle begins, as a new increment of the product is created.
- The spiral model bears some resemblance to the incremental life cycle, but the emphasis on risk evaluation presents a major difference.

This SDLC model is depicted in Figure 2.3.5.

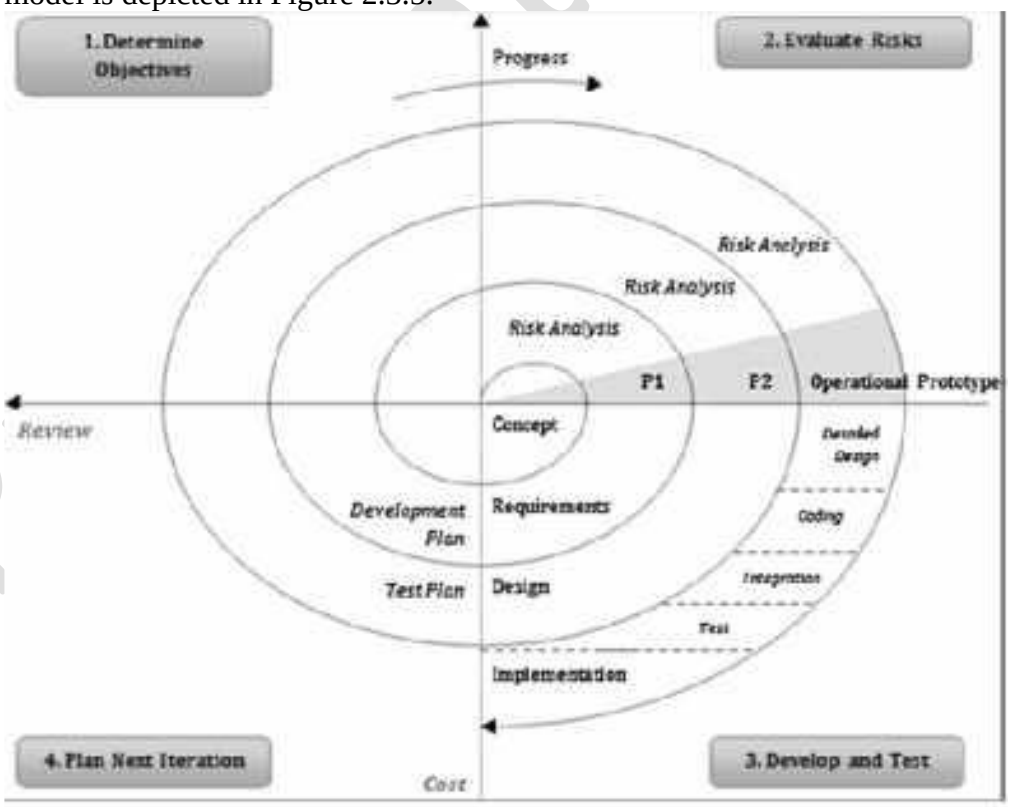


Figure 2.3.5: The Spiral Development Model

With this SDLC model, product delivery is not only faster, but it is also easier to test and eventually correct. However, the downside to this approach is that it can be more costly to develop and release

Print Edition

multiple versions of the product. Moreover, when a later increment is developed due to a new found problem or necessity, it can have compatibility issues with earlier versions of the product.
Note: The spiral model has significant advantages over previously described models and makes it an ideal model for large, mission-critical projects. On the downside, it is not very efficient in smaller projects.

3.6. Rapid Application Development (RAD)

Rapid application development (RAD) is a systems development methodology that focuses on quickly building a working model of the software, getting feedback from users, and then using that feedback to update the working model. After several iterations of development, a final version is developed and implemented. The RAD methodology consists of four phases as depicted in Figure 2.3.6.

Figure 2.3.6: The RAD Methodology

- Requirements Planning: This phase is similar to the preliminary-analysis, system analysis, and design phases of the SDLC. In this phase, the overall requirements for the system are defined, a team is identified, and feasibility is determined.
- User Design: In this phase, representatives of the users work with the system analysts, designers, and programmers to interactively create the design of the system based on JAD Session. JAD is an acronym for Joint Application Development.
- Construction: In the construction phase, the application developers, working with the users, build the next version of the system. This is an interactive process, and changes can be made as developers are working on the program. This step is executed in parallel with the User Design step in an iterative fashion, until an acceptable version of the product is developed.
- Cutover: In this step, which is similar to the implementation step of the SDLC, the system goes live. All steps required to move from the previous state to the use of the new system are completed here.

It can be seen that the RAD methodology is much more compressed than other SDLCs. Many of the SDLC steps are combined and the focus is on user participation and iteration.

Note: One of the most obvious flaws is that it removes a great deal of emphasis on minute planning and modeling at the start of the project, shifting the focus to the system construction. Another prominent issue is that in faster development cycles, extensive quality testing will become less prioritized, reflecting in poorer quality overall.

RAD makes more sense for smaller projects that are less resource intensive and need to be developed quickly.

3.7. Agile Life Cycle Model

Agile model is a group of methodologies that utilize incremental changes with a focus on quality and attention to detail. Each increment is released in a specified period of time (called a time box), creating a regular release schedule with very specific objectives. The characteristics of agile methods include:

- small cross-functional teams that include development-team members and users;
- daily/weekly status meetings to discuss the current state of the project;
- short time-frame increments (from days to one or two weeks) for each change to be
- completed;
- at the end of each iteration, a working project is completed to demonstrate to the stakeholders.
- Customer satisfaction is the highest priority;

The agile model is depicted in figure 2.3.7.

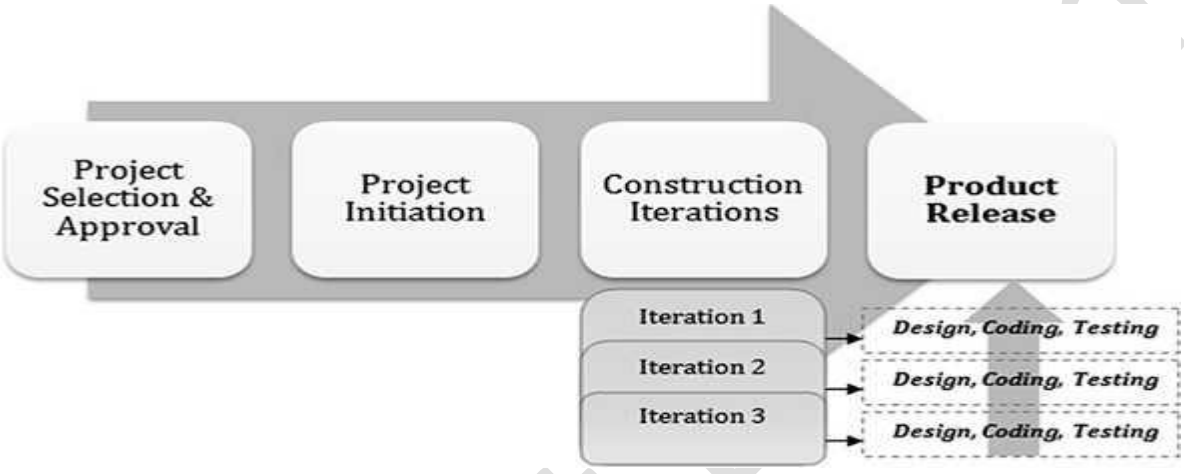


Fig 2.3.7: Agile Development Life Cycle Model

The Agile model is outlined in four steps as shown in figure 2.3.7:

- Project Selection and Approval: in this stage, a team consisting of developers, managers, and customers establishes the scope, purpose, and requirements of the product. There is also a thorough analysis of different alternatives to accomplish the established goals.

- Project Initiation: at this stage a working team is built, with the appropriate environment and tools, as well as the working architecture in which the system will be based. At this point, it is also adequate to establish working time frames and schedules.

- Construction Iterations: Developers release working software in successive increments that will accommodate the evolution of requirements as outlined by the various stakeholders, with each iteration, consisting of both planning and building. Close collaboration and extensive testing of each iteration are paramount at this point.

- Product Release: This stage encompasses two stages: First, final testing of the entire system is done, as well as any necessary final reworks and documentations. Next, the product is released, at which point training is provided to the users in order to maximize operational integration.

Note: Important advantage of the agile model is that it is very flexible. It has the capacity to deliver systems whose requirements go through constant changes while, at the same time, demanding strict time limits. Finally, this model is often praised for its high degree of client satisfaction and user-friendliness and reduced error margins.

3.8. Lean Methodology

Pre-print

There is a relatively new concept taken from the business bestseller "The Lean Startup" by Eric Reis. In this methodology, **the focus is on taking an initial idea and developing a minimum viable product (MVP)**. The MVP is a **working software application with just enough functionality to demonstrate the idea behind the project**. Once the MVP is developed, it is given to potential users for review. **Feedback on the MVP is generated in two forms: (1) direct observation and discussion with the users, and (2) usage statistics gathered from the software itself**. Using these two forms of feedback, the team determines whether they should continue in the same direction or rethink the core idea behind the project, change the functions, and create a new MVP. This change in strategy is called a pivot. Several iterations of the MVP are developed, with new functions added each time based on the feedback, until a final product is completed. This is shown in Figure 2.3.8.

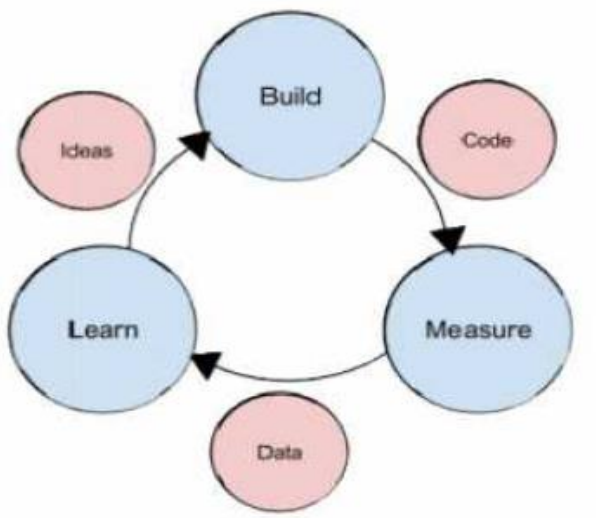


Figure 2.3.8: The lean model

The biggest difference between the lean methodology and the other methodologies is that the full set of requirements for the system is not known when the project is launched. As each iterations of the project is released, the statistics and feedback gathered are used to determine the requirements.

Note: The lean methodology works best in an entrepreneurial environment where a company is interested in determining if their idea for a software application is worth developing.

3.9 Information systems Professionals and Skills

3.9.1 Professional Skills in Information Systems

Skills that are required for professionals in information system are categorized into Interpersonal, Analytical, Management and Technical skills.

Interpersonal Skills

- Interface with users of the system.
- Facilitate groups and lead smaller teams.
- Managing expectations.
- Good understanding, communication, selling and teaching abilities.
- Motivation and the confidence to solve queries.

Analytical Skills

- System study and organizational knowledge
- Problem identification, problem analysis, and problem solving
- Sound commonsense
- Ability to access trade-off

Pre-print version

- Curiosity to learn about new organization

Management Skills

- Understand users jargon and practices.
- Resource & project management.
- Change & risk management.
- Understand the management functions thoroughly.

Technical Skills

- Knowledge of computers and software.
- Programming and software development[development]
- Keep abreast of modern development.
- Know of system design tools.
- Breadth knowledge about new technologies.

3.9.2 Information system Professionals

Career opportunities and professionals in information systems are briefly highlighted as follows:

Information officer: This person is responsible for managing information flow within an organization that uses IT and computer systems (Information Systems) that support the enterprise's goals. He is required to possess strong interpersonal communication and analytical skills as described in the previous sub-section.

Chief Technology officer: The main function of this professional is to set all technology goals and policies within an organization. He interfaces between the IT directors and the management. He also makes sure that the technologies employed by the organization align with the goal and vision of the organization. He must posses interpersonal communication skills and management skills

IT director: This person is responsible for the function of all of the business's technology tools and processes. He designs the use of information technology, their function and processes within the information system. This role is commonly called IT manager or IT leader. IT directors must possess Management, interpersonal communication and technical skills

Systems administrator: This person configures, manages, supports and troubleshoots a multiuser computing environment. Within an information system enterprise, this role can be segmented by technology, requiring an administrator or team dedicated to server, desktop, network, virtualization or other components. System administrators must possess Analytical, technical and interpersonal communication skills.

Application manager: This person's role centers on the provisioning and management of a high value business application. He acquires and configures application software or other tools that ensure the smooth running of the information system enterprise. Must possess analytical and technical skills as well as interpersonal communication skills

Software Developer: This person (or team) writes, updates and tests code for programs to meet business objectives internally and to ease the use of the system by customers. He must possess technical skills required to develop good software. Analytical and interpersonal skills are as well a must for software developers

Information System Architect: This person examines and changes IT functions to best support the business. He handles the design and modeling of the whole information system as an entity in an

Pre-Print Edition

organization. He gathers information from the environment and design a suitable information system to solve organizational and societal problems. Information system architect must possess analytical, management and interpersonal communication skill to work effectively in his role.

4.0 Summary

In this unit, you have learnt that:

- There are different system development life cycle models that can be employed in the development of information system in an organization or society, these include waterfall, incremental, V-model, prototyping, spiral, agile, RAD and lean models
- Skills required to be possessed by information system professionals are categorized into Interpersonal communication, Technical, Analytical and Management skills
- Career opportunities in Information Systems include: information office, chief technology officer, system administrator, application manager, software developer, IT director and information system architect.

5.0 Self-Assessment

I. Describe with the aid of a well labeled diagram any five (5) system development life cycle models you know

II. State at least two(2) skills required to be possessed by information system professional under the following categories:
   a. Interpersonal skills
   b. Technical skills
   c. Analytical skills
   d. Management skills

III. Mention and describe the role of any Information system professionals you know

6.0 Tutor-Marked Assignment

A. Agile Model of development is the most appropriate when developing large scale information system. Discuss

B. Distinguish vividly between the Lean methodology and the RAD model of information systems.

C. You have just been hired as an application manager in a University, highlight the professional skills you required to possess in order to discharge your role effectively.

7.0 References

Building Successful Information Systems – a Key for Successful Organization. Annals of Dunarea de Jos" University of Galati Fascicle I – (2010). Economics and Applied Informatics. - ISSN 1584-0409

Burstein, F. (2002). Systems development in information systems research. In K. Williamson (Ed.), Research methods for students and professionals: Information management and systems (Vol. 2nd edition, pp. 147–158). Wagga Wagga, Australia: Centre for Information Studies, Charles Sturt University.

Massey, V., & Satao, K. (2012). Comparing various SDLC models and the new proposed model on the basis of available methodology. International Journal of Advanced Research in Computer Science and Software Engineering, 2(4), 170–177.

8.0 Further Reading

Pre-print Edition

https://existek.com/blog/sdlc-models/#:~:text=Web%20Development-,SDLC%20Models%20Explained%3A%20Agile%2C%20Waterfall%2C,V%2DShaped%2C%20Iterative%2C%20Spiral&text=One%20of%20the%20basic%20notions,Software%20Development%20Life%20Cycle%20models.
https://www.innovativearchitects.com/KnowledgeCenter/basic-IT-systems/8-SDLC-models.aspx

MODULE 3: ICT APPLICATION IN LIBRARIES AND INFORMATION CENTRES
UNIT 1: Automation of Library and Information Centres

1.0 Introduction

Automation of Libraries and Information Centers has now become a global phenomenon. In this unit, you will be introduced to what library automation is all about, several related concepts to library automation, objectives and rationales of library automation and the benefits of library automation. This unit will expose you to steps in library automation processes to accomplish the set aims and objectives. You will also learn in this unit stage-by-stage planning and implementation of library automation project that can lead to a successful implementation as well as the various challenges confronting library automation in Nigeria.

2.0 Learning Outcomes

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

I. define library automation and other related concepts

Pre-print Edition

II. list the objectives and rationales of library automation
III. describe the benefits of library automation
IV. describe the different stages of ICT application in libraries and information centers
V. determine the factors to consider in planning for library automation
VI. identify the challenges of automating libraries and information centers in
VII. identify and explain the step-by-step processes involved in an effective library automation project
VIII. describe the library automation project planning and implementation

3.0 Main Content

3.1 Definition of Concepts

Automation of Libraries and Information Centers is now a global phenomenon. For libraries and librarians to provide effective and efficient information services to their esteemed users in this digital era, it requires that the library operations must be automated. Gone were the days when libraries and information centers depended solely on manual system of providing services to information users. The developments in ICT and its associated systems have altered the ways library services are offered. Thus automation of libraries and information centers is now a necessity in this era of globalization. This is to enable the libraries to be in line with the trends of the digital age and to attract positive perceptions of the users. This course has been designed to equip the students with the working knowledge required of LIS professional to effectively function in library automation project in any type of library.

3.1.1 Information and Communication Technology (ICT)

Information and Communication Technology (ICT) is perceived to be a force to be reckoned with in the 21st Century because it has caused and continues to cause major changes in the way we live. As far as the digital age is concerned, the benefits accrued from ICT is enormous. Virtually, every profession and sector of the economy has benefited immensely from the use of ICT. ICT has altered the way information is accessed and used globally. ICT is usually used interchangeably with information technology (IT). It is a term that has attracted a lot of definitions from different authorities and stakeholders. Some of the definitions include:

- The term Information and Communication Technology (ICT) is a merger of computing and telecommunication technologies for information acquisition, storage, retrieval, and dissemination.
- ICT is seen as the integration and utilization of computer technologies for the purpose of disseminating information to a target destination or consumer without the constraint of time and space.
- ICT is a generic term used to express the convergence of telecommunications, information, broadcasting and communications.
- ICT is seen as a set of activities which facilitate and enhance the processing, transmission and dissemination of information by electronic means.
- ICT is perceived as techniques people use in order to share, distribute, and gather information for communicating through computers and computer networks.
- ICT refers to forms of technology that are used to transmit, store, create, share or exchange information. This broad definition of ICT includes such technologies as: radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, computer and network hardware and software; as well as the equipment and services associated with these technologies, such as videoconferencing and social media.

A look at these definitions shows that there is no generally accepted meaning of ICT. However, ICT can be seen as the aggregate or convergence of computers, telecommunications gadgets, multimedia resources and other related technologies that are applied and utilized in the total process of information management and dissemination.

3.1.2 Automation

Pre-print Edition

Automation is the use of machineries and tools for easy working and saving of human power and time. It is generally known as a process of applying computers and other modern technology devices in carrying out certain tasks or activities as against using human beings. Apparently, automation is applicable to every sector of human life. Such sectors include: Education, transportation, banking, manufacturing, agriculture, businesses and governance. Automation is used to reduce the amount of staff time devoted to repetitive (and often less challenging) activities that must be done on a daily basis or from time to time. Computers are capable of introducing a high degree of automation in operations, and functions because they are electronic, programmable and are capable to control over the processes being performed.

3.1.3 Library Automation

When we use machineries for collection, processing, storage, preservation and retrieval of information as well as executing other responsibilities and information centers with the use of ICTs; that is what we call library automation. Library automation is the application and utilization of ICTSs to library operations and services. It is also seen as the general term for the ICTs that are used to replace manual systems in the operations and services of libraries and other information ***centers.*** It is the use of computer systems and networking technologies for the execution of tasks, operations and routines for the improvement of service delivery in libraries and information centers. Library automation can be elaborately defined as the transformation of library procedures and operations from manual into computer-based system for efficiency in the acquisition, processing, organization, storage, retrieval and dissemination of information to the end-users through the application of information and communication technologies.

Furthermore, library automation may is defined as the application of computers to perform traditional library housekeeping activities such as acquisition, circulation, cataloging, reference and serials control. It is to be remembered that, various library operations may be automated and not the entire library operations. Library automation refers to the use of computers, associated peripheral media such as magnetic tapes, disks, optical media and utilization of computer based products and services in the performance of all type of library functions and operations.

Library automation is a generic term used to denote the various activities related with the location, acquisition, storage, update, manipulation, processing, repackaging or reproducing, dissemination or transmission or communication, and improving the quality of products and services of library and information centers. It enhances the speed, productivity, adequacy and efficiency of the library professional staff and saves the manpower to avoid some routine, repetitive and clerical tasks such as filing, sorting, typing, duplication checking etc. on which we can conserve costly professional manpower for technical service and readers' service.

3.1.4 Automated systems

Automated systems in libraries are all the ICT components, hardware, software, and electronic resources in which a library system depends and use in its daily operations, including the online public access catalogue and circulation system, bibliographic databases, networked and stand-alone PCs, Web Server(s), application programmes etc. It is the responsibility of the Systems Librarian in conjunction with other library Personnel to keep the various components running smoothly, including any connection to outside networks. The development and management of automated systems in libraries involve the activities that are embedded in ***systems life cycle.*** This involves all the activities that are carried out when creating or developing an automated system.

3.1.5 System Librarian

Systems Librarian is a library professional whose primary responsibility is the development and maintenance of the hardware and software systems used in a library, especially the online catalogue and access to bibliographic databases and other electronic resources. In some libraries, the Systems Librarian is called Automation Librarian, ICT Librarian, IT Librarian, Electronic Librarian, or Digital Librarian.

Pre-print Edition

3.2. Stages of ICT Application in Libraries and Information Centres

There are many stages involved in ICT application in libraries and information centres. They are:

1. System Analysis- It involves the process of studying the present system of the library to ascertain if there is need for automation, the essence and possible benefits of automation, the users of the proposed system as well as the financial implication of the necessary resources required for the project. This is usually carried out through proper feasibility studies to determine the workability of the project or not.
2. Acquisition of ICT components- This is where the four components of ICT will be given due consideration. Computer systems, storage media, telecommunication gadgets and the Internet. Various factors should be considered in procuring the hardware and software, input and output devices, peripherals as well as other components. The cost, memory capacity, brand and manufacturer, durability, and reliability of the hardware counts. Parameters for acquisition will be based on the issues of cost, compatibility with hardware, integrated library system (ILS) for library management, open source for digitization, content management and others, should be taken into consideration.
3. Computerization of Library Routines- This is where computerization of house-keeping functions in libraries and information centres in the areas of acquisition, cataloguing and classification, circulation, reference services and serials management are carried out. This is also where the library has to prefer integrated library system (ILS) to single system. With ILS, data generated from acquisition of information resources will be channelled for other routines such as cataloguing and classification, circulation services, and the rest.
4. Acquisition of Electronic Resources- This involves the acquisition of both free and fee-based resources and databases such as e-granary digital library, Access to Global Online Resources in Agriculture (AGORA), Health Inter Network Access to Research Initiatives (HINARI), Online Access to Research in Agriculture (OARE), as well as other e-resources such as e-journals, e-books, e-monographs, aggregated databases from vendors and organisations.
5. Retrospective Conversion of Bibliographic Records- Before the commencement of automation, there are already existing paper-based access tools and finding aids in libraries such as card catalogues, book catalogues, indexes, abstracts, annotated bibliographies, and other essentials that facilitate retrieval of information resources. They need to be converted into machine-readable documents in order to complement the automation project and save the materials from deterioration.
6. Digitization of Information Resources- Digitization is a critical aspect of automation that requires adequate attention. Depending on the type of library, there are a lot of important information resources in form of grey literature: technical and feasibility reports, pamphlets, flyers, government publications and many other essential publications that may not be easily found except the attention of library personnel in charge of special publications. To facilitate better circulation and utilization of these materials, digitization is the way out.
7. Provision of Access to the Internet- This involves Internet connectivity, creation of library portals (website) and the availability of library's online resources and services, such as online catalogues of print-based publications, digitized collections, reference services, and the likes. The library has to consider and opt for the reliable Internet service providers (ISP) or enter into partnership with telecommunication giants like MTN, GLOBACOM, ETISALAT, and AIRTEL.
8. Emergence of and Linkage to Virtual Libraries- After computerization of library routines, digitization of resources, retrospective conversion of databases, and Internet connectivity, the library or an information centre should provide links in its website home page to existing virtual libraries, open access repositories and other online scholarly resources that are hosted by individuals, corporate organisations, non-governmental organisations, international agencies, as well as government ministries and parastatals.

Pre-Print Edition

It should be noted the implementation of the stages is not water-tight. In some cases, the stages are being executed either individually or simultaneously, without adherence to the order of presentation. This may be due to some factors like the development of recent versions of ICT facilities like automation software and the requirement of periodic evaluation, among others.

3.2.1 Rationales for Library Automation

Rationale is the principles or reasons which explain the decision, course of action, the need and benefits of embarking on library automation projects. However, the computerization or automation of library operations will lead to improved service delivery for the benefit of the library staff and library users. For instance, in the acquisition department of a library, there are a lot of repetitive tasks such as order files, process files, order placement, checking duplicates, claiming and receiving of materials, etc. All these tasks could easily be automated to save both the time and energy of the librarians.

Automation also facilitates the generation of a number of reports for better decision making in the overall management of libraries and information centres. Availability of various statistical and other usage and performance reports will ensure better appreciation from library users. For instance, vendor performance analysis is possible. Budgets can be monitored; circulation data can provide information on titles that are in great demand so that more copies can be procured. The need for automation is basically to ensure that delivery of information is timely, accurate, precise and relevant in libraries and information centres. Thus, automation of libraries and information centres is a necessity as a result of various factors. These include:

1. Information explosions and demands of the digital era
2. Increases operational efficiencies in information handling. That is the quality, speed and effectiveness
3. Relieves the professional staff from clerical chores so that they are available for user-oriented services
4. Improves access to remote users and resources of other networks and systems
5. Provides new services not hitherto possible, such as content dissemination of information resources that appears in electronic formats like CDROMs.
6. Availability of information resources in various formats- print, electronic, graphical, audio-visuals
7. Limitations of libraries and information centres in terms of time, space and human power
8. Duplications in house-keeping operations of libraries and information centres
9. Better management of information resources and knowledge assets of man
10. Increasing number of users and their varous[various] information needs
11. Enabling participation in resources sharing and information networks
12. Reduces the incidence of mutilation, defacing and theft of library materials

Aims and Objectives of Library Automation

(i) To improve control over collection;
(ii) To have an effective control over the entire operation;
(iii) To improve the existing services;
(iv) To share effectively the resources among various units in a library or amongst libraries;
(v) To avoid duplication of work;
(vi) To use the services of the existing staff effectively.

3.2.2 Benefits of Library Automation

3.2.2.1 Growing Information and Shrinking Space

The enormous growth or information explosion of literature in each area, subject in number and size and results fragmentation of literature and increasing specialization in every field of knowledge. Due to this information explosion, the quantity, variety and complexity of information are increasing rapidly in every field. Computer application can solve this problem, as it is capable of storing huge bulk of information on tiny storage mediums i.e. a CD-ROM can store the text of the complete set of

Preprint Edition

Encyclopedia Britannica. Serials, abstracts, indexing periodicals etc. are already available on CD-ROM.

3.2.2.2 Increment in Number of Users and organizing the flood of Information

Increasingly the number of library clientele and information centers and their specialized needs desire a change in the method of organizing information because traditional methods are becoming more and more inadequate. The manual method has serious limitations such as the problem of provision of access to reader's information.

3.2.2.3 Cost hike of printed and electronic reading materials and resource sharing

The rapid growth in price of information materials motivated the library and information centers to share their resources. They realized that the only way they could fulfill the needs of their client groups was by effective cooperation between libraries, information centers and networks and by sharing of all type of resources. However, this sharing of resources cannot be done without automation.

3.2.2.4 Budget Enhancement

As overhead costs increase on the staff members of the library, cost of information materials, services and growth of information or information explosion, the budget of the libraries is also affected. That has allowed for automation of the library activities and need to make maximum use of the library funds.

3.3.1 Library Automation Project Planning and Implementation

Planning for an automated library system needs system evaluation and preparation before implementation. The description of library automation project planning and implementation include:

1. ***Appraisal of current status:*** Statistics regarding total number of stock, accession of materials, daily issue and return, time taken for routine activities, services given, its effectiveness, etc were studied to find a true picture of the current status of the library and identified the problems facing by the users.
2. ***Needs Assessment:*** Routine library activities such as issue and return of the books take a lion's share of the total time of the library. The librarians were not getting enough time to do added services. So, for acquiring required time for a functional library, automation is necessary. Control over the stock was not adequate. Annual stock verification and generation of monthly library statistics were not up to the standards. An automated system will make the things better. Finding a book from the stack room was time taken. There is no perfect classification or cataloguing scheme. Books were arranged unscientifically. Card catalogues were absent and the users had to go through all the collection to find the wanted one. There was no system to find whether the book was present, issued, if yes, to whom it was issued or when will it return.
3. ***Cost evaluation:*** The cost contained in every library activity was higher in the case of a manual system. The human cost was many times greater than an automated environment. In the long run, the cost of work done by a librarian in manual system for routine activities will become less and that can be utilized in giving programmed or individualized information services.
4. ***Budget allocation:*** Library automation needs a huge initial investment. Administrators should be informed about the urgency and usefulness of the process. The fund for the process was earmarked in the annual budget and extracted from the library allotment. Since it was a onetime investment, it will not hamper the routine book and periodical accession in coming years.
5. ***Administrative support:*** Strong administrative backing is essential for the process. The Principal and the key officers of the library with their pragmatic vision and keen support should all combine together as the main factors for success.

Pre-Print Edition

6. ***Current and Existing Challenges:*** Such as erratic power supply, high cost of software, funds, inability to customize solution to suit environment or current processes, inability to integrate various applications handling different tasks, etc.

7. ***Understanding the needs***
   - Student population
   - Duration of services
   - Library services – cataloguing, reader services, administration, social, acquisitions, serials processing, circulation, reporting, referencing, etc.

8. ***Understanding existing library services and technology***
   - Identify existing services, processes and functions
   - Identify existing infrastructure and technology to be used in the library
   - Collect and organize basic statistical data.

9. ***Assessing needs and setting priorities***
   - Set up a Library Automation Committee
   - Determine people to be involved in planning
   - Determine required skill-set for pre, during and post implementation
   - Needs assessment
   - Identifying approaches to satisfy the needs
   - Setting priorities
   - Developing a preliminary plan

10. ***Translating needs and priorities into specifications***
    - Design specifications
    - Prepare and make the first cut analysis
    - Obtain a request for proposal
    - Presentations and Demos (from vendor, consultants, contractors)

11. ***Evaluation of Library Software***
    - Technical Requirements
    - Operating Systems and hardware configuration
    - Special versions and security
    - User friendliness and Documentation
    - Limitations
    - Database Vs Non-Databases (RDMS)
    - Input and Maintenance of Data
    - Indexing of stored information
    - Retrieval of stored information
    - Output of Data
    - Housekeeping activities
    - Ease of Use
    - Tried and Tested features
    - Good Documentation
    - Large User Community
    - Built-in Routines
    - Compatibility
    - Vendor
    - Performance
    - Flexibility
    - Value
    - Continuous support
    - Obsolescence and Upgrades
    - Software Guides and Directories

Pre-print Edition

- Reviews
- Benchmarks (no records)

12. ***Selection of software:*** To offer the complete satisfaction of users and perform library activities and functions, we must select competent and suitable software, which can meet USERS/LIBRARY requirements or can be developed on contracted TO any software company or can be developed by professional of the institution keeping in view the requirements of the library. An increasing numbers of library software companies and their attractive advertisements / propagandas confused the libraries of which software is very much suitable with their needs. Libraries and information centers must keep in mind some basic aspects before selection of library software. A library automation committee is to be constituted which includes library and computer software/ hardware experts.
13. ***Prepare a list of your library's areas, activities, services and functions which are to be automated.***
14. ***A profile of the library software is to be made***

Consult with the some organizations/ libraries using the same software to find out about the software and their functions (libraries that are already automated their services). The experiences of the other librarians who have used software are more valuable than the assurances of the manufacturers.

15. ***Let the vendors demonstrate their product:*** Library and computer software experts should prepare an observation report of library and software facts, and indicate how to meet or how much to meet or do not meet what is required and submit it to the chairman of library automation committee.
16. ***Consider the services after installation:*** Do do not believe in unjustifiable assurance, made by the companies' representatives and make agreement of all facts.
17. ***Consider the market reputation of manufacturing company, software or vendor:*** Software selection is a very complicated issue[process] on? the observation of experts, the discussion should be made by the selection committee and most suitable software with regard to flexibility, capacity, expandability, security, economic, user's friendly, module based and updated with the latest technology should be procured. Leading names of the software packages which are available in the market and which may be competent with your needs.
18. ***Training on the library software***
    - Self-demonstration programme
    - Help menu and software manual.
    - Separate training model for library professional and as well as for users.

3.3.2 Steps in Library Automation Processes

Planning is time-consuming, but it is usually cost-effective because time spent planning reduces the amount of time required for system implementation. Planning for Automation Project in Libraries and Information Centres is all about deciding on what to do, how to do it, when to do it and who is to do it, so as to accomplish the set aims and objectives. It is the process of establishing objective and suitable causes of action before taking action. The goals of planning include to off-set uncertainty and changes, to focus attention on objectives, to gain economic operation, to facilitate control and succeed in the execution of projects. However, it has been observed that lack of proper and adequate planning had led to the failure of automation efforts in libraries. Library automation requires careful planning, through implementation and periodic evaluation. Proper planning for library automation project determines to a large extent the success or otherwise of such projects.

The steps involved are:

Step 1: Describing existing library services and technology

1. Identifying existing services and functions provided by the library
2. Identifying existing technology being used in the library
3. Collecting and organizing basic statistical data

Pre-print Edition

Step 2: Assessing needs and setting priorities

1. Who should be involved in planning?
2. Needs assessment
3. Identifying approaches to satisfy the needs
4. Setting priorities
5. Developing a preliminary budget

Step 3: Translating needs and priorities into specifications

1. Designing specifications
2. Preparing and distributing the Request for Proposal (RFP)

Step 4: Evaluating proposals and selecting a system

1. Evaluating ILS
2. Seeing system demonstrations
3. Analyzing vendor responses
4. Costs
5. Obtaining responses from vendor's clients

Step 5: Putting your system into place

1. Contract negotiations
2. /Hardware and software installation
3. Training

Step 6: Retrospective conversion and barcoding (Note: We are going to have a comprehensive discussion on retrospective conversion of library holdings in our subsequent lectures)

3.4.1 Factors to Consider in Planning for Library Automation

The following factors must be considered while planning for automation in libraries and information centres:

1. Human Resources- Human resource is the most complicated aspect of any technological system, yet it is the one that gets least attention. Human factor for library automation requires due attention for a successful project. Human resources are the manpower or personnel that are needed for the realization of the automation project, from designing, installation, testing, operation and periodic evaluation. These human resources should be individuals with practical skills and experiences on the integration of ICT in libraries. It includes Library Automation Committee (LAC), or Library Automation Team (LAT) members, System librarian, vendors, consultants, programmers, designers, and other library staff. Training of staff in the areas of ICT is also part of human resources.
2. ICT Components- These are the hardware and software, input and output devices, peripherals, networking facilities, cabling, and others needed for the project. There should be local area networking with a star typology for sharing data within the library. In terms of the hardware, the memory capacity and the hard disk of the system to be acquired should be large enough and the processing speed should be fast. The library automation software should be carefully chosen in order to meet the needs of the library.
3. Infrastructural Facilities- These include building, appropriate furniture for the system, power supply, power generating plant, air conditioning, security provision and others.
4. End-Users- In planning, the library automation committee should take into account the nature, composition and education level of the end-users of the system especially their ability and willingness to learn to use the automated system. In other words, they should be computer and information literate. Otherwise, there is the need for training.
5. Financial Resources- Finance is a necessity for the successful implementation of a project. The success or otherwise of an automated library system depends on the availability of finance. The planning team should determine the ability of the library to finance and sustain an automated library system. Money is needed in all other factors mentioned above.

3.4.2 Challenges of Automating Libraries and Information Centres in Nigeria

Preprint Edition

The major challenges of automating libraries and information centres in Nigeria are:

1. Erratic power supply
2. Poor funding
3. Poor adoption and implementation
4. Knowledge and skills
5. Poor ICT infrastructure
6. Lack of regular ICT training
7. Attitude of the parent institution housing and managing the library
8. Inadequate support from the government and poor financial allocation to the education sector
9. Absence of maintenance and support agreement
10. Technological gap between the developed countries and developing countries

4.0 Summary

In this unit, you have learnt that:

- For libraries and librarians to provide effective and efficient information services to their esteemed users in this digital era, it requires that the library operations must be automated.
- Automation of libraries and information centres is now a necessity in this era of globalization to enable the libraries be in line with the trends of the digital age and to attract positive perceptions of the users
- Rationales for automation project in libraries and information centres
- There are basic benefits of library automation project
- There are different stages of ICT Application in Libraries and Information Centres
- There are many factors to consider in planning for library automation
- There are various challenges of automating libraries and information centres in Nigeria
- Step-by-step processes involved in an effective library automation project
- Principles of library automation project and implementation

5.0 Self-Assessment

A. Give any valid definition of library automation
B. Who is a System Librarian?
C. What do you understand by automated system in libraries?
D. Why do you think it is necessary for libraries and information centres in Nigeria to embark on library automation projects?
E. Mention the different factors to consider in planning for library automation
F. Describe the different stages of ICT Application in Libraries and Information Centres
G. Identify the various challenges of automating libraries and information centres in Nigeria
H. Identify and describe the steps in library automation processes.
I. How can library automation project be planned and implemented in libraries and information centres?

6.0 Tutor-Marked Assignment

A. List and describe how the major areas and aspects of library services are taking advantage from ICT.

B. Library automation requires careful planning, through implementation and periodic evaluation. Discuss

7.0 References

Igwe, K. N. & Uzuegbu, C. P. (2013). Automation of libraries and information centres. Lagos: Waltodany Visual Concepts. 1-21.

Aina, L. O. (2004). *Library and information science text for Africa.* Ibadan: World and Information Services. 322-330.

Pre-print Edition

8.0 Further Reading

http://www.javatpoint.com/c-programming-language-tutorial
https://ict.senecacollege.ca/~ipc144/pages/content/modul.html

Pre-print Edition

UNIT 2: Retrospective Conversion of Bibliographical Information of Library Holdings

1.0 Introduction

A comprehensive automation in libraries and information centres must be accompanied with retrospective conversion of existing catalogue into machine-readable form. In this unit, you will be exposed to what retrospective conversion of bibliographic information in libraries is all about, processes involved in the planning of retrospective conversion and the pre-conversion issues. This unit will also expose you to different methods of retrospective conversion as well as step-by-step in retrospective conversion.

2.0 Learning Outcomes

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

I. define Retrospective Conversion of Bibliographical Information
II. list the objectives and rationales of Retrospective Conversion of Bibliographical Information in libraries and information centres
III. identify different methods of Retrospective Conversion of Bibliographical Information in libraries and information centres
IV. describe the step-by-step processes involved benefits of library automation in retrospective conversion.

3.0 Main Content

3.1 Retrospective Conversion of Bibliographical Information in Libraries

As libraries and information centres are automating their activities and functions to meet the increasing need of users, retrospective conversion is an integral part of the process that needs not to be neglected. In other words, comprehensive automation in libraries and information centres must be accompanied with retrospective conversion of existing catalogue into machine-readable form. It may take years depending on the size of the existing collection of the library. Smaller libraries have advantage over the larger libraries because of the lesser quantity of data for retrospective conversion. New libraries are expected to either maintain both card and electronic catalogues or emphasize on only electronic catalogue.

3.1.1 The Concept of Retrospective Conversion

Pre-print Edition

The word “Retrospective” indicates that the process is only for already existing records and the meaning of the word “Conversion” refers to the form and format changing. Therefore, “Retrospective Conversion” is the process of changing format of existing records in a particular library into another format. It is changing of already existing catalogue from traditional form to a machine-readable form. Retrospective conversion is defined as the process of converting the database of a library’s holdings from non-machine-readable form to machine-readable form and that are not converted during day to day process. It is also defined as a partial or complete conversion of an existing catalogue into machine-readable form as opposed to converting records created currently. From the foregoing, it can be concluded thus that retrospective conversion is the conversion of bibliographical information of library holdings, especially from non-machine-readable form to machine-readable form; and that are not created during day to day process.

Retrospective conversion can also be described as the process by which existing hard-copy catalogues and lists, whether on cards or paper, are converted to machine-readable form. It is done by either scanning the existing finding aids or re-keying the existing finding aids. Finding aids provide gateway to the wealth of library resources, thereby helping users to discover and navigate through the boxes and folders that house collection of information resources. These finding aids are also guides that provide overview of unique library and information resources with descriptions of the scope of the materials and where they can be located. It includes catalogues cards, book catalogues, indexes and abstracts, unique files and other special finding aids in paper format that requires conversion. The choice of the best method for any library depends on the type and size of collection, budget available, quality standards required, time constraints, and size of the staff.

3.1.2 Objectives of Retrospective Conversion

The conversion of database of library holdings from non-machine-readable form to machine-readable form is a pre-requisite to implementing an automated system. This database would become the foundation for other library activities such as on-line public access catalogue (OPAC), circulation, catalogue maintenance, resource sharing nd other information that is needed to improve the existing services and introduction of new ones. The objectives of retrospective conversion are to:

1. Create a database for the automation system;
2. Maximize access to the collection;
3. Improve the services;
4. Reduction in time for searching of a document;
5. Improve library internal procedures- the integration of acquisition and cataloguing through automation and streamlining of other technical service;
6. Maximize returns on automation expenditure.

3.1.3 Planning for Retrospective Conversion

When we use machineries for collection, processing, storage, preservation and retrieval of information as For successful retrospective conversion projects, there is a need for sound and detailed plan with realistic expectations. The plans should:

1. Clearly identify the objectives;
2. Carefully document procedures (paying close attention to efficient work flow);
3. Specify standards to be used;
4. Identify reporting requirements;
5. Identify the necessary staff training; and
6. Plan for regular monitoring of quality and schedule.

If in-house conversion is to be done, each staff member on the project must clearly understand his/her tasks and responsibilities, the proper sequence of activities, and the standards to be enforced. If the conversion is undertaken through a vendor, care must be taken to ensure that contract has no loopholes, and the sufficient legal safeguards are included to protect the library in the event of serious difficulties with the vendors. In this regard, libraries can prevent many challenges by requiring progress check-points and periodic tests1 of the quality results.

Pre-print Edition

Retrospective conversion is never easy. It can be done successfully, with minimal problems, if expectations are clearly understood at outset, and if planning and documentation precedes the actual conversion. Once the project begins, success can be assured through regular and frequent monitoring of progress and quality towards as per plan documents. The plans that are scheduled for the conversion project must take care of all the parameters. These parameters have multiple dependencies as follows:

1. Budget: Total project of the conversion project
2. Quality: Standards and freedom from errors of records on OPAC
3. Manpower: Number of persons working on the conversion project
4. Supervision
5. Speed
6. Period

In addition, the planning framework asks some important questions. The following considerations provide a logical progression and suggest a series of checkpoints to guide library administrators in developing a basic framework for retrospective conversion.

3.1.4 Pre-conversion Issues

Record Format: To ensure that first conversion is the last conversion of the library or information centre, it is important that the bibliographical information of the documents should be converted into standard format.

Fields in the Database: It is very important to describe what fields are to be included in the database and what not to be included. Current practices for recording the bibliographical information may need modification when added to the machine-readable form. Decision should be taken after considering the users' present requirements and future needs.

Source for bibliographical information: Will the accession register, shelf list, or public catalogue be the source to record the bibliographical information for conversion? The choice should be based on that source, which has accurate and complete information to meet the requirements and quality standards.

Priorities of conversion: Determine priorities of the areas of conversion so that more important areas of the holdings may be converted first in the machine-readable format.

3.2. Methods of Retrospective Conversion

There are number of ways and options to convert the catalogue into machine-readable form. Best method for a library or information centre depends upon the available resources at hand.

3.2.1 In-House Conversion

Using in-house conversion method, the conversion is completed by existing library staff that lead to high quality and control, as the staff understand the users' needs, quality requirements, and the objectives of the conversion well. But it has some disadvantages as:

i. It disturbs the routine work;
ii. It increases work-load; and
iii. More time is required for completion of the project.

3.2.2 Outsourced / Contract Conversion

By this option, the retrospective conversion job is contracted to a vendor / agency / consortium specializing in such work. This option is quite expensive. The library staff especially from cataloguing department of the library will still be involved in the preparatory work for the project, continuous monitoring, and quality control that is required during the execution of the project. This can also prove to be time consuming. Outsourced/ contract conversion can be categorized into two:

***Outsourced In-House Conversion*:** In outsourced in-house conversion, the conversion is completed by outside contracted person within the library premises. The thing that should be taking care is that the person doing the conversion should be competent.

The advantages are:

1 Easy to meet quality standards as conversion is done under the supervision of the library staff; and

Preprint Edition

2 Less disturbance the routine work of the library

It equally has some disadvantages such as:

i. Temporarily additional space is required; and
ii. Higher cost of conversion.

Outsourced off-site conversion: In outsourced off-site conversion, the process is completed by an agency away from the library or information centre. The advantage of it is only that the process is completed within the time frame with less impact on the library's routine work. But it has the following disadvantages:

i. Conversion cost per item will be more.
ii. Library has least control during the process;
iii. Shelf list /catalogue may probably have to leave the library.

One possible solution to the above is to provide photocopy of the title page of each of the document but it incurs additional cost and labour intensive.

3.3 Steps in Retrospective Conversion

3.3.1 Filling of Data input Sheets/Worksheet:

Current practices for recording the bibliographical information may need modification when converted to the machine- readable format. Thus, as per requirements Data Input Sheets/ Worksheets may be printed so that all the required information may be noted forgetting no field and repeating none. Those who have good knowledge of cataloguing, scope, goals, and objectives of the project must design the Data Input Sheets. The person employed to fill-up the Data Input Sheet must have good knowledge of cataloguing and must be aware of what information has to be recorded and what not. These Data Input Sheets / Worksheets must be checked by Library Staff to ensure that correct and required information has been recorded to meet the quality standards.

3.3.2 Entering Data into Software*:*

After filling the data input sheets / Worksheets, the information is keyed in the Library Automation package. This can be done by one who has basic knowledge of computer and he is good at typing. Here, the knowledge of cataloguing is not required but it will be good if he is made aware of cataloguing rules to reduce the mistakes.

3.3.3 Editing of the Database*:*

After keying the bibliographical information into the software, the database must be checked for errors and edited by a responsible person to achieve the quality standards. This process must be repeated into a loop till the required precision is achieved. Typographical spelling mistakes make the catalogue problematic for search.

3.4 Key to Successful Retrospective Conversion in Libraries

The key to successful retrospective conversion is careful and meticulous planning. There are several actions on the part of a library that will contribute significantly to the success of the conversion project. These measures include:

1. Careful planning
2. Close examination of each method of the conversion, taking into account the library's budget, time, and manpower constraints;
3. Weeding of titles and copies that have marginal value. Since it is expensive, it makes no economic sense to convert materials that are of little or no worth.

4.0 Summary

In this unit, you have learnt that:

- Retrospective conversion is the process of converting the existing catalogue of libraries and information centres from non-machine-readable to machine-readable database form.
- The best method for conversion for a library or information centre depends upon the type and size of the collections, time, quality standard, and manpower.

Pre-print Edition

- Planning and proper documentation of procedures and achievable milestones for monitoring will lead to consistency in the conversion.
- To achieve the desired result, it is necessary to have good understanding of the relationship of each aspect of conversion process and the database thus created will be able to achieve the objectives and will reflect the image of the library or information centre as well as that of the host institution.

5.0 Self-Assessment

A. What do you understand by Retrospective Conversion of bibliographic information in libraries?
B. What are the objectives of Retrospective Conversion?
C. What are methods for Retrospective Conversion?
D. List and explain the steps involved in Retrospective Conversion.

6.0 Tutor-Marked Assignment

A. Comprehensive automation in libraries and information centres must be accompanied with retrospective conversion of existing catalogue into machine-readable form. Discuss

7.0 References

Igwe, K. N. & Uzuegbu, C. P. (2013). Automation of libraries and information centres. Lagos: Waltodany Visual Concepts. 1-21.
Igwe, K. N., Sadiku, S. A. & Edam-Agbor, I. B. (2019). Themes and trends in information science, Lagos: Zeh Communication Limited.145-180.
Aina, L. O. (2004). *Library and information science text for Africa.* Ibadan: World and Information Services. 322-330.

8.0 Further Reading

http://www.javatpoint.com/c-programming-language-tutorial
https://ict.senecacollege.ca/~ipc144/pages/content/modul.html

Pre-print Edition

UNIT 3: Entrepreneurship in Library and Information Profession

1.0 Introduction

A comprehensive automation in libraries and information centres must be accompanied with retrospective conversion of existing catalogue into machine-readable form. In this unit, you will be exposed to what retrospective conversion of bibliographic information in libraries is all about, processes involved in the planning of retrospective conversion and the pre-conversion issues. This unit will also expose you to different methods of retrospective conversion as well as step-by-step in retrospective conversion.

2.0 Learning Outcomes

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

I. define Retrospective Conversion of Bibliographical Information
II. list the objectives and rationales of Retrospective Conversion of Bibliographical Information in libraries and information centres
III. identify different methods of Retrospective Conversion of Bibliographical Information in libraries and information centres
IV. describe the step-by-step processes involved benefits of library automation in retrospective conversion.

3.0 Main Content

3.1 Entrepreneurship in Library and Information Profession

Entrepreneurs are those individuals in society who take the lead as well as the risk in mobilising the production factors (natural resources, human resources and capital) in specific combinations to produce products and services for their communities. An entrepreneur is one who is willing to bear the risk of a new venture if there is a significant chance for profit while and infopreneur is an entrepreneur who makes money by selling/sharing information either physically or on the Web.

3.1.1 Importance of Entrepreneurship Training for LIS Graduates

Pre-print Edition

1. Opportunity for self-employment
2. Contribution to the economy
3. Creation of employment opportunities

3.1.2 Career Opportunities for LIS Graduates

1. Libraries
2. Information centres
3. Setting up a Bookshop
4. Cataloguing
5. Indexing
6. Abstracting
7. Compilation of bibliographies
8. Teaching in library school
9. Library consultant
10. Editing books, journals, newspapers and magazines
11. Proofreading of books, journals, newspapers and magazines
12. Records management in business organizations
13. Archives administration
14. Publishing
15. Photocopying
16. Dealer in library publications, equipment and materials

3.1.3. Required Skills for a LIS Graduate to be Self-employed in Nigeria

1. Creativity and innovation
2. Possession of good entrepreneurial skills and competencies
3. Possession of conventional training skills
4. Ability to take risks
5. Communication skills

3.1.4 Obstacles to Self-employment of LIS Graduates in Nigeria

1. Initial capital
2. Risk of failure
3. Lack of appropriate policies
4. Poor implementation of government policies on entrepreneurship
5. Lack of essential ICT skills LIS graduate
6. Lack of mentorship and tutelage
7. Jealousy if successful
8. Transport cost
9. Site availability

3.2 Business Plan

3.2.1 What is a Business Plan?

A business plan is a written outline that evaluates all aspects of the economic viability of your business venture including a description and analysis of your business prospects.

3.2.2 Essential Parts of a Business Plan

1. Concept development
2. Concept Testing
3. Business planning writing

Preprint Edition

4. Description of the business
5. Product or service description
6. Marketing plan
7. Operational plan
8. Strategic review and implementation

3.2.3 Functions of a Business Plan

1. It serves as road map
2. It provides necessary details of your business
3. It helps in marketing plan
4. It helps to identify initial costs of a business
5. It helps in securing finances

3.2.4 Supporting Documentation for a Business Plan

1. Resumes of the business owner
2. Executive summary of the business plan
3. Table of content
4. Financial analysis
5. Appendixes

3.3 Information Products and Services

3.3.1 What is information product?

Information product can be simply defined as tangible or physical good. Information products are tradable commodities; they can be bought and sold in the information market with a price. The price is the exchange value for the information product, especially when it was looked from the perspective of information product consumer. It must be noted that information is not a normal good.

3.3.2 Types Information Products and Services

There are different types of information products. They can be classified or categorised into two main groups:

i. Paper-based information products
ii. Electronic or machine-readable information products

The following are the types of information products that can be traded with by information management organisations such as libraries, documentation centres, information centres, archives, or record offices:

1. Newspaper
2. Magazines
3. Textbooks
4. Journals
5. Directories
6. Dictionaries
7. Encyclopaedias
8. Handbills/manuals
9. Diaries/calendars
10. Computer print out
11. CD-ROM
12. DVD
13. Scanners
14. Telephone
15. Microfilms
16. Film strips

Pre-print Edition

17. Software
18. Video tapes
19. Radio cassette
20. Gazettes
21. Constitution
22. Book of estimate
23. Account book
24. Building plans
25. Survey maps
26. Engineering designs
27. Patents and standards
28. Company files / organization files
29. Memoranda and circulars
30. Year book

3.4 Fee-based Library and Information Services

Information service can be defined as intangible goods. It is not physical. It could be service and good at the same time.

3.4.1 What is fee-based information service?

Fee-based information service refers to those information and services made available to the information seeker for a fee.

3.4.2 Types of Fee-based Library and Information Services

The following are fee-based library and information services that can be offered to users by any information service organisation:

Technical Services

- Abstracting
- Analysing information.
- Appraising collections
- Bibliographies
- Cataloguing
- Indexing
- Thesaurus construction

Consultancy in Library Automation

- Networking
- CD-Rom
- System analysis
- Developing software packages
- Training
- Systems design

Consultancy in Internet and Web Development

- Web design and management
- Blog/Wiki creation
- Computer software design
- Training

Freelancing and Publishing Services

- Translating
- Verifying facts

Pre-print Edition

- Writing
- Editing
- Editorial services

3.4.3 Factors to Consider when Planning to Produce Information Products or Services

The classical economic factors called factors of production (land, labour, capital and entrepreneur, as well as technology) are not enough to produce value added information goods and services. The behavioural factors should be combined with the classical economic factors when planning to produce information goods and services by any individual and organisation. Such factors should include:

1. Land- Land is a critical resource in the production of good and services. The reward of the owner of the land is rent. In most cases, the cost of land acquisition could be high compared to related accommodation. The location of the business should be where there is primary demand for the product or service. It is erroneous ides to believe that the cost of land is free even when it is family heritage.
2. Labour- Labour or human capital is an important factor when planning to produce information product or service. In the third countries of the world, labour is cheap. The highly skilled labour is different to come by but its cost is high. Labour with high level of qualification and skills together with cognate relevant experience should be put into consideration. The marginal productivity of labour must be equal to price of labour or wages and salary. In a situation where the productivity of labour could not be quantify, uniform price, wages, salary should be charged.
3. Money/Capital- Capital is relatively scarce. The owner of information service organisation should look for credible sources of money or capital and explore or harness those sources to his or her own advantage. Mobilization of funds for the production of high quality of goods and services is one of the quantities or principal function of an information manager. Money raised through loaning is a very delicate one. A reasonable manager information manager should endeavour to commit loan fund into a productive venture.
4. Machines/Appropriate Technology- An information manager must look for appropriate technology to produce desired information products and services. The price of the machine, the good will of manufacturer, the technical know-how, sales after service, the availability rate, failure rate must be taken into consideration. It must be noted that every equipment has a life span but there is always the most economic order year to replace equipment.
5. Entrepreneurship- The owner of the business is a critical factor in the production of goods and services. The type of ownership, the philosophy of the enterprise, the mission and vision statement, leadership style, and management style, should be considered. For example: cost recovery, no cost information service, price-based services, free based services, profit based.
6. Government Policy- Experience has shown that classical economic production factors are not enough to produce desired goods and services. Government policy plays important roles. Information managers must be conscious of this and take government policy into consideration. The tax laws relating to capital gains, excise and duties, registration of companies, patents and standards, export quota, import quota, tariffs and monetary policy.
7. Creativity and Innovation- Creativity has to do with generating new ideas while innovation has to do with translation of the new ideas into sellable products or services, or new method or system. If you generate idea and transform it into working i.e. innovation. In the third countries, human element in organisation particularly information management organisation lack creativity and innovation. Creativity and innovation is the sole of modern business production of value added information products and services that can withstand global market competition calls for creativity and innovation.

3.5 Lobbying and Advocacy

3.5.1 What is Lobbying?

Pre-Print Edition

Lobbying is the specific type of advocacy which tends to influence government bodies in their decision making.

3.5.2 What is Advocacy?

Advocacy is a system or discipline of organized support, promotion, and defence of a cause, an association, or an institution in the public arena. It is the public, organized support and promotion of individual libraries or individual library services and the public, organized support of libraries in general or of library issues and causes

3.5.3 Forms of Advocacy

1. Library trustee
2. Friends of library
3. Library users
4. Institutional and community leaders
5. Librarians and library staff
6. Potential advocates
7. Cultural figure
8. Silent supporters

3.5.4 The Use of Lobbying and Advocacy to Set Up a Small-Scale Business

Advocacy

1. Meeting with philanthropist
2. Meeting with community leaders and intimate them about the business and need to support it
3. Meeting with potential advocate for small business creation in the community
4. Identify silent supporters

Lobbying

Grassroots lobbying mounting a campaign to reach out to the affluent people to support and donate towards establishing the small scale business

Direct meeting with legislators in the community such as the politicians, councilors

3.6 Role of Price in Marketing Information Products and Services

3.6.1 What is price?

Price is a means of exchange offered by a buyer for buying the product/service being marketed by a seller/marketer. It is generally expressed in currency units, such as dollars and cents, Naira and Kobo. However, it may also be expressed in services or other goods which the seller and buyer may agree to exchange for the item. Price (or the value of an offer) goes by many names like (Kinnear and Bernhardt, 1986) tuition, rent, interest, fee, fare, toll, dues, salary, wage or commission depending on what is being exchanged. For information products and services, the relevant terms may be *price* of a physical product like CD-ROM and *fee* of a service or membership of the information centre/library.

3.6.2 Roles of Price in Marketing Information Products and Services

1. It can be used to express the value of information services: a physical product like a CD-ROM or a fee of a service or membership in a library.
2. It allows the producer to realign the products to market conditions and to negotiate contracts on a more informed basis
3. It helps in appropriately positioning the product or service right in the mind of the targeted segments vis-à-vis the competitors
4. It is one of the four important marketing decisions (the other three decisions are product, promotion, and distribution)

Pre-print Edition

5. It plays a very important role as economic indicators that will enable the buyer to assess the price-competitiveness of the products
6. It is used to balance supply and demand in the market

3.6.3 Factors to Consider in Pricing an Information Product

1. The marketer
2. Product characteristics
3. The product/service
4. The type of product
5. The customer
6. Value added product services
7. Value of information
8. Ability/willingness to pay
9. The competition/competitors
10. Competitors' prices

4.0 Summary

In this unit, you have learnt that:

- Retrospective conversion is the process of converting the existing catalogue of libraries and information centres from non-machine-readable to machine-readable database form.
- The best method for conversion for a library or information centre depends upon the type and size of the collections, time, quality standard, and manpower.
- Planning and proper documentation of procedures and achievable milestones for monitoring will lead to consistency in the conversion.
- To achieve the desired result, it is necessary to have good understanding of the relationship of each aspect of conversion process and the database thus created will be able to achieve the objectives and will reflect the image of the library or information centre as well as that of the host institution.

5.0 Self-Assessment

A. What do you understand by Retrospective Conversion of bibliographic information in libraries?
B. What are the objectives of Retrospective Conversion?
C. What are methods for Retrospective Conversion?
D. List and explain the steps involved in Retrospective Conversion.

6.0 Tutor-Marked Assignment

A. Comprehensive automation in libraries and information centres must be accompanied with retrospective conversion of existing catalogue into machine-readable form. Discuss

7.0 References

Aina, L. O. (2004). *Library and information science text for Africa.* Ibadan: World and Information Services. 322-330.

8.0 Further Reading

http://www.javatpoint.com/c-programming-language-tutorial
https://ict.senecacollege.ca/~ipc144/pages/content/modul.html

MODULE 4: INFORMATION AND COMMUNICATION TECHNOLOGY: AN EMBODIMENT OF MASS COMMUNICATION

Unit 1 Communication and ICT infrastructure

Pre-print Edition

1.0 Introduction

This unit covers the concepts of communication and ICT viable tools. It also elaborates on all the tasks and elements needed to have effective communication process. The communication barriers are also discussed in this unit. In addition, ICT architecture and infrastructures are not left out for discussion in this unit.

2.0 Learning Outcomes

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

i. define communication and effective communication
ii. describe the elements of communication process
iii. discuss communication barriers
iv. discuss ICT architecture and ICT infrastructure

3.0 Main Content

3.1 Communication

Communication is the process of sharing ideas, thoughts, beliefs, and feelings with other people through verbal and non-verbal means, and having those ideas, thoughts, and feelings understood by the other party.

This definition depicts some notable key terms which are the central pivot of the term? "communication". The terms include "sharing", "verbal and non-verbal means", and "understood by other party". Simply put, any idea, thought, belief, and feeling that is not shared remains a stimulus to the encoder. This stimulus could only be transmitted through a selected medium. This medium could be either verbal or non-verbal as the scenario requires. Also, the decoder must be better considered to understand the ideas, thoughts, beliefs, and feelings. This consideration is hung on two things: a suitable medium and structured coding.

The better placement of the central pivot in the definition of the communication turns such communication become effective. In a nutshell, e**ffective communication** is the quality of sharing meaning and understanding between the message encoder and the message decoder. That is, communication is effective if the message received by the decoder is the same one sent by the encoder. So, the key element of effective communication is understanding. Fig.4.1.1 depicts communication model.

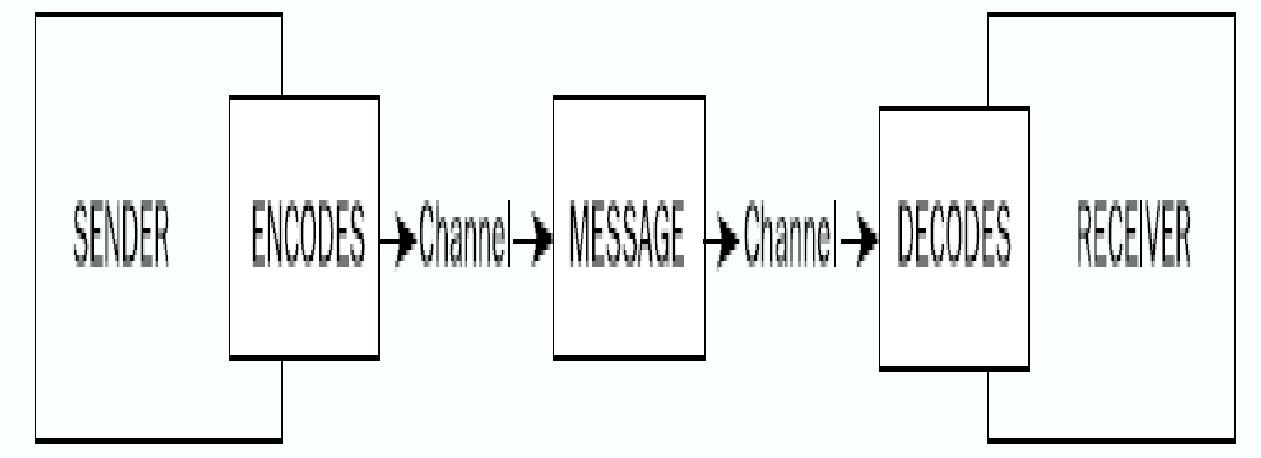


Fig. 4.1.1. Communication Model

Print Edition

It has been found in the literature that every successful communication must be enveloped in seven powers, referred to as **7 C's of Communication.** The 7 C's of Communication are Content, Continuity & Consistency, Clarity, Context, Channels, Credibility, and Capability

3.2 Communication Process

Communication process is a simple model that demonstrates all the factors that can affect communication. These factors are determined by some elements.

3.2.1. Elements of Communication Process

These are the sequential steps that make up effective communication. The breakdown of any of the steps results into *communication loop.*

Elements of Communication process

- Referent: It motivates the sender (or receiver) to share information that may initiate communication
- Sender
- Message: It contains contents of the information which could be verbal, non-verbal, and symbolic language.
- Channel: A medium through which the message is sent across
  - ❖ Types of Channel include: Auditory, Visual, Tactile, and Combined
  - ❖ Considerations for Channel Selection include: Availability, Purpose, Suitability, and Types of receiver
- Receiver
- Feedback

Fig. 4.1.2 clearly shows that communication is not completely processed until the feedback is executed.

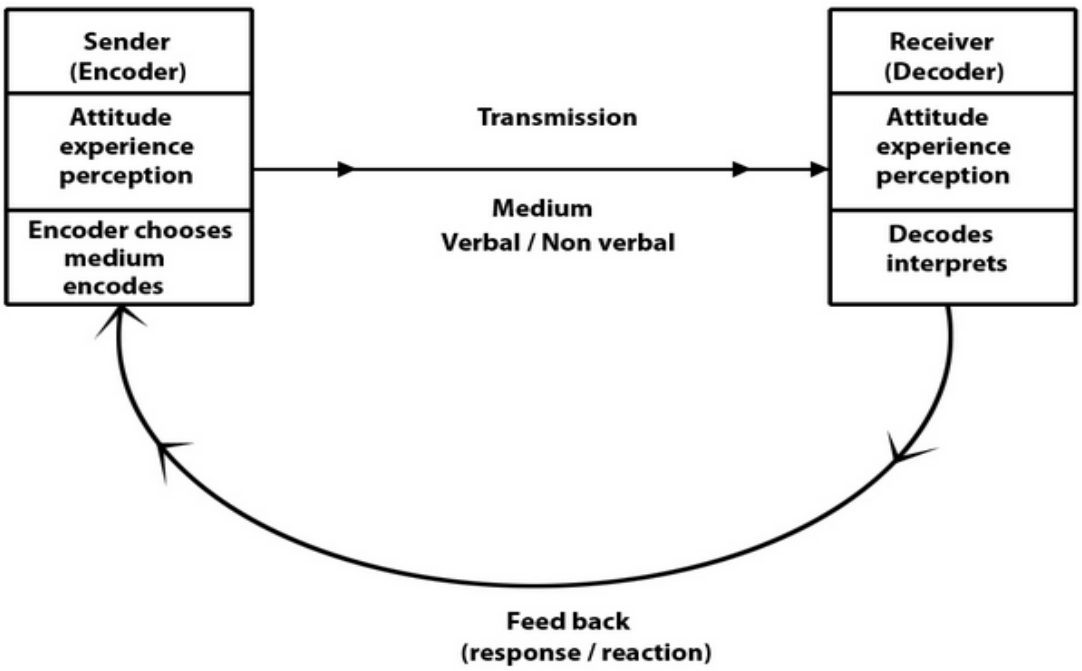


Fig. 4.1.2 Communication Process

Print Edition

3.3. Communication Barriers

These are the series of obstacles or breakdown that hinder the flow of effective communication. Communication barriers keep communicating parties from understanding others' ideas and thoughts.

3.3.1. Types of Communication Barriers

There are major two types of barriers—internal and external.

Internal barriers are the obstacles solely generated by the communicating parties knowingly or unknowingly. This type of communication barriers is psychological. The examples include, but not limited to, fatigue, poor listening skills, attitude towards the sender or the information, lack of interest in the message, fear, mistrust, past experiences, negative attitude, problems at home, lack of common experiences, and emotions.

External barriers are obstacles not manifested by the communicating parties but hinder the effective communication. This type of communication barriers is environmental factor. Examples of external barriers include noise, distractions, e-mail not working, poor network connections, time of day, sender using too many technical words for the audience, and environment.

In addition, according to Eisenberg, 2010, there are some four types of barriers (called-noise). These are process barriers, physical barriers, semantic barriers, and psychosocial barriers.

- **Process Barriers**: These are the barriers along the elements of communication.
- **Physical Barriers**: Any number of physical distractions that interfere with the effectiveness of communication, including a telephone call, drop-in visitors, distances between people, walls, and static on the radio.
- **Semantic Barriers**: The words we choose, how we use them, and the meaning we attach to them cause many communication barriers. The problem is semantic, or the meaning of the words we use.
- **Psychosocial Barriers**: Three important concepts are associated with psychological and social barriers. They are *fields of experience*, *filterin*g, and *psychological distance.*

Psychosocial Barriers

- *Fields of experience* include people's backgrounds, perceptions, values, biases, needs, and expectations.
- *Filtering* means that more often than not we see and hear what we are emotionally tuned in to see and hear
- *psychological distance* between people that is similar to actual physical distance. Such as resentment attitude

3.4. ICT ARCHITECTURE AND ICT INFRASTRUCTURE

Due to remedy-rendering nature of ICT, a lot of solutions have been proffered by ICTs to virtually all the communication barriers with a little or no cost a times. This is as a result of flagship applications of ICT enhancement. These flagship applications include Multipurpose smartcard, Telemedicine, Technopreneur Development, R&D Clusters, E-Government, E-Business, and Smart School. However, to achieve this deployment, ICT architecture and infrastructure must be firstly prioritized.

3.4.1. ICT architecture serves as a broad blue print for acquiring, developing, implementing and integrating ICT in order to support the business functions and strategies of an organization. It integrates the information requirements of the organization and all users, the ICT infrastructure and all ICT applications of the organization.

Pre-print Edition

ICT Architecture Preparation

The process of preparing an ICT architecture must start with an ICT planning.

- The ICT planning process starts by getting a holistic perspective on what and how the organization aims to achieve it
- The process involves the steps shown in Fig. 4.1.3

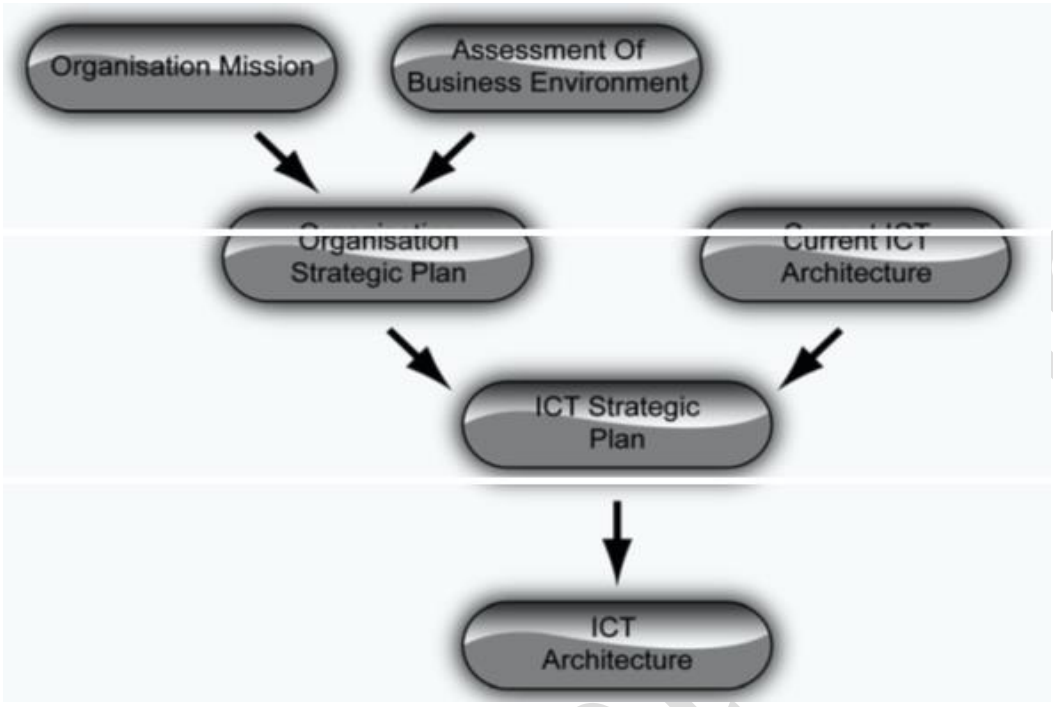


Fig. 4.1.3. ICT architecture development step

3.4.2. ICT Infrastructure is dedicated to support and manage all ICT resources and ICT services in the organization. Thus, an organization's ICT infrastructure consists of three elements as shown in Fig. 4.1.4.

Pre-print

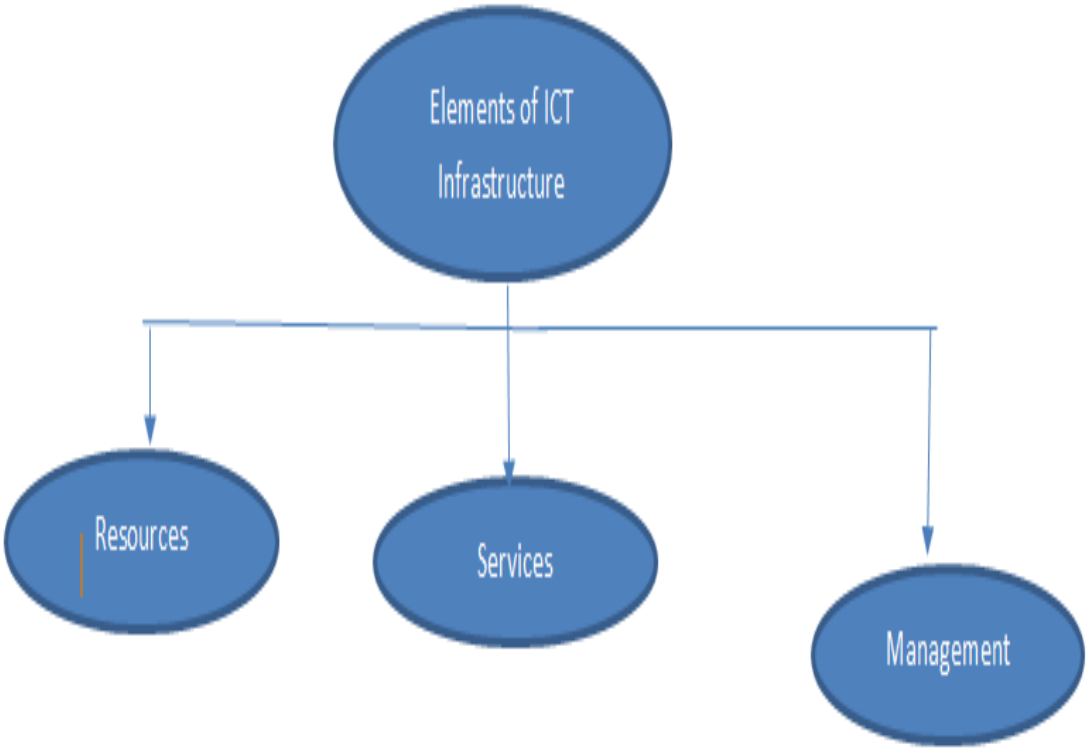


Fig. 4.1.4. Elements of ICT Infrastructure

Elements of ICT Infrastructure

- **ICT resources** include Computer hardware, Computer Software, Communication technology, and Data.
- **ICT services** provide means for utilizing all ICT resources available within the organization. Examples of ICT services are e-learning, e-commerce and knowledge management.
- **ICT management** explains how the available ICT resources and ICT services are arranged, operated, maintained and managed.

3.4.2.1. ICT Acquisition Process

ICT acquisition process is an operational plan of ICT architecture. The acquisition process must be based on the organization's ICT architecture. The ICT acquisition process is as follow:

- Analyze and understand the organization's ICT architecture;
- Develop ICT Operational Plan; and
- The process involves the steps as shown in Fig. 4.1.5.

Pre-print Edition

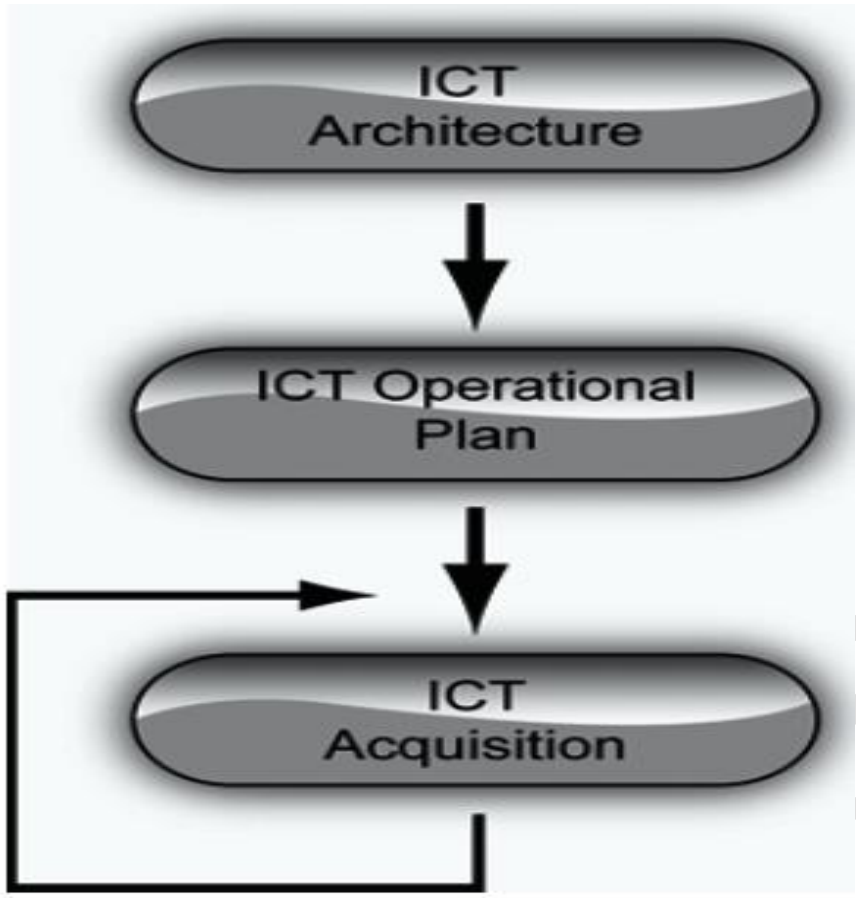


Fig. 4.1.5. ICT Acquisition process

4.0 Summary

In this unit, you have learnt that:

-
- Communication is not well defined until the three central pivot terms are included - “sharing”, “verbal and non-verbal means”, and “understood by other party”.
- Only the elements communication process make up effective communication. And the elements are referent, sender, message, channel, receiver, and feedback
- Communication barriers is the bane of effective communication, but remedied by the deployment of ICTs
- ICT architecture and ICT infrastructure

5.0 Self-Assessment Questions

A. Differentiate between communication and effective communication

B. Highlight and briefly explain the elements of communication process

C. State and explain the major types of communication barriers.

D. Distinguish between ICT architecture and ICT infrastructure.

6.0 Tutor-Marked Assignment

A. Explain communication model with the aid of suitable diagram.

B. Discuss the types of communication barriers, according to Eisenberg.

C. Discuss ICT architecture development step with the aid of diagram.

D. Is it possible to achieve ICT infrastructure through ICT acquisition process? If yes, how?

7.0 References

https://www.ict4cart.eu/technologies/ict-infrastructure-architecture#:

Pre-print edition

8.0 Further Reading

https://www.redhat.com/en/topics/cloudcomputing
https://www.toppr.com/guides/business-studies/directing/communication/

Pre-print Edition

Unit 2: **ICT and ICT Policy**

1.0. Introduction

In the recent century, ICT is second to none. It is the only language that is understood as a communication medium to drive the global economy. It is never an overstatement, rather an undisputable fact, that any sector that is devoid of ICT deployment and execution might likely be undiscovered on the global map of existence. Therefore, it is a must concept to understand, especially to the undergraduate students. In the real sense, ICT concept is well guided by the established policy laid down by the standard group. In other word, ICT can never be taught and/or learnt in isolation without ICT policy. This unit is, therefore, to explain the concept in detail.

2.0. Learning Outcomes

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

i. Define ICT
ii. Discuss WSIS as a roadmap to ICT
iii. Appraise ICT in Africa
iv. Describe the concept of ICT policy

3.0. Main Content

3.1. Information and Communication Technology

Several definitions have been given to the concept called Information and Communication Technology, ICT. Each of these definitions is constrained to the domain at which such ICT is perceived and deployed. As variants as the definitions are, some terms remain constant. To bring the concept closer, here presented some of the definitions.

ICT is defined as an umbrella term that encapsulates any communication device – radio, television, mobile phones, computer and network hardware, satellite systems – as well as various services and tools such as videoconferencing and virtual learning. ICT could also be referred to as the convergence of audiovisual and telephone networks with computer networks via a single cabling or link system. ICT has equally been found to strengthen the role of unified communications to enable users to access, transmit, store, and manipulate information using high tech digital deployment (Capena, 2010). In a nutshell, ICTs is a generic term referring to technologies that are used for collecting, storing, editing and passing on (communicating) information in various forms. These definitions separate distinct fields of ICTs and at the same time link them together so as to operate as an entity.

3.2. **ICT: A focus of WSIS**

Essentially, to better understand what ICT stands for and the mandates of ICT policy, the Heads of States and Governments, therefore, agreed to and signed the global plan of action at the World Summit on the Information Society (WSIS) Geneva, as far back in 2003. In this action plan, ten key strategies were aimed to bring about a global information society. The strategies are as follow:

i. To connect villages with ICTs and community access points;
ii. To connect universities, colleges, secondary schools and primary schools with ICTs;
iii. To connect scientific and research centers with ICTs;
iv. To connect public libraries, cultural centers, museums, post offices and archives with ICTs;
v. To connect health centers and hospitals with ICTs;
vi. To connect all local and central government departments and establish websites and e-mail addresses;
vii. To adapt all primary and secondary school curricula to meet the challenges of the Information Society, taking into account national circumstances;
viii. To ensure that all of the world's populations have access to television and radio services;

Pre-Print Edition

ix. *To ensure that more than half the world's inhabitants have access to ICTs within their reach; and*
x. *To encourage the development of content and to put in place technical conditions in order to facilitate the presence and use of all world languages on the Internet.*

3.3. ICT in Africa

In general, ICT goals in Africa, like other continents, are to establish an environment that encourages networking of services and applications; promoting e-commerce and trade promotion programmes for goods and services; promoting Internet access to exchange and access digital content; establishing e-government; promoting e-education and on-line services; strengthening network security; building and developing e-society and ICT human resources, as all contained in WSIS. To achieve these goals, pragmatic, practical, innovative education systems must constantly be developed and reviewed to address Africa's needs today and in the future in line with technological developments in the ICT sector. This roadmap was focused by Mark Warschauer, who in his book "Technology and Social Inclusion: Rethinking the Digital Divide"

3.3.1. ICTs CHALLENGES IN AFRICAN COUNTRIES

As good as African countries keep abreast of the benefits derived through adoption and use of ICTs; there are also serious challenges which are timely to be addressed. Here listed are some of the leading challenges:

- Inadequate communications and power infrastructure
- Shortage of ICTs facilities and ICTs skills
- Inadequate institutional arrangements
- Limited financial resources
- Inadequate public private partnership
- Limited data management capacity
- Inadequate horizontal and vertical communication
- Inadequate bandwidth nationally and on the Gateway

3.4. ICT Policy

There is need to have a policy that governs ICTs and regulatory mechanism to monitor and manage operations in the ICTs sector. This policy would reduce, if not totally eradicate, the challenges listed above. However, some of the components to form a firm foundation, as a policy, for ICTs include: assessment of ICT status in all sectors of the society (e-readiness), the challenges encountered in the establishment of an e-society, and above all the will and commitment by leaders to adopt ICTs as enablers for national economic development. The development of any Policy takes into consideration what has been done in the subject area before.

3.4.1. Policy in ICT Sector

Despite the challenges, ICTs still provide remarkable opportunity for nations to address the digital divide and reduce poverty through the ICT inclusion for economic growth. This is evidenced in the developed and some developing nations. As emergence of a vibrant ICT sector has significantly contributed towards national gross domestic product (GDP). So, ICT sector needs to be built and strengthened, for its direct impact on other sectors, through public-private partnerships to foster the required growth and development. To strengthen ICT, policy has been formulated for the mandates, and the policy is highlighted as follow:

Policy Thrust to strengthen the ICT sector

Pre-Print Edition

- Develop and improve ICTs infrastructure for all sectors of the economy (communications, electricity and transport).
- Encourage full utilization of existing communications infrastructure to reduce resource wastage.
- Implement an integrated and equitable framework for accelerated ICTs development and uptake.
- Increase bandwidth on the national backbone and international gateway(s) systems to enhance speed and efficiency of operations.
- Develop supportive and enabling infrastructure to ensure equitable access to ICTs by all citizens including disadvantaged groups and rural communities.
- Promote local production of ICTs products to ensure relevance of content and use of appropriate technologies that meet international standards.
- Establish institutional mechanisms to co-ordinate inter-organizational planning, policy-making and implementation of strategies to develop ICTs taking into account the convergence of broadcasting, telecommunications and on-line computer services.
- Implement measures to develop and retain skilled human resources in the ICTs sector.
- Rationalize the ICTs tariff structure to make ICTs more affordable and accessible.
- Introduce and enforce stringent quality of service standards in the provision of ICTs.
- Create a conducive environment for investment through PPPs in the ICTs sector.
- Promote local research and development in software and hardware relevant to all sectors of the economy.
- Promote awareness and use of ICTs.

3.4.2 ICT Policy for Capacity Building

Capacity building is important if the society is to accept, adopt and use ICTs. There is need for publicity, debate and above all exposure to ICTs. The ICT policy should adequately provide for capacity building including life-long learning.

Policy Thrust in Capacity Building

- Provide equitable access to ICTs enabled education and training in all parts of the country, including the disadvantaged communities.
- Facilitate acquisition of basic, applicable and affordable ICTs equipment.
- Build ICTs capacity skills.
- Promote stakeholder participation and partnerships.
- Promote training in software development, provision of ICTs service and ICTs resources development.
- Promote e-learning and use of e-learning materials.
- Standardize ICTs in the education sector.
- Embed ICTs literacy in the pedagogy of our schools, colleges and universities.

3.5. Purpose of ICTs Policy

The purpose is to provide strategic direction and guidance for sustainable national development through the systematic application of ICTs in a country. This would in turn aid the realization of economic development, poverty alleviation, inclusive government, among others.

Pre-print Edition

To strategically achieve the purpose, the following objectives are to be put in action:

- Provision and maintenance of infrastructural facilities necessary for ICTs development, such as reliable supply of electricity, telecommunications and transport.
- Promotion and support of the systematic, relevant and sustainable development of ICTs.
- Ensuring of technical-know-how of qualified ICTs personnel through an extensive educational and training programme.
- An established integrated system for effective implementation of ICTs strategies.
- Establishment of institutional mechanisms and procedures for determining sectoral application priorities; and
- Facilitation of the development, use of, and equitable access to benefits offered by ICTs across gender, youths, the disabled and the elderly.

4.0. Summary

In this unit, you have learnt:

- What ICT stands for as a technology that aids information gathering, processing, and communication to with an ubiquitous attribute
- The action plan of WSIS and as it remains the building block of the advancement in today's ICT dispensation
- That despite the sorry state of ICTs in Africa, ICT has also remained what still makes the continent to remain on the world map.
- That to build and strengthen ICT in the globe, and Africa in particular, ICT policy must be ensured execution and update if need be.

5.0. Self-Assessment Questions

- In your best understanding, define ICT
- Compare and contrast the state of ICT in your country with WSIS's action plan
- Highlight the challenges of ICT in Africa
- Describe the concept of ICT policy

6.0. Tutor-Marked Questions

- Compare and contrast policy thrust in ICT sector with Policy thrust in capacity building
- Compare and contrast Millennium Development Goals with WSIS's action plan

7.0. References

Capena A. (2010), Integrating ICT into Sustainable Local Policies. ISBN 9781615209293

Kundishora, S. M (2012), The Role of Information and Communication Technology ICT) in Enhancing Local Economic Development and Poverty Reduction

8.0. Further Reading

Kundishora, S. M. (2006), Partnership Framework for ICT Infrastructure development in Africa 'at World Congress on ICT for Knowledge Society, Seoul, July 2006'

Capena A. (2010), Integrating ICT into Sustainable Local Policies. ISBN 9781615209293

Pre-Print Edition

Pre-print Edition

Unit 3 Current Trends on ICTs for Next Generation Enterprise Information Systems (NG-EISs)

1.0. Introduction

The dynamism of the globe is as old as the dynamism of man. Interestingly, the deployment of ICTs has also brought to limelight the insatiable nature of human race. Due to this factor, ICT is also placed on the track to transform human learning in totality to machine learning. One of these set goals is what referred to as Next Generation Enterprise Information Systems, which this unit is saddled to expatiate.

2.0. Learning Outcomes

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

i. Discuss the key trends in ICT
ii. Explain roadmaps for the Next Generation of Information Systems (NGIS)
iii. Appraise the contributions towards the NGIS
iv. Discuss grand challenges of NG-EISs

3.0. Main Content

3.1. ICT in Microscopic View

In unit 2 of the module 4, ICTs and ICT policy are extensively discussed. This has paved way to understand the indispensable application of ICT in everyday life. Therefore, to achieve and succeed in the next generation as a whole and Information systems in particular, ICT is the only driving force. So, the explosion of the use of ICT should:

- Enhance the performance of classical tasks especially in a new distributed context
- Strengthen the integrated synchronization between actors; the actors and the products; and the actors and the information systems of their organizations.

Having stated what the mandates of ICT should be in order to achieve the tasks ahead, there is a need to figure out the key trends in ICT in the recent years. This appraisal would thereafter show the bearing to the anticipated developments in ICT as explained below.

3.1.1. KEY TRENDS IN ICT: A LOOK AT 2016 AND BEYOND

In the literature, the following facts have been found as the soaring-up key trends in ICT since 2016.

- Ubiquity - Anytime, anywhere, any device access to communications, content, commerce, and applications
- Machine Learning - Increased emphasis on non-human communications
- Machine-to-Machine (M2M); Internet-of-Things (IoT); Social Media; and Big Data - The convergence and integration of many things
- Open networks, open interfaces, and many applications - to enable third party developers to offer services in return for revenues, such as Telco Network Application Programmer Interface (API), which plays a critical part in carrier networks as a secondary stream of revenue.

3.1.2. ANTICIPATED DEVELOPMENTS IN ICT

Rising key trends in ICT has birthed the hopeful developments of ICT to align with the global proposed NGISs. Some of the developments are hereby highlighted:

- Artificial Intelligence is becoming a part of everything – that is, integration from machine learning, predictive analytics, security software, intelligent agents, and more.
- Data is a central part of all Corporate Planning - from Analytics, Big Data, Business Intelligence, Discovery and Visualization (of data), and more
- Cloud Computing is moving beyond IT
- The IoT (or Internet of Everything, IoE) is becoming more than just buzz words
- Broadband (particularly wireless) is enabling key technology areas – for instance, 5G in 2020 facilitated expansion of a number of advanced applications such as Augmented Reality and Haptic Internet, despite the rumor around COVID-19.

In Nigeria, as other countries, there are lot of determinants of the future of ICT deployment and management. The movement towards the availability of these ICT-inclined projects would determine ICT future, especially in Nigeria. Some of the determinants are E-commerce, Data centers, Rise of the

Pre-print Edition

local app, Technology funding, Incubators mature, Evolution of Corporate IT, Local adoption of cloud, Mature of mobile payment, Security, and Rise of local hardware brands.

3.2. ROADMAPS FOR THE NGISs

NGIS is a worldwide competition based on the design and management of very efficient *global supply networks*, in a context of increased uncertainty and instability. Similarly, NGIS can also be referred to as the parallel emergence of *local supply chains* (at the regional, national or continental levels) in order to answer to political, ethical, environmental or supply reliability constraints.

The adoption of NGIS by the enterprise economy is what referred to as Next Generation Enterprise Information Systems (NG-EISs). NG-EISs have many challenges as well as benefits. But for the benefit of having best when fully deployed, the challenges will be explained in this unit.

3.3. CONTRIBUTIONS TOWARDS THE NEXT GENERATION OF INFORMATION SYSTEMS

Countless benefits abound the NGISs. Among the benefits are diagrammatically discussed below under four major contributions.

1. Ontology based solutions for semantic interoperability

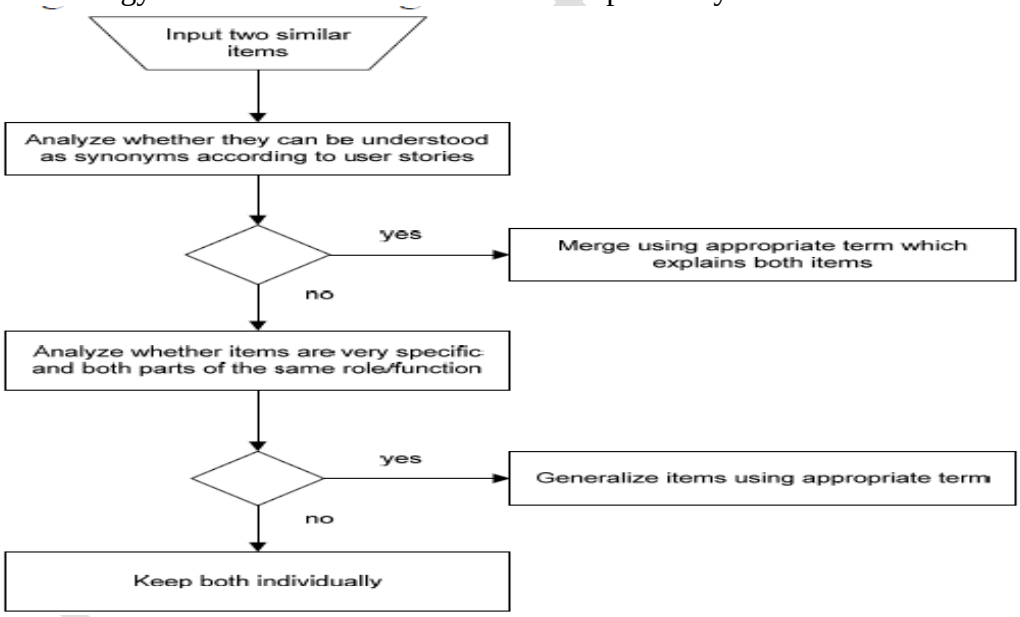


Fig. 4.3.1. Proposed process for USM's merging (Milicic et al., 2014)

2. Context-aware infrastructures

Edition

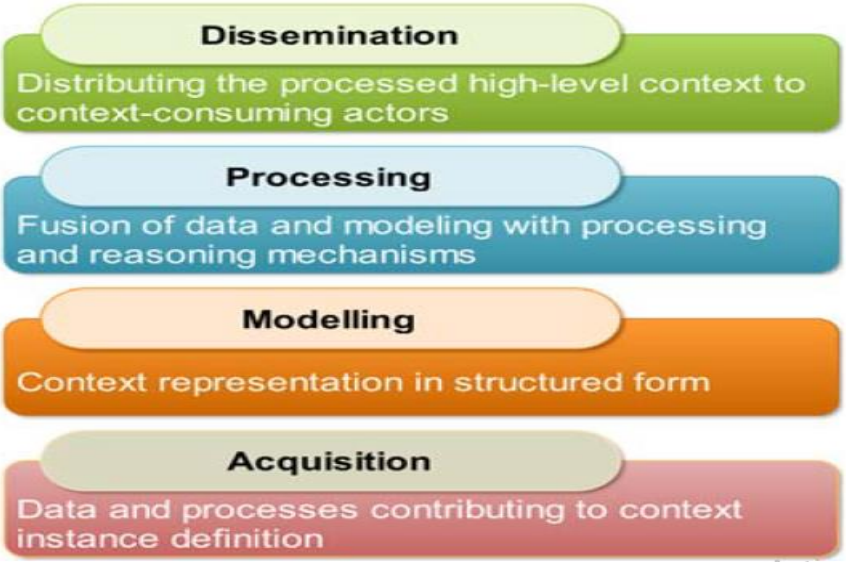


Fig. 4.3.2. Context Processing Layers (Perera et al, 2014)

3. The Product Avatar as a contribution to an evolutionary social, collaborative and product centric, and interaction metaphor with EIS.

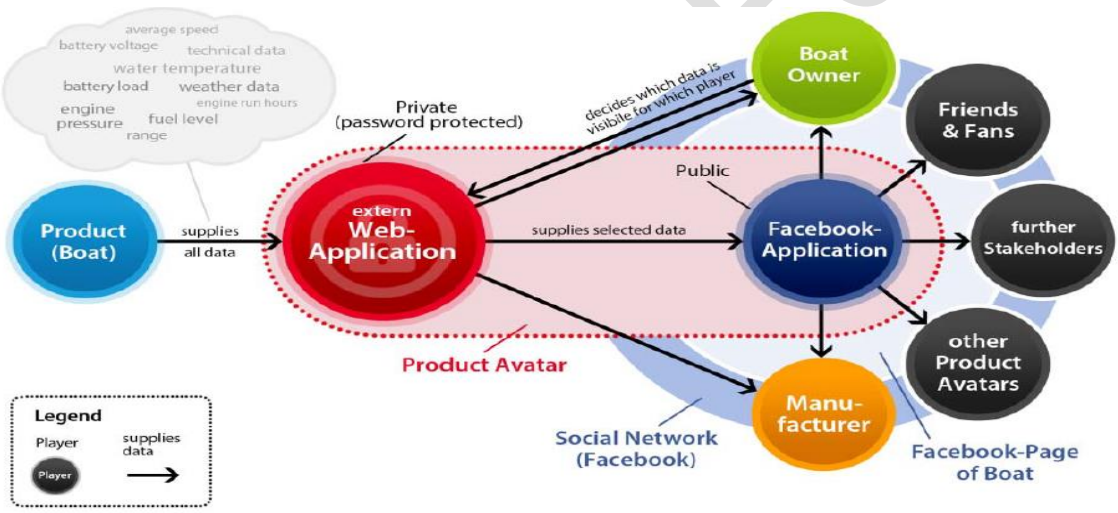


Fig. 4.3.3. Product Avatar for a leisure boat (Hribernik, Wuest, and Thoben, 2013)

4) Human learning solutions for continuous education

Pre Edition

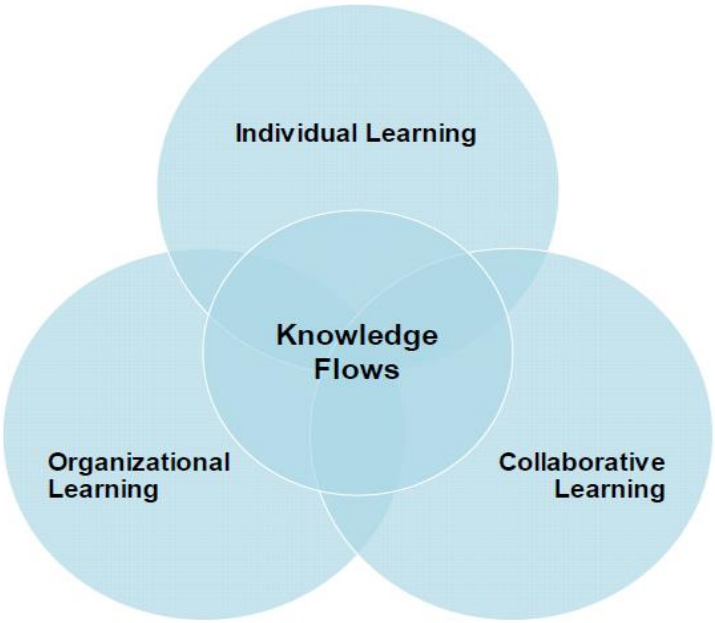


Fig. 4.3.4. Learning flows in Enterprise learning (Goggins, Jahnke, and Wulf, 2013)

3.4. GRAND CHALLENGES OF NG-EISs

NG-EISs are majorly categorized into four. To better understand these challenges, related questions are succinctly provided against each as depicted in table 4.3.1.

GRAND CHALLENGES	RELATED QUERIES
Data Value Chain Management	How to allow data/information analysis, mining, integration, sharing, security through interoperability?
Context Awareness	How to offer scalability and integration capabilities between processes within EIS?
Usability, Interaction, and Visualization	How to deliver new and intuitive ways for interacting with EIS?
Human Learning and Continuous Education	How to support development of professional competencies triggered by new scientific and technological advances?

Table 4.3.1. Grand Challenges of NG-EISs

4.0. Summary

In this unit, you have learnt:

- to discuss ICT, the notable key trends of ICT in the present digital age, as well as the anticipated development in ICT
- what NGIS is and its mandates
- that NGIS cannot be achieved over night except some important contributions are rightly put in place. Those contributions are diagrammatically explained.
- that NGIS birthed NG-EISs which is the world driving force. The latter challenges are clearly discussed in the unit.

5.0. Self-Assessment Questions

- State the value added developments in ICT since 2016
- With the aid of suitable diagram, explain the contributions towards NGIS
- Discuss the grand challenges of NG-EIS

6.0. Tutor-Marked Questions

- Differentiate between NGIS and NG-EIS

Pre-print Edition

- In your best understanding, explain product avatar as a contribution towards evolutionary social, collaborative and product centric

7.0. References

El Kadiri, S., Grabot, B., Thoben, K., Hribenik, K., Emmanouilidis, C., and von Cieminski, G. and Kiritsis, D. (2016). *Current trends on ICT technologies for enterprise information systems.* Computers in Industry, *79*, 14-33.

8.0. Further Readings

https://www.skillsoft.com/blog/2016/02/key-trends-in-information-and-communications-technology-ict-a-look-at-2016-and-beyond/

https://www.pulse.ng/news/pulse-list-ten-trends-that-will-determine-the-future-of-tech-in-nigeria/etdg6z6

Pre-print Edition

MODULE 4: INTRODUCTION TO NETWORKING, INTERNET AND NETWORK ARCHITECTURE

UNIT 1: Introduction to network and internet

1.0 Introduction

This unit covers the introduction and definition basic components of networking and internet

2.0 Learning Objectives

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

I. Define computer networking
II. Identify the various types of networks and examples
III. Define the internet

3.1 Computer Network

A computer network, or data network, is a digital telecommunications network which allows nodes to share resources. In computer networks, computing devices exchange data with each other using connections (data links) between nodes. A network consists of two or more computers that are linked in order to share resources (such as printers and CDs), exchange files, or allow electronic communications. The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams. The very common types of networks include: Local Area Network (LAN) and Wide Area Network (WAN), Metropolitan Area Networks (MAN), a Wireless LAN (WLAN), or a Wireless WAN (WWAN).

3.2 Local Area Network

A Local Area Network (LAN) is a network that is confined to a relatively small area and it is generally limited to a geographic area such as student computer laboratory, faculty building or offices. Computers connected to a network are broadly categorized as servers or workstations. Servers are generally not used by humans directly, but rather run continuously to provide seamless services to the other computers on the network. Services provided can include printing and faxing, software hosting, file storage and sharing, messaging, data storage and retrieval, complete access control for the network's resources, and many others. Workstations are called such because they typically do have a human user which interacts with the network through them. Workstations were traditionally considered a desktop, consisting of a computer CPU and its peripheral such as keyboard, display monitor, and mouse, or a laptop, with integrated keyboard, display, and touchpad. With the advent of the tablet computer, and the touch screen devices such as iPad and iPhone, our definition of workstation is quickly evolving to include those devices, because of their ability to interact with the network and utilize network services. The Servers tend to be more powerful than workstations,

Preprint Edition

although configurations are guided by needs. However, the size and speed of the server's processor(s), hard drive, and main memory might add dramatically to the cost of the system.
On a single LAN, computers and servers may be connected by cables or wirelessly. Wireless access to a wired network is made possible by wireless access points (WAPs). These WAP devices provide a bridge between computers and networks. A typical WAP might have the theoretical capacity to connect hundreds or even thousands of wireless users to a network. Servers are always connected to the network by cables to the network, because the cable connections remain the fastest. Workstations which are stationary computer system that are always connected by a cable to the network, although the cost of wireless adapters has dropped to the point that, when installing workstations in an existing facility with inadequate wiring, it can be easier and less expensive to use wireless for a desktop but the problem of network fluctuation is the major project.

3.3 Metropolitan Area Network

A metropolitan area network, or MAN, covers a city. The best-known example of a MAN is the cable television network available in many cities. This system grew from earlier community antenna systems used in areas with poor over-the-air television reception. In these early systems, a large antenna was placed on top of a nearby hill and signal was then piped to the subscribers' houses. At first, these were locally-designed, ad hoc systems. Then companies began jumping into the business, getting contracts from city governments to wire up an entire city. The next step was television programming and even entire channels designed for cable only. Often these channels were highly specialized, such as all news, all sports, all cooking, all gardening, and so on. But from their inception until the late 1990s, they were intended for television reception only.
Starting when the Internet attracted a mass audience, the cable TV network operators began to realize that with some changes to the system, they could provide two-way Internet service in unused parts of the spectrum. At that point, the cable TV system began to morph from a way to distribute television to a metropolitan area network.

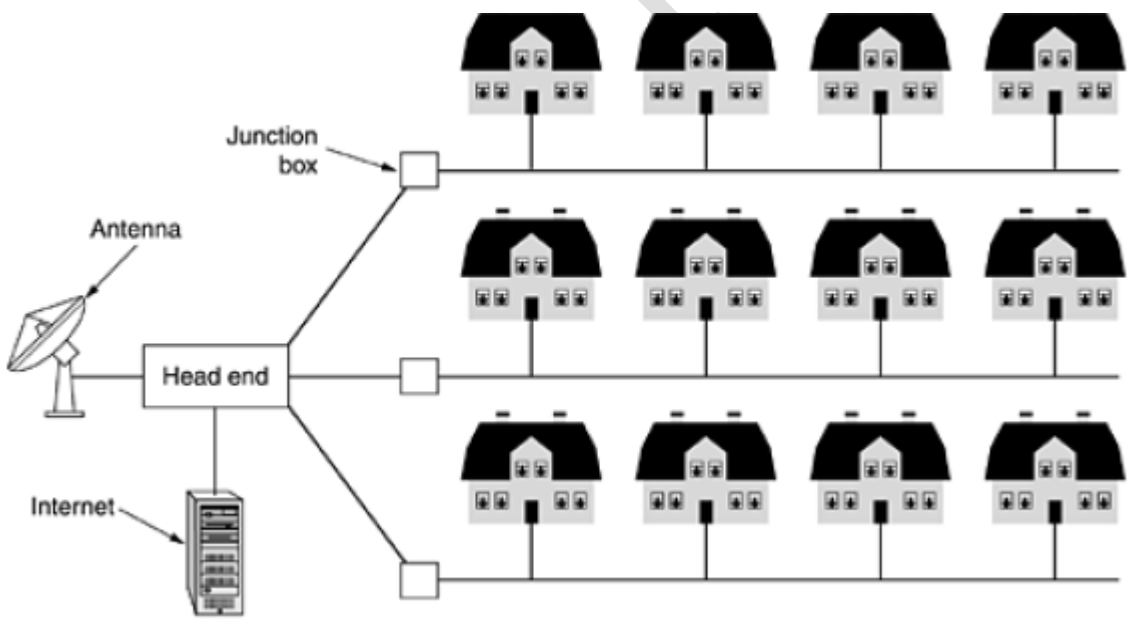


Figure 5.1.1: Metropolitan Area Network [Source: Andrew S. Tanenbaum]

3.4 Wide Area Network

Wide Area Networks (WANs) connect networks in larger geographic areas, such as Florida, the United States, or the world. Dedicated transoceanic cabling or satellite uplinks may be used to connect this type of global network. A WAN is complicated. It uses multiplexers, bridges, and routers to connect local and metropolitan networks to global communications networks like the Internet. To users, however, a WAN will not appear to be much different than a LAN.

3.5 Internet

The Internet is the global system of interconnected computer networks that use the internet protocol suite (TCP/IP) to link devices worldwide. It is a network of networks that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies. The Internet carries a vast range of information resources and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), electronic mail, telephony and file sharing. Using the Internet seems pretty easy. We go to a web address and up comes a page. Or we go to our favourite social site and see pictures of our friends, families, and pets. But it takes a lot of complex software and hardware to make the Internet seem so simple. The design of the technologies that make today's Internet work started in the 1960s, and there were over 20 years of research into how to build internetworking technologies before the first "Internet" was built in the late 1980s by academics in a project called NSFNet. Since then, the research and development into improving network technologies has continued as networks have become far larger and faster and globally distributed with billions of computers.

4.0 Summary

In this unit, you have learnt that:

- The meaning of computer network and Internet
- The Types of Network
- The concept of internet

5.0 Self-Assessment

A. List all the types of network and explain computer network
B. Explain the concept of internet

6.0 Tutor Marked Assessment

A. Differentiate between Computer network and Internet
B. Explain the meaning of all types of computer network

7.0 References

Communications and Networking: An Introduction (Computer Communications and Networks) Author(s): John Cowley: Springer, Year: 2007

Introduction to Computer Networking, Author(s): Thomas G. Robertazzi: Springer International Publishing, Year: 2017

Introduction to networking: Author: Saravanan A.M researchgate.net/publications.2018

Introduction to computer networking Varna Free University "Chernorizec Hrabar" Institute of Technology, Author: Prof. T. Bakardjieva

8.0 Further reading

CCNA INTRO: Introduction to Cisco Networking Technologies Study Guide: Exam 640-821: Sybex, 2006, 9780470068502

https://learn.saylor.org/course/cs402

Pre-print Edition

UNIT 2: Computer Networking

1.0 Introduction

This unit covers the introduction and definition of computer networking, the architecture and various software's that aid the successful operation of a network.

2.0 Learning Objectives

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

I. Explain Computer Networking
II. Operation of computer networking
III. Explain the concept of architecture of computer networking

3.1 Computer Networking

Networking is referred as connecting computers electronically for the purpose of sharing information. Resources such as files, applications, printers and software are common information shared in a networking. The advantage of networking can be seen clearly in terms of security, efficiency, manageability and cost effectiveness as it allows collaboration between users in a wide range. Basically, network consists of hardware component such as computer, hubs, switches, routers and other devices which form the network infrastructure. These are the devices that play an important role in data transfer from one place to another using different technology such as radio waves and wires.

There are many types of network available in the networking industries and the most common network are Local Area Network (LAN) and Wide Area Network (WAN).LAN network is made up of two or more computers connected together in a short distance usually at home, office buildings or school. WAN is a network that covers wider area than LAN and usually covers cities, countries and the whole world. Several major LAN can be connect together to form a WAN. As several devices are connected to network, it is important to ensure data collision does not happened when this devices attempt to use data channel simultaneously. A set of rules called Carrier Sense Multiple Access / Collision detection are used to detect and prevent collision in networks.

3.2. Called Carrier Sense Multiple Access / Collision detection

WHAT IS CARRIER SENSE MULTIPLE ACCESS (CSMA)

Carrier Sense Multiple Access is one of the popular ways to transmit information packets across networks. Packets is referred as data bits which are sent over a network. According to Wikipedia, Carrier Sense Multiple Access (CSMA)) is a "probabilistic Media Access Control (MAC) protocol in which a node verifies the absence of other traffic before transmitting on a shared transmission medium, such as an electrical bus, or a band of the electromagnetic spectrum". In a simple word, CSMA will check to ensure the line is not being used before the data is sent, if it is in use, it waits until the line is idle before proceeding with transmitting.

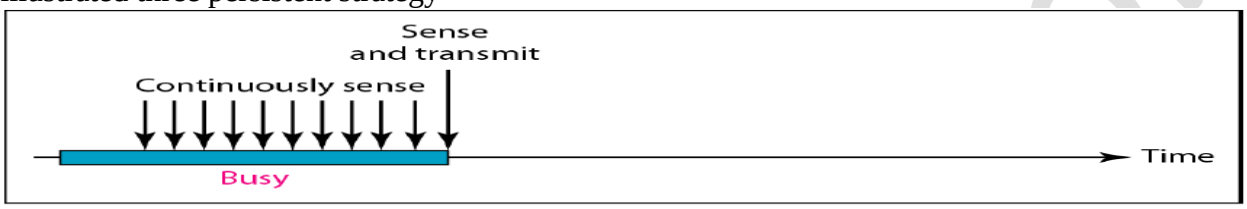
Ethernet networks use this method to send information packets. One of the important purpose CSMA was developed is to minimize the chances of collision and improve the performance by preventing computers from exchanging information at same time. Collision occurs when computers attempt to

Pre-Print Edition

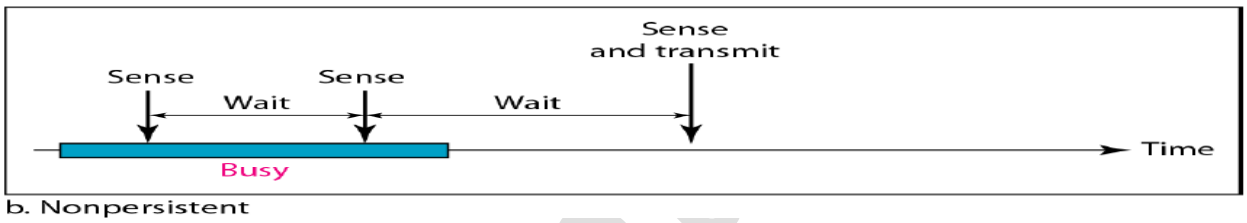
send information to each other at the same time. Thus, the data does not reach its destination or destroyed. With CSMA, collision can be reduced as it will hold the data and wait until the line is clear before data is transmitted to the particular computer and user.

According to Wikipedia, "**Carrier Sense**" describes how transmitter uses feedback from a receiver to detect existence of encoded signal from any other station before trying to transmit. The chances of collision can be reduced if the station can sense the medium before it is used. Station should listen to medium about ongoing transmission in process before sending its own information. CSMA is based on the principle "sense before transmit" or "listen before talk".

"**Multiple Access**" means that more than one device can listen and waiting to transmit at a time. Multiple stations may share multiple access medium. This means every data bits transmitted by a station is generally received by all the stations using that medium. CSMA actually uses several different methods where they wait for the medium to become idle, known as the persistence strategy. Persistence strategy defines the procedures for a station that senses a busy medium. Figure 5.2.1a&b illustrated three persistent strategy

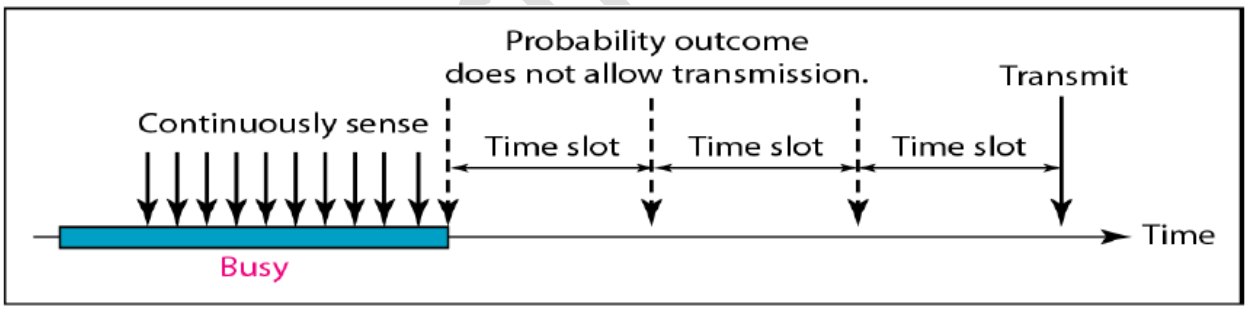


a. 1-persistent



b. Nonpersistent

Figure 5.2.1a: Persistent Strategy Behavior [Source: Saravanan A.M 2018]



c. p-persistent

Figure 5.2.1b: Persistent Strategy Behavior [Source: Saravanan A.M 2018]

i. 1-persistent method

In this strategy, the station will sense the channel and transmit packets immediately if the channel is sensed free. If the medium is busy it will wait until the channel becomes idle. Then it will send the data with probability of 1.

ii. P-persistent method

In P-persistent protocol, when the line is free the sender will transmit frame with probability *p*. If the medium is busy, it will wait until the line is free before sending the packet with probability *p*. If the station choose to hold back, it will not transmit with the probability *1-p*. The sender will wait and the process will be repeated until the frame are sent with the same probability *p* when the next time slot is available. The strategy are used in Wi-Fi and packet radio systems.

iii. Non-persistent method

Station will sent immediately if the line is idle or the station will have to wait for a random amount of time and then sense the line again to check its status. The advantage of this strategy is that, it reduces the chances of collision since it is out of ordinary for two station to wait for the same period of time before retrying concurrently.

CARRIER SENSE MULTIPLE ACCESS WITH COLLISION DETECTION (CSMA / CD)

As described earlier, in CSMA data is transferred by sensing the channel. Possibility for collision happens is high when the computers try to send information one to another concurrently. This problem can be reduced if the station can detect if the data transmission deteriorate a collision during the transmission. Instead of randomly transmitting data which has collided with others, the collision can be detected by a station which could immediately halt the collided transmission to reduce the duration of collision. The protocol which perform this action is called Carrier Sense Multiple Access with Collision Detection or CSMA/CD. It is a protocol used to ensure only one network node are transmitted at one time in the Ethernet network. This is the technique used to access the 802.3 Ethernet network channel.

Collision Detection

Collision Detection means that when two devices try to send data simultaneously at the same time, they are able to detect this error. CSMA/CD operates in the same manner with CSMA except the moment collision is detected, the operation of data transmission will be aborted immediately. The collision that occurs on the shared media are detected when the devices in the listening mode. When a device is in listening mode, it can detect collision occurs on the shared media. The detection of a collision happen when there is increase of amplitude above the normal level. Once the increase in the signal amplitude detected all the transmitting devices will transmit to assure devices in network detect the collision.

Jamming Signal Back off Algorithm

Once the collision is heard the sender will send jamming signal to announce other devices that the collision had happened and the devices should stop sending data onto the wire. After the jamming signal is sent, the sender will wait for an indefinite amount of time. This random time will ensure the devices which were involved in the collision do not transmit simultaneously again. This process is called back off algorithm which make sure traffic from two devices are not transmitted at the same time. The back off period is decided by collision counter of each node and usually generate random numbers. The possibility of repeated collision exist even after the back off when the nodes trying to transmit the data again. It can be reduces if each nodes back off at different time.

Retransmission

Final step in CSMA/CD data transmission process is retransmitting the frame that is corrupted or terminated because of a collision. The process of retransmitting is performed after a collision is detected, and the node backs off for a period of time. If the retransmission is successful, the node clears its collision counter.

The entire operation of the CSMA/CD can be described by flow diagram in Figure below. The operation of CSMA/CD are same with CSMA before the collision detection starts as shown in the figure 5.2.2. The transmission is successful if there is no collision is detected. In case of collision is detected, the transmission will be aborted. The jamming signal will be sent and all the station involved in collision will back off. The process will be repeated after the packets backs off.

Pre-print Edition

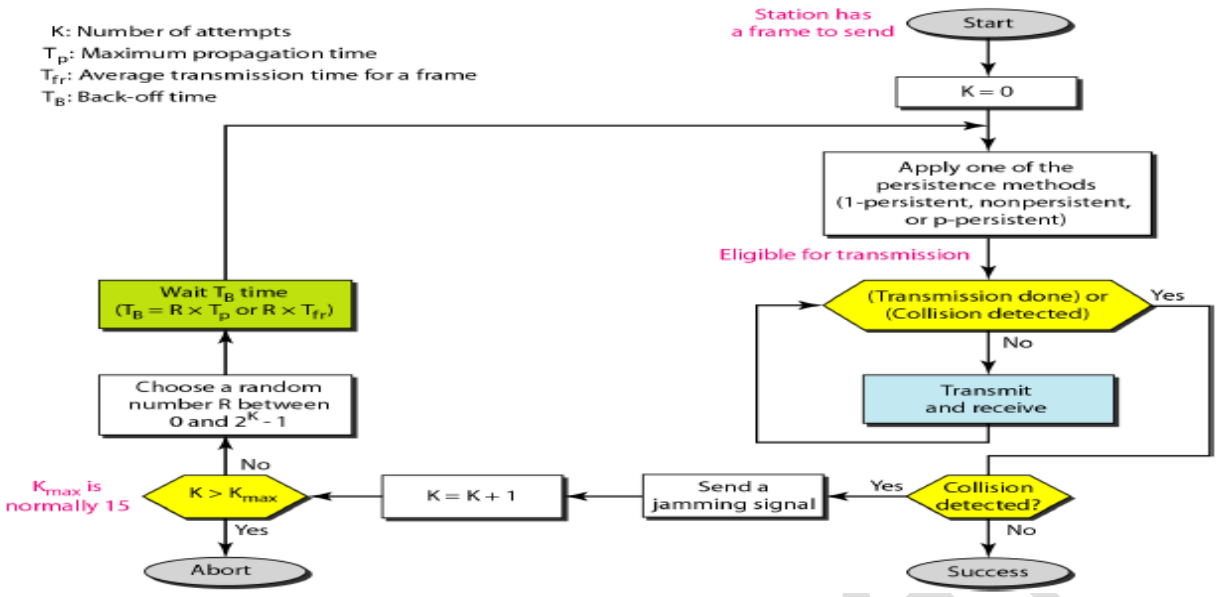


Figure 5.2.2: Flow diagram for CSMA/CD, [Source: Saravanan A.M, 2018]

3.3 Architecture of Computer Networking

These are ways at which network devices are being configured, which can be broadly categorized into two types of network configuration, peer-to-peer networks and client/server networks.

3.3.1 Peer-peer Networking

Peer-to-peer networks are more commonly implemented where less than ten computers are involved and where strict security is not necessary. All computers have the same status, hence the term 'peer', and they communicate with each other on an equal footing. Files, such as word processing or spreadsheet documents, can be shared across the network and all the computers on the network can share devices, such as printers or scanners, which are connected to any one computer.

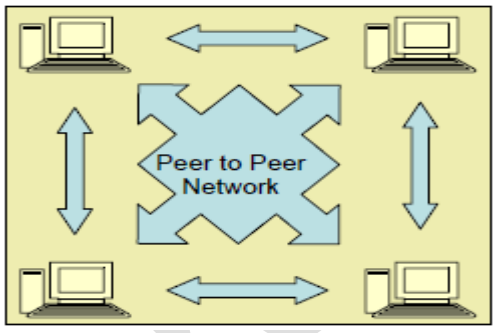


Figure 5.2.3: Peer-Peer Networking [Source: T. Bakardjieva]

Client/server networks are more suitable for larger networks. A central computer, or 'server', acts as the storage location for files and applications shared on the network. Usually the server is a higher than average performance computer. The server also controls the network access of the other computers which are referred to as the 'client' computers. Typically, teachers and students in a school will use the client computers for their work and only the network administrator (usually a designated staff member) will have access rights to the server.

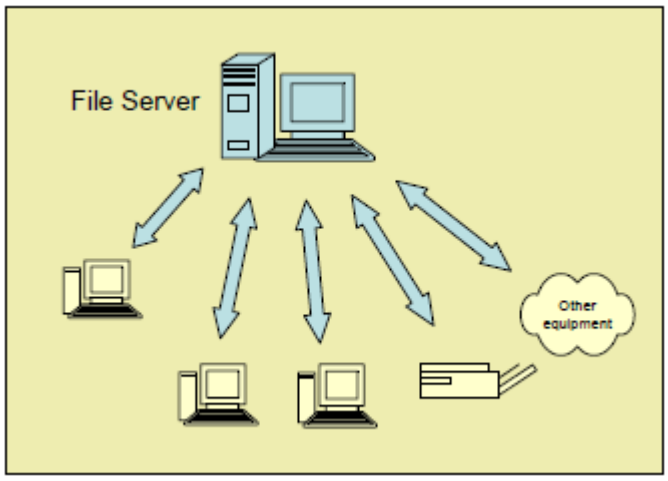


Figure 5.2.4: Client-Server Networking [Source: T. Bakardjieva]

4.0 Summary

In this unit, you have learnt that:

- The meaning of computer networking
- How computer networking operates
- The three persistent behavior

5.0 Self-Assessment

1. The flow of CSMA/CD, List and explain briefly the three persistent behavior
2. Explain, the concept of Jamming signal back off algorithm and retransmission

6.0 Tutor Marked Assessment

A. With the aid of diagram, explain in detailed CSMA/CD
B. Explain with the aid of diagram the architecture of computer networking

7.0 References

Communications and Networking: An Introduction (Computer Communications and Networks) Author(s): John Cowley: Springer, Year: 2007

Introduction to Computer Networking, Author(s): Thomas G. Robertazzi: Springer International Publishing, Year: 2017

Introduction to networking: Author: Saravanan A.M researchgate.net/publications. 2018

Introduction to computer networking Varna Free University "Chernorizec Hrabar" Institute of Technology, Author: Prof. T. Bakardjieva

8.0 Further Reading

CCNA INTRO: Introduction to Cisco Networking Technologies Study Guide: Exam 640-821: Sybex, 2006, 9780470068502

https://learn.saylor.org/course/cs402

Preprint Edition

UNIT 3: Network Architecture

1.0 Introduction

This unit covers the introduction and definition basic components of network and its architecture

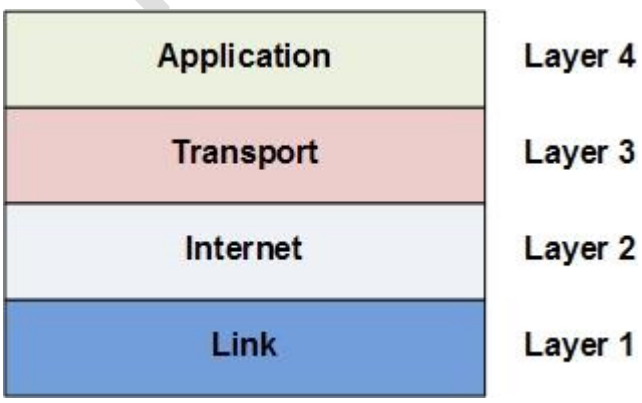
2.0 Learning Objectives

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

I. Explain Network Architecture
II. Identifying how computers communicates
III. Explain the concept of internetworking layer
IV. Describe the domain name system

3.1 Network Architecture

In order to build a system as complex as the Internet, the most effective way is try to break a single challenging problem into a set of smaller problems that can be solved independently and then put back together to solve the original large problem. The engineers who built the first internets broke the overall problem into four basic sub-problems that could be worked on independently by different groups. The groups are: (1) Link, (2) Internetwork, (3) Transport, and (4) Application. These different areas as layers stacked on top of each other, with the Link layer on the bottom and the Application layer on the top. The Link layer deals with the wired or wireless connection from the computer to the local area network and the Application layer is what we as end users interact with. A web browser is one example of an application in this Internet architecture. We informally refer to this model as the "TCP/IP model" in reference to the Transport Control Protocol (TCP) used to implement the Transport layer and Internet Protocol (IP) used to implement the Internetwork layer.



Preprint Edition

Figure 5.3.1: The Four-Layer TCP/IP Model

3.2 The Link Layer

The Link layer is responsible for connecting the computer to its local network and moving the data across a single hop. The most common Link layer technology today is wireless networking. When you are using a wireless device, the device is only sending data a limited distance. A smartphone communicates with a tower that is a few kilometres away. If smartphone on a train, it needs to reconnect with a new tower every few minutes when the train is moving. A laptop that is connected to a Wi-Fi network is usually communicating with a base station within 200 meters. A desktop computer that is connected using a wired connection is usually using a cable that is 100 meters long or shorter. Link layer technologies are often shared amongst multiple computers at the same location. The Link layer needs to solve two basic problems when dealing with these shared local area networks. The first problem is how to encode and send data across the link. If the link is wireless, the network designer must agree on which radio frequencies are to be used to transmit data and how the digital data is to be encoded in the radio signal. For wired connections, they must agree on what voltage to use on the wire and how fast to send the bits across the wire. For Link layer technologies that use fiber optics, they must agree on the frequencies of light to be used and how fast to send the data. In addition to agreeing on how to send data using a shared medium such as a wireless network, they also need to agree on how to cooperate with other computers that might want to send data at the same time.

If all the computers on the network tried to transmit whenever they had data to send, their messages would collide. The result would be chaos, and receiving stations would only receive noise. So there is need to find a fair way to allow each station to wait its turn to use the shared network. The idea of breaking a large message into packets and then sending each packet separately makes this sharing easier. If only one computer wants to send data, it will send its packets one right after another and move its data across the network as quickly as it can. But if three computers want to send data at the same time, each computer will send one packet and then wait while the other two computers send packets. After each of the other computers sends a packet, the first computer will send its next packet. This way the computers are sharing access to the network in a fair way. But how does a computer know if other computers want to send data at the same time? The network engineers designed an ingenious method to solve this problem called “Carrier Sense Multiple Access with Collision Detection”, or CSMA/CD. It is a long name for a simple and elegant concept. When your computer wants to send data, it first listens to see if another computer is already sending data on the network (Carrier Sense). If no other computer is sending data, your computer starts sending its data. As your computer is sending data it also listens to see if it can receive its own data. If your computer receives its own data, it knows that the channel is still clear and continues transmitting. But if two computers started sending at about the same time, the data collides, and your computer does not receive its own data. When a collision is detected, both computers stop transmitting, wait a bit, and retry the transmission. The two computers that collided wait different lengths of time to retry their transmissions to reduce the chances of a second collision.
When your computer finishes sending a packet of data, it pauses to give other computers that have been waiting a chance to send data. If another computer senses that your computer has stopped sending data (Carrier Sense) and starts sending its own packet, your computer will detect the other computer’s use of the network and wait until that computer’s packet is complete before attempting to send its next packet. This simple mechanism works well when only one computer wants to send data. It also works well when many computers want to send data at the same time. When only one computer is sending data, that computer can make good use of the shared network by sending packets one after another, and when many computers want to use the shared network at the same time, each computer

Pre-Print Edition

gets a fair share of the link. Some link layers, like a cellular connection for a smartphone, a Wi-Fi connection, or a satellite or cable modem, are shared connections and need techniques like CSMA/CD to insure fair access to the many different computers connected to the network. Other link layers like fiber optic cables and leased lines are generally not shared and are used for connections between routers. These non-shared connections are still part of the Link layer. The Link layer technologies focus solving the issues so computers can transmit data across a single link that ranges in distance from a few meters to as long as hundreds of kilometres. But to move data greater distances, we need to send our packets through multiple routers connected by multiple link layers. Each time our packet passes through another link layer from one router to another we call it a "hop".

3.3 The Internetwork Layer (IP)

Once the packet destined for the Internet makes it across the first link, it will be in a router. Your packet has a source address and destination address and the router needs to look at the destination address to figure out how to best move your packet towards its destination. With each router handling packets destined for any of many billions of destination computers, it's not possible for every router to know the exact location and best route to every possible destination computer. So the router makes its best guess as to how to get your packet closer to its destination. Each of the other routers along the way also does its best to get your packet closer to the destination computer. As your packet gets closer to its final destination, the routers have a better idea of exactly where your packet needs to go. When the packet reaches the last link in its journey, the link layer knows exactly where to send your packet. Only the routers that are closest to the destination computer know the exact path to that computer. All of the routers in the middle of the journey work to get your message closer to its destination. But just like when you are traveling, unexpected problems or delays can come up that require a change in plans as your packets are sent across the network. Routers exchange special messages to inform each other about any kind of traffic delay or network outage so that packets can be switched from a route that is no longer working to a different route. The routers that make up the core of the Internet are smart and adapt quickly to both small and large outages and failures of network connections. Sometimes a connection slows down because it is overloaded. Other times a connection is physically broken when a construction crew mistakenly digs up a buried wire and cuts it. Sometimes there is a natural disaster like a hurricane or typhoon that shuts down the routers and links in a large geographical area. The routers quickly detect these outages and reroute around them if possible. But sometimes things go wrong and packets are lost.

3.4 The Transport Layer (TCP)

The Internetwork layer is both simple and complex. It looks at a packet's destination address and finds a path across multiple network hops to deliver the packet to the destination computer. But sometimes these packets get lost or badly delayed. Other times the packets arrive at their destination out of order because a later packet found a quicker path through the network than an earlier packet. Each packet contains the source computer's address, the destination computer's address, and an offset of where this packet "fits" relative to the beginning of the message. Knowing the offset of each packet from the beginning of the message and the length of the packet, the destination computer can reconstruct the original message even if the packets were received out of order. As the destination computer reconstructs the message and delivers it to the receiving application, it periodically sends an acknowledgement back to the source computer indicating how much of the message it has received and reconstructed. But if the destination computer finds that parts of the reconstructed message are missing, this probably means that these packets were lost or badly delayed. After waiting a bit, the destination computer sends a request to the source computer to resend the data that seems to be missing. The sending computer must store a copy of the parts of the original message that have been sent until the destination computer acknowledges successful receipt of the packets.

Pre-print Edition

Once the source computer receives the acknowledgment of successful receipt of a portion of the message, it can discard the data that has been acknowledged and send some more data. The amount of data that the source computer sends before waiting for an acknowledgement is called the "window size". If the window size is too small, the data transmission is slowed because the source computer is always waiting for acknowledgments. If the source computer sends too much data before waiting for an acknowledgment, it can unintentionally cause traffic problems by overloading routers or long-distance communication lines. This problem is solved by keeping the window size small at the beginning and timing how long it takes to receive the first acknowledgements. If the acknowledgments come back quickly, the source computer slowly increases the window size and if the acknowledgements come back slowly, the source computer keeps the window size small so as not to overload the network. Just like at the Link layer, a little courtesy on the Internet goes a long way toward ensuring good use of the shared network infrastructure. This strategy means that when the network has high-speed connections and is lightly loaded the data will be sent quickly, and if the network is heavily loaded or has slow connections the data will be slowed down to match the limitations of the network connections between the source and destination computers.

3.5 The Application Layer

The Link, Internetwork, and Transport layers work together so as to quickly and reliably move data between two computers across a shared network of networks. With this capability to move data reliably, when the first widely used Internet came into being in the mid- 1980s, the first networked applications allowed users to log in to remote computers, transfer files between computers, send mail between computers, and even do real-time text chats between computers. In the early 1990s, as the Internet came to more people and computers' abilities to handle images improved, the World Wide Web application was developed by scientists at the CERN high-energy physics facility. The web was focused on reading and editing networked hypertext documents with images. Today the web is the most common network application in use around the world. But all the other older Internet applications are still in wide use. Each application is generally broken into two halves. One half of the application is called the "server". It runs on the destination computer and waits for incoming networking connections. The other half of the application is called the "client" and runs on the source computer. When you are browsing the web using software like Firefox, Chrome, or Internet Explorer, you are running a "web client" application which is making connections to web servers and displaying the pages and documents stored on those web servers. The Uniform Resource Locators (URLs) that your web browser shows in its address bar are the web servers that your client is contacting to retrieve documents for you to view. When we develop the server half and the client half of a networked application, we must also define an "application protocol" that describes how the two halves of the application will exchange messages over the network. The protocols used for each application are quite different and specialized to meet the needs of the particular application. Later we will explore some of these Application layer protocols.

3.5.1 The Domain Name System

The Domain Name System lets you access websites by their domain name like (www.khanacademy.org), so you don't have to keep a list of numeric Internet Protocol (IP) addresses like "212.78.1.25". IP address are determined by where your computer connects to the Internet. When you have a portable computer and you move from one location to another, you get a new IP address at each new location. Since no one connects to your portable computer, it does not matter if your IP address changes from time to time. But since so many people connect to a web server, it would be inconvenient if the server moved to a new location and needed to change its IP address.

When your computer makes a connection to a system using a domain name address, the first thing your computer does is look up the IP address that corresponds to the domain name. Then your computer makes the connection using the IP address. Adding the separate step of looking up the IP address for a DNS address also makes it easier to move a server from one location to another. The server is given a new IP address and the entry for the domain address is updated. Once the DNS entry

Pre-print Edition

is updated, new requests for the domain name are given the new IP address. Since end users access most servers using domain names and never see the IP address, a server can be moved to a new network connection without affecting the end user's ability to access the server.

3.5.1.1 Allocating Domain Names

If you recall from the previous section, IP addresses are allocated based on where you connect a new network to the Internet. Domain names are allocated based on organizations that "own" the domain name. At the top of the domain name hierarchy is an organization called the International Corporation for Assigned Network Names and Numbers (ICANN). ICANN chooses the top-level domains (TLDs) like .com, .edu, and .org and assigns those to other organizations to manage. Recently a new set of TLDs like .club and .help have been made available. ICANN also assigns two-letter country code top-level domain names like .ng, .us, .za, .nl, and .jp to countries around the world we call these Country-Code Top-Level Domain Names. Countries often add second-level TLDs, like .co.uk for commercial organizations within the UK. Policies for applying for domain names with any particular TLD vary widely from one country to another.

Once a domain name is assigned to an organization, the controlling organization is allowed to assign subdomains within the domain. As an example, the .edu top-level domain is assigned to the educational organization. Educational assigns domains like @unilorin.edu to higher education institutions. Once the University of Ilorin is given control of unilorin.edu, it can make its own choices for subdomains within its new domain. Domains ending in .com and .org can be purchased by individuals. The individual owners of those domains are allowed to manage their domain and create subdomains under it for their own use or use by others.

12.0 Summary

In this unit, you have learnt that:

- The network architecture
- The role of TCP/IP protocol layers
- The domain name systems

13.0 Self-Assessment

A. List all the TCP/IP layer and explain their roles in internetworking.
B. Explain the role of domain name systems
C. Draw the TCP/IP protocol and label it appropriately

14.0 Tutor Marked Assessment

A. With the aid of diagram, explain in detail the TCP/IP
B. Explain the meaning of network architecture

15.0 References

Communications and Networking: An Introduction (Computer Communications and Networks) Author(s): John Cowley: Springer, Year: 2007

Introduction to Computer Networking, Author(s): Thomas G. Robertazzi: Springer International Publishing, Year: 2017

16.0 Further Reading

CCNA INTRO: Introduction to Cisco Networking Technologies Study Guide: Exam 640-821: Sybex, 2006, 9780470068502

https://learn.saylor.org/course/cs402

Pre-print Edition

Pre-print Edition

UNIT 4 Introduction to OSI model and the TCP/IP Model

1.0 INTRODUCTION

This unit covers the introduction and definition basic components of OSI model and their characteristics

2.0 Learning Objectives

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

I. List all the layer of OSI model
II. State the property of each layer
III. Compare the OSI model and TCP/IP model

3.1 The OSI Model

The Open Systems Interconnection model (OSI model) is a conceptual model that characterizes and standardizes the communication functions of a telecommunication or computing system without regard to its underlying internal structure and technology.

In today's networked world, the OSI model and the TCP/IP model serve two different purposes. The TCP/IP model is an implementation model, in that it provides the guidance for those who would build TCP/IP-compatible network hardware or software. The OSI model is more of an abstract model that can be used to understand a wide range of network architectures. While TCP/IP is the most widely used network technology today, many different types of networks have been implemented and deployed over the past 50 years. And as we continue to improve and evolve networking, new implementation models may emerge. The OSI model has seven layers instead of the four layers of the TCP/IP model. Starting at the bottom of the OSI model, the layers are: (1) Physical, (2) Data Link, (3) Network, (4) Transport, (5) Session, (6) Presentation, and (7) Application.

3.1.1 Physical (Layer 1)

The OSI Physical layer deals with the physical attributes of the actual wired, wireless, fiber optic, or other connection that is used to transport data across a single link. The Physical layer also defines the

Pre-print Edition

shapes of the connectors and type of media which can be used. Another problem solved at this layer is how to encode the bits (0's and 1's) that make up the data being sent across the medium. The "bit encoding" (or modulation) determines how fast data can be sent across the link.

3.1.2 Data Link (Layer 2)

The OSI Data Link layer is concerned with how the systems using a physical link cooperate with one another. When data is broken into packets, the Data Link layer defines special sequences to indicate the beginning and end of each packet. The stations communicating using the physical connection are assigned addresses to allow for effective use of the media. Sometimes multiple stations are sharing the same media (as on a wireless network) and the Data Link layer defines how those stations will share the connections with the other systems connected to the network. Most Data Link layers also have some form of checksum to detect and/or correct for errors in the transmitted data. The design problems solved in the Physical and Data Link layers of the OSI model are addressed by the Link layer of the TCP/IP model.

3.1.3 Network (Layer 3)

Like the Internetwork Layer (IP) in the TCP/IP model, the OSI Network layer deals with the global assignment of "routable" addresses to the various systems connected to the network. Network layer governs how routers forward packets across multiple hops to get from their source to their destination. Like the IP layer, The OSI Network layer does not attempt to be error free, as it assumes that lost data will be detected and retransmitted at the next layer up.

3.1.4 Transport (Layer 4)

The Transport layer in the OSI model manages packet loss and retransmission as well as flow control and window size. The rest of the functionality of the TCP/IP Transport layer is handled in the Session layer in the OSI model.

3.1.5 Session (Layer 5)

The OSI Session layer handles establishing connections between applications. The Session layer deals with "ports" so that a connecting client application can "find" the correct server application on a particular system. Some aspects of secure transmission are also handled in the OSI Session layer.

3.1.6 Presentation (Layer 6)

The Presentation layer focuses on how data is represented and encoded for transmission across the network. As an example, the Presentation layer would describe how to encode the pixels of an image so that the receiving application can properly decode the data. The Presentation layer also handles data encryption and decryption.

3.1.7 Application (Layer 7)

The OSI Application Layer is very similar to the Application layer in the TCP/IP model, in that it contains the applications themselves. Some applications are client applications that initiate connections, and other applications are the server applications that respond to those connection requests. The various pairs of applications have protocol standards that define interoperability between multiple clients and multiple servers from different vendors.

3.2 Comparing the OSI and TCP/IP Models

We can use the OSI model to provide an alternative "view" of the TCP/IP model by comparing how the OSI model breaks network functionality into its layers and how the TCP/IP model breaks its functionality into layers.

3.2.1 Link Layer (TCP/IP)

The TCP/IP Link layer combines the Physical and Data Link layers from the OSI model. The Physical and Data Link layers are usually implemented in hardware. Products like Ethernet, Wi-Fi, satellite, or fiber optic often are implemented in a network driver card that plugs into the back of a computer or

Pre-print Edition

router The network driver card generally implements both the physical and the data link aspects of the connection in the hardware on the card. In most cases, the data link layers are tuned to the limitations and requirements of their corresponding physical layers. So in real systems, it is somewhat rare for a particular data link layer to be arbitrarily paired with any number of physical layers. Since it can be hard to separate the physical and data link aspects for a particular link technology, the TCP model combines them into a single layer for simplicity.

3.2.2 Internetwork Layer (TCP/IP)

One place that maps pretty cleanly between the two models is the OSI Network and TCP/IP Internetwork layers. They perform the same functions of creating a globally routable address space and building routers to insure that packets properly find their way from the source to the destination across multiple hops.

3.2.3 Transport Layer (TCP/IP)

The features of the Transport layer in TCP/IP are spread across the Transport and Session layers of the OSI model. The OSI Transport layer deals with flow control and packet retransmission, while the OSI Presentation layer deals with multiple applications running on multiple ports as well as session establishment and teardown. The Secure Sockets Layer (SSL) in the TCP/IP model corresponds to parts of the Session and Presentation layers in the OSI model.

3.2.4 Application Layer (TCP/IP)

The TCP/IP Application Layer combines the non-security aspects of the OSI Presentation layer and the OSI Application layer. While many TCP/IP applications deal with issues like encoding and decoding various types of data, the TCP/IP model does not see data formatting as a separate “layer”. Various data encoding and decoding technologies are used in TCP/IP applications, but TCP/IP tends to treat these capabilities as library code that applications make use of as needed for the application.

3.2.5 Diagram representation of OSI Model with TCP/IP Model

In the OSI network model, there are seven layers as compared to four layer in TCP/IP. TCP/IP was later lunched after the development of OSI protocol, was published but there is a linkage between OSI model and TCP/IP standards. OSI is a seven-layered standard, but TCP/IP is a four layered standard. The OSI protocol model has been very influential in the growth and development of TCP/IP standard, and that is why much OSI terminology is applied to TCP/IP. The figure compares the TCP/IP and OSI network models. As we can see from the above figure, presentation and session layers are not there in TCP/IP model. Also note that the network layer in TCP/IP model combines the functions of Data link Layer and Physical Layer.

Pre-print Edition

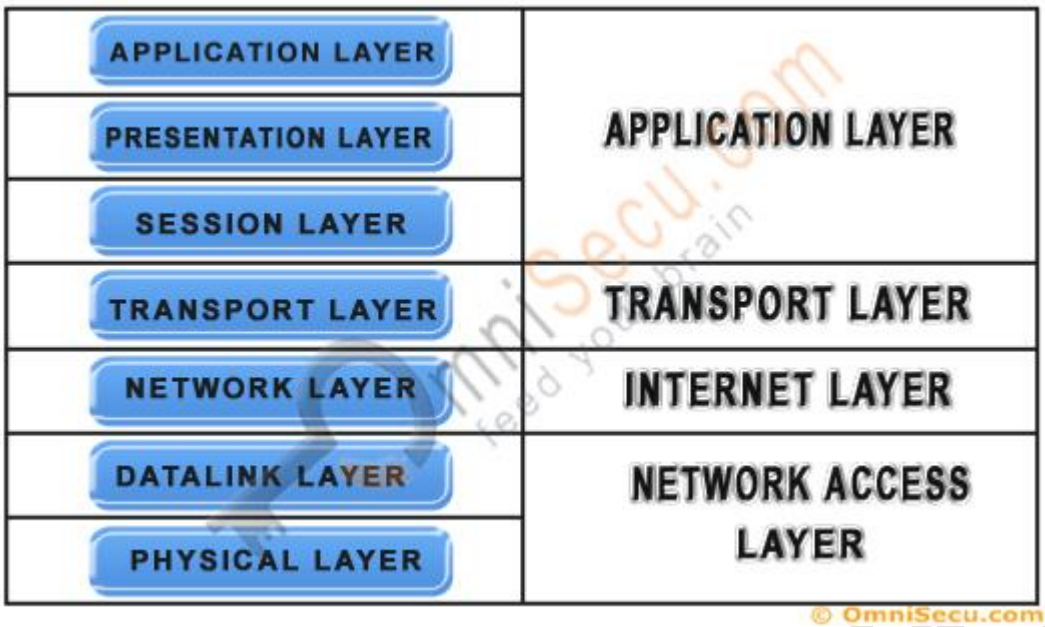


Fig. 5.4.1 Comparing OSI Model with TCP/IP Mode (http://www.omnisecu.com/tcpip/tcpip-model.php)

Layer 4. Application Layer
Application layer is the top most layer of four layer TCP/IP model. Application layer includes all the higher-level protocols like DNS (Domain Naming System), Telnet, SSH, FTP (File Transfer Protocol), TFTP (Trivial File Transfer Protocol), SNMP (Simple Network Management Protocol). Comparing this with the OSI model layer, application layer performs the similar function as performed by session, presentation and application layer in OSI model

Layer 3. Transport Layer
This is the third layer of the four layer TCP/IP model. The position of the transport layer is between application and internet layer. The purpose of transport layer is to allow devices on the source and destination hosts to have the capacity to exchange conversation. Transport layer perform the same function both in OSI model and TCP/IP network model. The main protocols in the transport layer are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Layer 2. Internet Layer
Internet layer in TCP/IP model is the same as Network layer in OSI model. This layer pack data into data packets known as IP datagrams, which contain source and destination address (logical address or IP address) information that is used to forward the datagrams between hosts and across networks. Also, this layer is also responsible for routing of IP datagrams. The main protocols included at this layer are Internet Protocol (IP), Internet Control Message Protocol (ICMP) and IGMP (Internet Group Management Protocol).

Layer 1. Network Access Layer
Network layer is the first layer of the four layer TCP/IP model which equates to both the physical and data link layer in OSI Model. Network layer defines details of how data is physically sent through the network, including how bits are electrically or optically signaled by hardware devices that interface directly with a network medium, such as coaxial cable, optical fiber, or twisted pair copper wire. The protocols available at network layer are Token Ring, Ethernet, Frame relay etc.

4.0 Summary

In this unit, you have learnt that:

- The meaning of OSI model

- The layer that comprises of OSI model
- The comparison between OSI model and TCP/IP model
- The property of each of OSI model layer

5.0 Self-Assessment

A. List all the OSI model layer and explain their roles in internetworking.
B. Comparison of OSI/TCP/IP Model

6.0 Tutor Marked Assessment

I. With the aid of diagram, explain in detail the OSI model
II. Explain the difference between OSI and TCP/IP model with the aid of diagram

7.0 References

Communications and Networking: An Introduction (Computer Communications and Networks) Author(s): John Cowley: Springer, Year: 2007

Introduction to Computer Networking, Author(s): Thomas G. Robertazzi: Springer International Publishing, Year: 2017

8.0 Further reading

CCNA INTRO: Introduction to Cisco Networking Technologies Study Guide: Exam 640-821: Sybex, 2006, 9780470068502

https://learn.saylor.org/course/cs402

Pre-print Edition

Unit 5 Introduction to Network topologies

1.0 INTRODUCTION

This unit covers the introduction and definition basic components of network topologies and their various configurations

2.0 Learning Objectives

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

I. Define network topology
II. State the different types of network topology
III. Identify the area of applications of each
IV. List the merit and demerit of each network topology

3.1 Network topologies

A network topology is the arrangement of a network, including its nodes and connecting lines. There are two ways of defining network geometry: the physical topology and the logical (or signal) topology. Network topology can also be defined as the arrangement of the elements or various type of a communication network, including command and control radio networks, industrial field busses, and computer networks.

3.2 Types of Network Topologies

Network topologies are categorized into the following basic types:

- Bus
- Ring
- Star
- Tree
- Mesh

More complex networks can be built as hybrids of two or more of the above basic topologies.

3.2.1 Bus Topology

Bus networks (not to be confused with the system bus of a computer) use a common backbone to connect all devices. A single cable, the backbone functions as a shared communication medium that devices attach or tap into with an interface connector. A device wanting to communicate with another device on the network sends a broadcast message onto the wire that all other devices see, but only the intended recipient actually accepts and processes the message. Ethernet bus topologies are relatively easy to install and did not require much cabling compared to the alternatives. 10Base-2 ("ThinNet") and 10Base-5 ("ThickNet") both were popular Ethernet cabling option many years ago for bus

Pre-print Edition

topologies. However, bus networks work best with a limited number of devices. If more than a few dozen computers are added to a network bus, performance problems will likely result. Entire network shuts down if there is a break in the main cable. Terminators are required at both ends of the backbone cable. Difficult to identify the problem if the entire network shuts down.

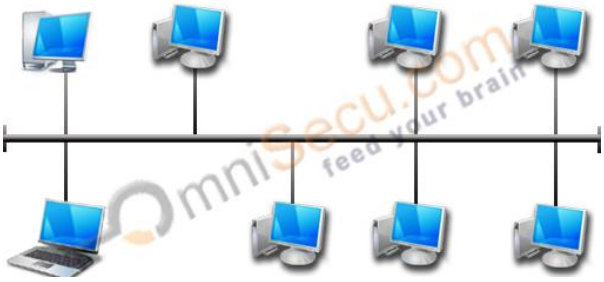


Figure 5.5.1: Bus topology

Advantages of Bus Topology

- Easy to connect a computer or peripheral to a linear bus.
- Requires less cable length than a star topology.

Disadvantages of Bus Topology

- Entire network shuts down if there is a break in the main cable.
- Terminators are required at both ends of the backbone cable.
- Difficult to identify the problem if the entire network shuts down.
- Not meant to be used as a stand-alone solution.

3.2.2 Ring Topology

In a ring network, every device has exactly two neighbours for communication purposes. All messages travel through a ring in the same direction (either "clockwise" or "counterclockwise"). A failure in any cable or device breaks the loop and can take down the entire network. To implement a ring network, one typically uses FDDI, SONET, or Token Ring technology. Ring topologies are found in some office buildings or school campuses. In a ring network, packet of data travel from one device to the next until they reach their destination. Most ring topologies allow packets to travel only in one direction, called a unidirectional ring network. Others permit data to move in either direction, called bidirectional.

Ring topologies may be used in either LANs (Local Area Networks) or WANs (wide area networks). Depending on the type of network card used in each computer of the ring topology, a coaxial cable or an RJ-45 network cable is used to connect computers together.

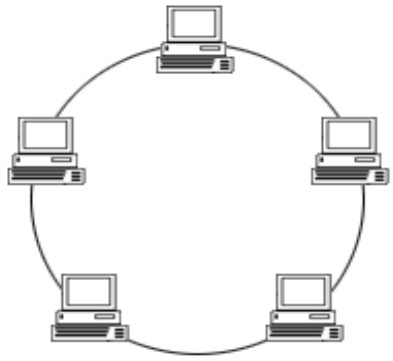


Figure 5.5.2: Ring Topology

Advantages of ring topology

- All data flows in one direction, reducing the chance of packet collisions.
- A network server is not needed to control network connectivity between each workstation.
- Data can transfer between workstations at high speeds.
- Additional workstations can be added without impacting performance of the network.

Print Edition

Disadvantages of ring topology

- All data being transferred over the network must pass through each workstation on the network, which can make it slower than a star topology.
- The entire network will be impacted if one workstation shuts down.
- The hardware needed to connect each workstation to the network is more expensive than Ethernet cards and hubs/switches.

3.2.3 Star Topology

Many home networks use the star topology. A star network features a central connection point called a "hub node" that may be a network hub, switch or router. Devices typically connect to the hub with Unshielded Twisted Pair (UTP) Ethernet. Compared to the bus topology, a star network generally requires more cable, but a failure in any star network cable will only take down one computer's network access and not the entire LAN. (If the hub fails, however, the entire network also fails.). Star Topology requires more cable length than a linear topology. If the hub, switch, or concentrator fails, nodes attached are disabled. More expensive than linear bus topologies because of the cost of the hubs, etc.

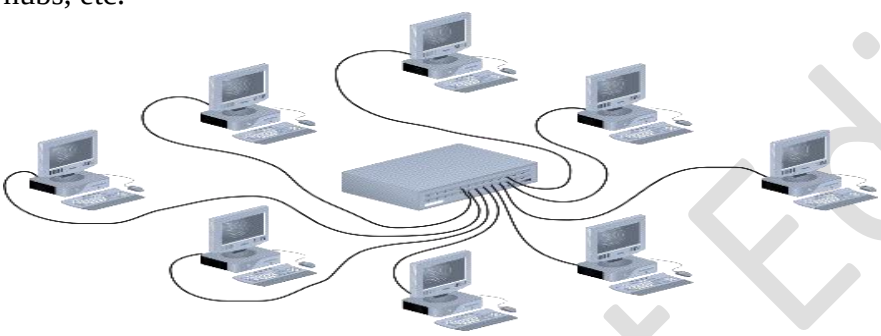


Figure 5.5.3: Star Topology

Advantages of Star Topology:

- Less damage in case of a single computer failure as it does not affect the entire network

Disadvantages of Star topology:

- More cables are required to be connected because each computer individually connects to the central server
- Single point of failure in case the server get down.

3.2.4 Tree Topology

A tree topology joins multiple star topologies together onto a bus. In its simplest form, only hub devices connect directly to the tree bus, and each hub functions as the root of a tree of devices. This bus/star hybrid approach supports future expansion of the network much better than a bus (limited in the number of devices due to the broadcast traffic it generates) or a star (limited by the number of hub connection points) alone.

Advantages of tree topology

- Highly flexible: In tree topology computers can be added by simply adding a hub in a network topology.
- Centralised monitoring: It makes users to control and manage a larger network easily and also it is easy to reconfigure the tree topology.
- Computers have access: Because tree topology is a large network, all computers have better access to the network.
- Point-to-point connection: In tree topology each computer is connected to the hub and also each part of a network is connected to the main cable.
- Tree topology is supported by many hardware and software venders.
- In tree topology it is easy to add a computer by simply extending using cables to connect computers.

Pre-print Edition

Disadvantages of tree topology

- Single point of failure: In tree topology, if the backbone of the entire network breaks both part of the network may not communicate to each other but a part of the network continues to communicate alone.
- Difficult to configure: It is difficult to configure tree topology because is a large topology and also wiring the network is difficult.
- In tree topology, the length of the network is limited by the type of cable to be used on the network.

Usage of tree topology

- It is easy to identify the system in the network and also connect to a larger network.
- To share information across a larger network.
- Tree topology allows the users to have many servers on the network.
- Tree topology reduces network traffic.

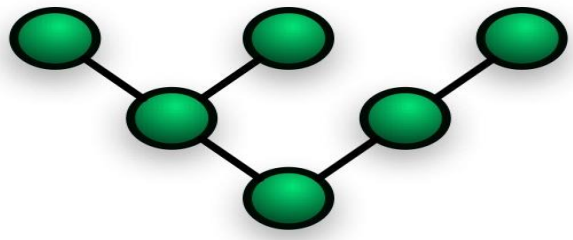


Figure 5.5.4: Tree Topology

3.2.5 Mesh Topology

Mesh topology introduces the concept of routes. Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination. (Recall that even in a ring, although two cable paths exist, messages can only travel in one direction.) Some WANs, most notably the Internet, employ mesh routing. A mesh network in which every device connects to every other is called a full mesh. As shown in the illustration below, partial mesh networks also exist in which some devices connect only indirectly to others.

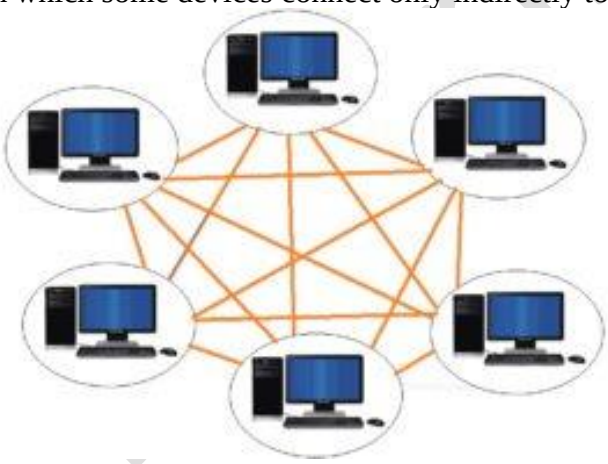


Figure 5.5.6: Mesh Topology

Advantages of Mesh topology

- Adding or removing any device is not effecting the network.
- This creates a large source of data and useful information that many user connected to the network can avail.
- A fault is diagnosed easily.
- Good in security and privacy.
- It is relatively power efficient.

Disadvantages of Mesh topology

First Edition

- In case of wired network, it required cables in bulk.
- Overall cost of this network is way too high as compared to other network topologies.
- Installation can be more difficult.

3.3 Opportunities in Telecommunication Industry

3.3.1 Employment Opportunity

According to the available information, telecommunication industries had provided over 15 million jobs in the last 20 years in Nigeria. Wired telecommunications carriers accounted for about 54% while wireless industry account for the remaining 46%. Telecommunications jobs are found in almost every part of the country, but most employees work in cities that have large concentrations of industrial and business establishments.

3.3.2 Occupations opportunity

Although the telecommunications industry employs workers in many different occupations, but majority of the employment available is in installation, maintenance, and repair occupations or office and administrative support services. Installation, maintenance, and repair occupations. Telecommunications craft workers install, repair, and maintain telephone equipment, cables and access lines, and telecommunications systems, these workers are categorized based on the type of services they rendered. In the industry, telecommunications equipment installers and repairers, install, repair, and maintain the array of increasingly complex and sophisticated communications equipment. Their work includes setting up, rearranging, and removing the complex switching and routing equipment used in central offices. They may also solve network-related problems.

3.3.3 Training and Advancement

Due to rapid changes in technological advancement and introduction of new technologies and services, telecommunication industry is among the most rapidly changing with the current trend, hence the professional in the field must be up-to-date in able to cope with recent changing in the industry. Hence, telecommunications industry employers now look for workers with knowledge of and skills in computer programming and software design; voice telephone technology; laser and fiber optic technology; wireless technology; and data compression. To maintain their skills and stay abreast of new technologies, workers may continue to receive training throughout their careers. Most companies prefer to employ highly specialized skill professional or any staff that require little training instead of a novice in the field of telecommunication.

4.0 Summary

In this unit, you have learnt that:

- The meaning of network topology
- The different types of topology configurations
- The advantages and disadvantages of each configurations

5.0 Self-Assessment

A. List all the types of network topologies.
B. List the advantages and disadvantages of each

6.0 Tutor Marked Assessment

A. With the aid of diagram, explain in detail the bus, mesh and tree topologies
B. Explain the difference between ring and mesh topology
C. As a network engineer, kindly recommend with reason the most suitable kind of topology for a large governmental organization

Pre-Print Edition

7.0 References

Ad-hoc Networks: Fundamental Properties and Network Topologies: Ramin Hekma: Springer, Year: 2006
An Introduction to Computer Networks
Introduction to Distributed Computer Systems : Principles and Features: Ludwik Czaja : Lecture Notes in Networks and Systems: Springer International 2018

8.0 Further reading

https://study.com/academy/lesson/how-star-topology-connects-computer-networks-in-organizations.html

Pre-print Edition