



Odisha State Open University



Commonwealth of Learning

INTRODUCTION TO MULTIMEDIA

Introduction to Computers & Networks



Diploma in
Multimedia and Animation (DMA)

DMA-01
BLOCK-1

Introduction to Multimedia

Block – I: Introduction to Computers & Networks



ଓଡ଼ିଶା ରାଜ୍ୟ ମୁକ୍ତ ବିଶ୍ୱବିଦ୍ୟାଳୟ, ସମ୍ବଲପୁର
ODISHA STATE OPEN UNIVERSITY, SAMBALPUR

Introduction to Multimedia

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Course Overview

Welcome to Introduction to Computer & Networks

Multimedia is a mode of communication in multiple ways (Multi-many, Media- source of communication). For an effective presentation Multimedia is an inevitable part. It has discovered an assortment of application via the level of entertainment till educating. The advancement of web has endlessly expanded interest and need for multimedia knowledge. Multimedia softwares are application, which utilizes various types of data content and its procedure of preparing (e.g. content, audio, designs/graphics, animation, video, interactivity, simulation etc.) for educating or entertaining the client. Multimedia likewise alludes the utilization of electronic media for provision of storage and extensive experience of the multimedia content. It is like conventional blended media in artistic work, however with a more extensive scope and reach. For interactive multimedia the term “rich media” is synonymous. Now a days, multimedia applications are popular among the users particularly learners because adding different media to explain or present a concept, increases the level of perception.

Multimedia Hardware

This course is proposed for individuals whose area of interest is in the field of multimedia and for that they should be aware of the equipment's and its required specifications. A multimedia computer system has the capability to integrate two or more types of media i.e. text, graphics, images, audio, and video to generate, manipulate, store and present to the audience.



Multimedia Software

This course is planned for individuals who need to pursue their career in Multimedia. Multimedia software is an application which is used to create, modify and process different forms of multimedia contents (e.g. text, audio, graphics, animation, video, interactivity, simulation etc.). Multimedia software enables the user to manipulate and generate desired information according the requirement of the content. Multimedia likewise alludes the utilization of electronic media for provision of storage and extensive experienceof the multimedia content.

Multimedia Operating Systems



This course is for individual who wants to explore the boundaries of creativity by using Multimedia operating systems. The operating system provides different type of services concerned with the best utilization of the integral parts of a computer: Memory storage, CPU &entire input & output devices. In case of multimedia production, the Operating System has the great role in processing the multimedia data that needs a lot of computing resources.

Multimedia Communication Systems

This course is planned for individuals who meant to make creation outlines for multimedia. Multimedia presentations are useful in communicating one on one or to a bigger mass with the use of projector,transmitted through web or can be displayed in the local platform using a media player. Broadcast is another form of multimedia communication system such as news, sports, etc. the broadcasting may be live or presented as recording of multimedia presentation. Broadcasts and recordings can be either analog or digitalelectronic media technology. Digital online multimedia may be downloaded or streamed.



This video will provide a brief overview of this course

Topic	YouTube link	QR Code
Video 1 –Hardware and Software Requirement in Multimedia	https://youtu.be/5Mu3phxx7-c	
Video 2 – Impact of Multimedia in Global Communication	https://youtu.be/nOmbOaPLL0w	

Course outcomes

Upon completion of Preproduction you will be able to:



Outcomes

- Learn about Multimedia hardware.
- Learn about Multimedia Software.
- Learn the steps for operating multimedia systems.
- Learn the steps for making communication through multimedia.

Timeframe



How long?

This course will be completed within “1” class.
This course is of “1” credits.
2Hours of study time is required for this unit.



Study skills



Learning about the software options and tools are a part of Multimedia Coaching. But, when it comes to creation of an output, there is no specific ABC formula for doing so. It is just like a painting in which the artists choose the colour and proportion according to the need, not as per a written plan.

In creating outputs for TV, Films etc. we have to utilize the software tools from one corner to another randomly. So for every project, the formula is different. There is no fixed recipe for all kind of output. So, the more and more you learn about the tools and options, you will get variety while creating an output. Each and every option are explained step by step in the course material.

Apart from this course material, the learner has to adopt the tendency of learning from multiple sources i.e.,

- Internet tutorials
- Video tutorials on Youtube
- Collaboration with people working in the industry etc.

Only classroom study will not make you a professional. You have to be active to grab the opportunity of learning wherever you get a chance.



Need help?



Help

In case of any help needed you can browse the internet sites like youtube.com for video tutorials about the subject.

Assignments



Assignments

There will be some assignments are the end of each unit.

These assignments are mostly practical based and should be submitted in CD or DVD. Theoretical assignments are to be submitted neatly written on A4 size sheet.

All assignments will be submitted to respective study centre of Odisha State Open University or as directed by Co-ordinator.

All assignment should be unit wise on separate CD/DVDs clearly mentioning course title and unit on Top. Theoretical Assignment will be neatly filed or spiral bind with cover clearly mentioning necessary information of course, student detail on top.



Assessments



Assessments

There will be “1” assessments for each unit.

All practical assessment will be submitted to OSOU.

Assessment will take place once at the end of each unit.

Learner will be allowed to complete the assessment within stipulated time frame given by the university.

Video Resources



Reading

This study material comes with additional online resources in the form of videos. As videos puts in human element to e-learning at the same time demonstrating the concepts visually also improves the overall learning experience.

You can download any QR code reader from Google Play to view the videos embedded in the course or type the URL on a web browser.



















Getting around this Course material

Margin icons

While working through this Course material you will notice the frequent use of margin icons. These icons serve to “signpost” a particular piece of text, a new task or change in activity; they have been included to help you to find your way around this Course material.

A complete icon set is shown below. We suggest that you familiarize yourself with the icons and their meaning before starting your study.

 Activity	 Assessment	 Assignment	 Case study
 Discussion	 Group activity	 Help	 Note it!
 Outcomes	 Reading	 Reflection	 Study skills
 Summary	 Terminology	 Time	 Tip



Unit-1

Multimedia Hardware

Introduction

Computers are now capable of combining text, sound, images and motion together to form a kind of content called multimedia. A multimedia content may involve one or more of these elements.

Now-a-days, a wide variety of hardware and software tools are available for developing multimedia content. So, for the development of these contents, one has to identify the appropriate hardware to meet the required purpose and quality standard.

The delivery requirement of the project, its content and budget helps to determine the type of hardware that is required for multimedia PC.

In the following unit we shall discuss different hardware types used in multimedia computer systems.

Outcomes

Upon completion of this unit you will be able to:



Outcomes

- Have a conceptual idea on multimedia system, its application and different components.
- Identify and classify different input/output devices in computer systems
- Choose appropriate input/output devices for multimedia development
- List and describe the functions of various communication devices
- Identify various storage devices and their applications for multimedia content



Terminology



Terminology

- keyboard:** It is a device that enables you to enter data into a computer or other devices. Computer keyboards are similar to typewriters but contain additional typing keys.
- RAM:** **Random Access Memory**, a type of computer memory that stores the data at random interval of current usage while operating different system applications which can be quickly accessed by processor to compute faster.
- ROM:** **Read Only Memory**, built-in computer memory containing data that normally can only be read, not written to. ROM contains the programming data that allows your computer to be "booted up" or regenerated each time you turn it on.

A multimedia computer system is a computer system, which has the capability to integrate two or more types of media i.e. text, graphics, images, audio, and video to generate, manipulate, store, represent and access multimedia information. In general, the data size for multimedia information is much larger than textual information, because representation of such varieties of data in digital form requires much larger number of bits than the ones required for representation of plain text.

The current market scenario demands a faster processing computer with large storage capacity and higher speed. So it is necessary to know the components that will make the computer more efficient.

The components of a typical multimedia computer are categorised in to five types, namely Output devices, Input devices, Memory and storage devices and System devices along with Communication devices.



System Devices:

One of the important components of the computer is system devices which include the memory, motherboard as well as the microprocessor; the microprocessor is the heart of the computer. The processor of a computer looks like a small microchip and performs some of the operations of the computer when it is turned on. BIOS, a part of the computer's memory provide instructions to the microprocessor to load the operating system onto the RAM while booting the computer. A motherboard is responsible for containing the basic circuitry as well as the other components of the system like basic input/output system (BIOS), memory, microprocessor, interconnecting circuitry and expansion slots. The expansion slot in the motherboard can also add additional components to the system. RAM (Random Access Memory), also called primary memory is responsible for containing the operating system, data and the application programs which are present in the computer so that they can be accessed easily by the processor when needed. RAM is referred to as "random access" because it allows direct access to the storage locations. The speed of RAM is too faster than the hard disk; the floppy disk and the CD-ROM. RAM and hard disk are the long-term and short-term memory of the computer but it tends to slow down after a certain limit. And since more memory is required while working on the multimedia, the personal computers these days come with 40 GB RAM or more.

A GPU or Graphics Processing Unit in addition, is primarily used for 3-D applications. It is a single-chip processor that creates lighting effects and transforms objects every time a 3D scene is redrawn. These are mathematically-intensive tasks, which otherwise, would put quite a strain on the CPU.

Input Devices:

Those devices which are under the direct control of the user and are used for the purpose of communicating instructions or commands to the computer are referred to as the input devices. The command that they provide to the computer are then processed and the output is transmitted back to the user with the help of output devices.



Classification of Input Devices:

The classification of input devices is as follows:

- The different ways of input (e.g. sound, visual, mechanical motion, audio etc.)
- If the input is continuous (e.g. a mouse position, though digitized is in the form of a discrete quantity; either a high-resolution can be considered as a continuous one or a discrete one (e.g. key press
- Those involved number of degrees of freedom (e.g. the 2D positional input is allowed by many mice and the 3D input is allowed by some devices like the Logitech Magellan Space Mouse)
- Other input gazettes or devices will be basically the pointing devices specify a position in space and that could be again subdivided in accord to the direct and indirect nature of the input device. The input space in case of occurrence of direct input corresponds to that of the display space, i.e. you need to do the pointing in the space where the cursor or the visual feedback is shown.
- Whether the positional information of the input device is absolute (e.g. on a touch screen) or relative (e.g. using a mouse that can be repositioned or lifted)
- **Keyboards**

The most common device which is used to interact with the computer is the keyboard.

Keyboards have different tactile responses (from mushy to firm) and they also have different layouts according to the model of the computer as well as the keyboard.



Title :Keyboard

Attribution :

Source :pexels.com

Link :<https://www.pexels.com/photo/white-computer-keyboard-34490/>

The most 110 style keyboard are the most common ones (which provides 101 keys) but there are different styles available with certain exceptional keys(also), LEDs, and various others features, such as the flexible “ergonomic” styles or food-service applications or plastic membrane cover for industrial. Macintosh keyboards can likewise get easily connected to the Apple Desktop Bus (ADB) and controls the entire forms of input that is providedby the user- from digitizing tablets to mice.

Examples of types of keyboards include

- Computer keyboard
- Keyer
- Chorded keyboard
- LPFK

Pointing devices

A hardware component which helps the client to input spatial (i.e., multi-dimensional and continuous) information to the PC is called as a pointing device. The graphical user interfaces (GUI) or CAD systems help the user to control the computer by providing data to it using physical gestures - point, drag and click. This can be fulfilled when in the surface by moving a hand-held mouse over the surface of the physical desktop and pressing the mouse buttons as and when required.



Title: Light Pen

Attribution: Jess Watters

Source: pexels.com

Link: <https://www.pexels.com/photo/person-holding-white-stylus-768472/>

Examples of common pointing devices include

- Touch screen
- Touchpad
- Trackball
- Space ball - 6 degrees-of-freedom controller
- Mouse
- Graphics tablets (or digitizing tablet) that use a stylus
- Light gun
- Eye tracking devices
- Light pen
- Yoke (aircraft)
- Isotonic joysticks - where the user can freely change the position of the stick,
- Steering wheel - can be thought of as a 1d pointing device
- With more or less constant force
 - Joystick
 - Analog stick
- Jog dial - another 1d pointing device
- Isometric joysticks - where the user controls the stick by varying amount of force they push with, and the position of the stick remains more or less
- Discrete pointing devices
 - Directional pad - a very simple keyboard
 - Dance pad - used to point at gross locations in space with feet
- Constant
 - Pointing stick

High-degree of freedom input devices:

A few devices permit ceaseless continuous degrees of freedom for input, and at some point scan can be utilized as pointing devices. These could be likewise utilized as in different methods it do not reasonably involve pointing at a location in space.



Title :Pointing Devices

Attribution :

Source : pexels.com

Link :<https://www.pexels.com/photo/computer-mouse-equipment-components-42255/>

Composite devices

Joysticks and buttons are some of the input devices which could be joined with a solitary physical device that is called as a composite device. Many gaming devices have controllers like this.

- Game controller
- Gamepad (or joypad)
- Paddle (game controller)
- Wii Remote controller



Title: Game Controller

Attribution:[laleshaldarwish](#)



Source: pexels.com

Link: <https://www.pexels.com/photo/gray-scale-image-of-xbox-game-controller-194511/>

Imaging and Video Input Devices

Flat-Bed Scanners

A scanner proves to be a very important component for producing multimedia projects. There are two types of scanners: flat-bed and hand-held. The most common ones are available in gray-scale but the colour flat-bed ones have a resolution of around 300 or 600 dots per inch (dpi).

The electronic images of the artwork are like the pen drawings, cartoons, photos, ads etc. are cleared with the help of a scanner. In this way the time otherwise required to incorporate proprietary art into the application is saved. Scanners help in starting the creative diversions. The different devices through which videos and images can be captured are:

- Fingerprint scanner
- Image scanner
- Barcode reader
- Webcam
- 3D scanner
 - Medical imaging sensor technology
 - Computed tomography
 - Magnetic resonance imaging

Audio input devices

The devices through which audio can be captured are:

- Microphone
- Speech recognition

Note that through MIDI the musical instruments can also be used as input devices.

Touch screen

Touch screens are monitors that usually have a textured coating across the glass face. This coating is sensitive to pressure

and registers the location of the user's finger when it touches the screen.



Title: Touch Screen

Attribution:

Source: pexels.com

Link: <https://www.pexels.com/photo/laptop-technology-ipad-tablet-35550/>

Other touch screens which are present use invisible beams of infrared light which appear in a crisscross pattern in front of the monitor in order to calculate the position where the cursor has been pointed. A mouse click and drag can be done here by double-clicking over the screen and then dragging the cursor, without lifting it, to a different area.

Output Devices:

Certain hardware devices are used as components of a multimedia project for the presentation of the audio as well as visual components. These devices include the computer itself as well as the amplifiers, speakers, motion video devices, monitors and the other capable storage systems.

Audio Devices

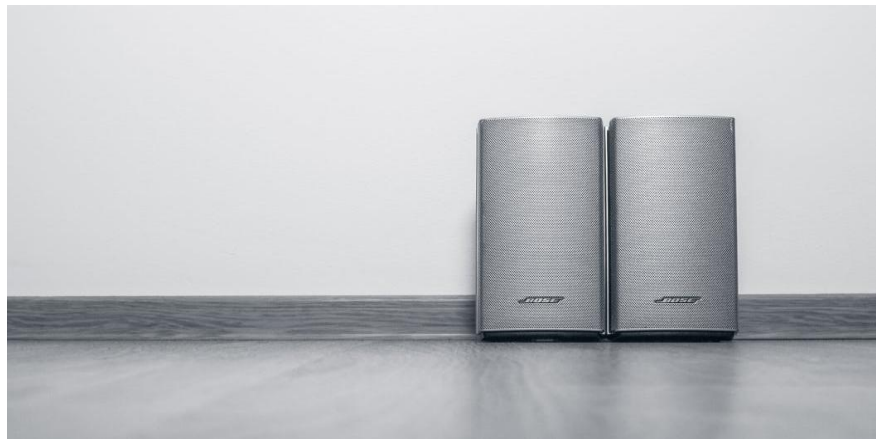
All Macintoshes have internal speakers along with a dedicated sound chip which provide the audio output without the need of any additional software or hardware. The built-in stereo sound can be utilized properly with the help of external speaker.

Amplifiers and Speakers

Often it happens that the speakers which are utilized during the development of a project are inadequate. The built-in amplifiers in the speakers or which are attached to the external amplifiers are



used to present the project before a substantial gathering of people in a noisy setting.



Title : Speakers

Attribution :

Source :pexels.com

Link :<https://www.pexels.com/photo/black-and-white-bose-floor-music-75509/>

Monitors

The monitors which are used in the multimedia projects depend on the types of computer which is used in the project. Different types of high-end monitors with large-screen graphics will be accessible by both Macintoshes and PCs but they are a bit expensive.



Title : Monitor

Attribution :

Source : pexels.com

Link:<https://www.pexels.com/photo/apple-technology-ipad-computer-38568/>

Video Device

The visual impact to the video is provided by this contemporary message medium. The digitizing board on the computer is used to display a television picture on it. The frame-grabber in the boards is used to capture the image so that they can be converted into a colour bitmap and then saved as a PICT or TIFF file. This can be then utilized as a background or graphic in the project.

Projectors

The viewers need to huddle around the computer monitor when something is shown to them. So a projector is used to project the information on the large screen or on the white wall. The information is displayed onto a large screen through a Cathode Ray Tube (CRT) projectors, the liquid crystal display (LCD) which are attached to the stand-alone LCD projectors, light-valve projectors and overhead projectors.

CRT projectors are compatible and provide outputs which are similar to television.

The LCD panels are portable devices. The small LCD panels are popular for on-the-road presentations as they can be connected to a laptop computer with the help of an overhead projector which are locally available.



Title:LCD Projector

Attribution:ThamizhpparithiMaari

Source:wikimedia.org

Link:https://commons.wikimedia.org/wiki/File:%22LCD_Projector%22.jpg



Printers

As the reasonably priced colour printers entered into the market, the hard-copy of the output could be obtained. The colour printers provide the storyboards, presentations, produce the collateral marketing material for the multimedia development environment. The colour in the output helps to elucidate ideas, enhance understanding and retention of data as well as helps to organize complex data. The multimedia designers use colours in an intelligent way for the project to succeed. A Tektronix provides solid ink and laser alternatives, and either Phases 560 would be printing more than 10000 pages in an speed of of 5 colour pages or 14 monochrome pages per minute before the requirement of a new toner.

Multimedia Storage Systems:

To keep in pace the need and habits of computing more of storage and memory space is needed to be added to the computer, the main aim will be to increase the capacity of the computer.

In an event that in the project of your making of multimedia, you will likewise require to distribute or provide memory for storing and archiving worked or working files utilized while production, edited pieces, original video and audio clips and final blended pieces, creation of printed material and correspondence, and no less than one backup of your project files, with you need to store a sa second backup in any other location.

Before going to study different types of storage systems and their capacity, we should discuss the units in which their capacity is measured.

The capabilities of storage devices are measures using the following units.

Bit: A bit is a value of either a 1 or 0 (on or off).

Nibble: A Nibble is 4 bits.

Byte: A Byte is 8 bits.

1 character, e.g. "a", is one byte.

Kilobyte (KB): A Kilobyte is 1,024 bytes.

- 2 or 3 paragraphs of text.

Megabyte (MB)



A Megabyte is 1,048,576 bytes or 1,024 Kilobytes

- **873** pages of plaintext (1,200 characters)
- **4** books (200 pages or 240,000 characters)

Gigabyte (GB)

A Gigabyte is 1,073,741,824 (2^{30}) bytes. 1,024 Megabytes, or 1,048,576 Kilobytes.

- **894,784** pages of plaintext (1,200 characters)
- **4,473** books (200 pages or 240,000 characters)
- **640** web pages (with 1.6MB average file size)
- **341** digital pictures (with 3MB average file size)
- **256** MP3 audio files (with 4MB average file size)
- **1** 650MB CD

Terabyte (TB)

A Terabyte is 1,099,511,627,776 (2^{40}) bytes, 1,024 Gigabytes, or 1,048,576 Megabytes.

- **916,259,689** pages of plaintext (1,200 characters)
- **4,581,298** books (200 pages or 240,000 characters)
- **655,360** web pages (with 1.6MB average file size)
- **349,525** digital pictures (with 3MB average file size)
- **262,144** MP3 audio files (with 4MB average file size)
- **1,613** 650MB CD's
- **233** 4.38GB DVD's
- **40** 25GB Blu-ray discs

Petabyte (PB)

A Petabyte is 1,125,899,906,842,624 (2^{50}) bytes, 1,024 Terabytes, 1,048,576 Gigabytes, or 1,073,741,824 Megabytes.

- **938,249,922,368** pages of plaintext (1,200 characters)
- **4,691,249,611** books (200 pages or 240,000 characters)
- **671,088,640** web pages (with 1.6MB average file size)
- **357,913,941** digital pictures (with 3MB average file size)
- **268,435,456** MP3 audio files (with 4MB average file size)
- **1,651,910** 650MB CD's
- **239,400** 4.38GB DVD's
- **41,943** 25GB Blu-ray discs



Exabyte (EB)

An Exabyte is 1,152,921,504,606,846,976 (2^{60}) bytes, 1,024 Petabytes, 1,048,576 Terabytes, 1,073,741,824 Gigabytes, or 1,099,511,627,776 Megabytes.

- **960,767,920,505,705** pages of plaintext (1,200 characters)
- **4,803,839,602,528** books (200 pages or 240,000 characters)
- **687,194,767,360** web pages (with 1.6MB average file size)
- **366,503,875,925** digital pictures (with 3MB average file size)
- **274,877,906,944** MP3 audio files (with 4MB average file size)
- **1,691,556,350** 650MB CD's
- **245,146,535** 4.38GB DVD's
- **42,949,672** 25GB Blu-ray discs

Zettabyte (ZB)

A Zettabyte is 1,180,591,620,717,411,303,424 (2^{70}) bytes, 1,024 Exabytes, 1,048,576 Petabytes, 1,073,741,824 Terabytes, 1,099,511,627,776 Gigabytes, or 1,125,899,910,000,000 Megabytes.

- **983,826,350,597,842,752** pages of plaintext (1,200 characters)
- **4,919,131,752,989,213** books (200 pages or 240,000 characters)
- **703,687,443,750,000** web pages (with 1.6MB average file size)
- **375,299,970,000,000** digital pictures (with 3MB average file size)
- **281,474,977,500,000** MP3 audio files (with 4MB average file size)
- **1,732,153,707,691** 650MB CD's
- **251,030,052,003** 4.38GB DVD's
- **43,980,465,111** 25GB Blu-ray discs



Yottabyte (YB)

A Yottabyte is 1,208,925,819,614,629,174,706,176 (2^{80}) bytes, 1,024 Zettabytes, 1,048,576 Exabytes, 1,073,741,824 Petabytes, 1,099,511,627,776 Terabytes, 1,125,899,910,000,000 Gigabytes, or 1,152,921,500,000,000,000 Megabytes.

- **1,007,438,183,012,190,978,921** pages of plaintext (1,200 characters)
- **5,037,190,915,060,954,894** books (200 pages or 240,000 characters)
- **720,575,937,500,000,000** web pages (with 1.6MB average file size)
- **384,307,166,666,666,666** digital pictures (with 3MB average file size)
- **288,230,375,000,000,000** MP3 audio files (with 4MB average file size)
- **1,773,725,384,615,384** 650MB CD's
- **257,054,773,251,740** 4.38GB DVD's
- **45,035,996,273,704** 25GB Blu-ray discs

Memory and storage devices:

A computer memory refers to the physical devices used to store programs (sequences of instructions) or data (e.g. program state information) on a temporary or permanent basis for use, in a computer or other digital electronic device.

A computer system memory is divided into two parts:

- Read Only Memory (ROM) and
- Random Access memory (RAM) which is better known as Read Write Memory (RWM).

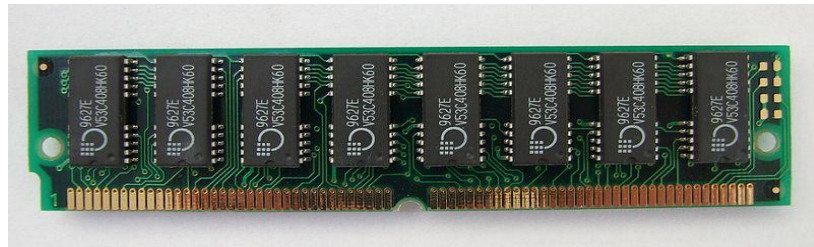
Random Access Memory (RAM)

A RAM memory chip is an integrated circuit (IC) made of millions of transistors and capacitors. In the most common form of computer memory, dynamic random access memory (DRAM), a



transistor and a capacitor combines to create a memory cell, which represents a single bit of data.

RAM is the vital memory where initially the Operating system is loaded and at a later stage the application programs are loaded. RAM is known to be volatile. Whenever a program is ended the RAM erases it out of its memory. The RAM capacity is directly proportional to the processing speed i.e. If the RAM capacity is more, the processing speed will be higher.



Title : RAM

Attribution : Appaloosa

Source : [wikimedia.org](https://commons.wikimedia.org/wiki/File:PS2_RAM_Module.jpg)

Link : https://commons.wikimedia.org/wiki/File:PS2_RAM_Module.jpg

Read-Only Memory (ROM)

Read-only memory is basically non-volatile. It never loses its memory even after the power to a ROM chip is turned off so its different from RAM. ROM is normally utilized as a part of PC in order to held fixed applications such as the small BIOS program that is used at first to boot up the computer and also utilized as a part of printers in order to held inbuilt fonts. Programmable ROMs (called EPROM's) are such in which the changes made cannot be changed and are permanent. Another new and economical innovation technology, optical read-only memory (OROM), is given in proprietary information cards that utilizes licensed holographic storage. Commonly, OROM offers storage of 128MB (units), it does not have any mobile parts and use only about 200 milliwatt

of power. It is perfect for devices that are handy and battery-



operated gadgets.

Title : ROM

Attribution : RaimondSpekking

Source : wikimedia.org

Link: [https://commons.wikimedia.org/wiki/File:Elitegroup_761GX-M754_-_AMIBIOS_\(American_Megatrends\)_in_a_Winbond_W39V040APZ-5491.jpg](https://commons.wikimedia.org/wiki/File:Elitegroup_761GX-M754_-_AMIBIOS_(American_Megatrends)_in_a_Winbond_W39V040APZ-5491.jpg)

The storage devices can be divided into the following categories:-

Hard Disks

A hard disk is part of a unit, often called a "disk drive," "hard drive," or "hard disk drive," that store and provides relatively quick access to large amount of data on an electromagnetically charged surface or set of surfaces. Today's computers typically come with a hard disk that contains several billion bytes (gigabytes) of storage.



Title : HARD DISK DRIVE

Attribution : [Azz Bad](#)

Source : pexels.com

Link : <https://www.pexels.com/photo/analogue-business-close-up-computer-117729/>



A hard disk is extremely an arrangement of stacked "disks," each of which, similar to phonograph records, has information recorded electromagnetically in concentric circles or "tracks" on the disk. A "head" (like a phonograph arm but in a generally fixed position) records (writes) or reads the data on the tracks. Two heads, one on each side of a disk, read or write the data as the disk spins. Each read or write operation requires that data be located, which is an operation called "seek" (Data already present in a disk cache, however, will be located more quickly).the hard disks are well known widely recognized mass-storage device utilized on PC's, and while creation of multimedia projects, it is important that one should have at least one huge limit or capacity of drives of hard disk.

Zip, jaz, SyQuest, and Optical storage devices

SyQuest the cartridges that can be removed of 44MB that is generally utilized versatile medium, portable medium within multimedia professionals & developers. Iomega has economical Zip drives with their in like manner cheap 100MB cartridges. They have altogether entered market share of SyQuest's for removable media. Iomega's Jaz cartridges has a provision of gigabyte of removable storage media and also provides quicker rate of transfer for audio and video improvement and better production. Yamaha, Pinnacle Micro, Philips, Sony, , and others provides CD-R "burners" in order to create write-once compact discs, and some double as quad-speed players. As blank CD-R disc are modest so the write-once media contends as a vehicle used for transfer and distribution. Compact disc R is depicted in more noteworthy detail in the content in later part.

Digital Versatile Disc (DVD)

In December 1995, nine noteworthy electronics organizations (Matsushita, Toshiba, Philips, Sony, Pioneer, JVC, Mitsubishi Electric, Time Waver, and Hitachi) consented to advance another new optical disc technology for circulation of multimedia and DVD (also known as feature-length movies).

The newly developed medium is competent of storing gigabyte capacity as well as entire movie (MPEG2) along with large-quantity of audio in surround sound. The level rose for multimedia developers. Commercial multimedia projects became even more costlier as production has turned out to be more costly to create as consumers or buyer's expectations rose. There are two sorts of



DVD-DVD-Video and DVD-ROM; these mirror the advertising marketing channels, but the innovative technology used differs.

CD-DVD ROM Players

Compact disc read-only memory (CD-ROM) and Digital versatile disk read-only memory (DVD-ROM) players have turned into a basic piece of the multimedia development workstation. They are a vital conveyance medium for substantial, projects that require massive production. A vast assortment of graphic backgrounds, utilities of developer, stock applications & photography, games, sounds, educational software, and reference texts are accessible just using this media.

Compact disc ROM players are commonly too slow for accessing and transmitting the data (150k per second that is the basic speed required for consumer Red Book Audio CDs).

DVD-ROM players perform better than CD-ROM players as well as it offers more storage space in order to access the content.

CD or DVD Recorders/Writers

You can make your own CDs and DVDs, with a disc recorder. Making own CDs and DVDs require the use of special CD recordable (CD-R) or DVD recordable (DVD-R) blank optical discs in order to produce a disk in different formats for storing data or digital content. Software, such as Adaptec's Toast for Macintosh or Easy CD Creator for Windows, enables to arrange documents on the hard disk(s) into a "virtual" structure, and after that in the same order write those in the CD. They could be accessible as indicated by recording time, in either a "63 minute" or "74 minute" limit with respect to the previous, that implies around 560MB, and for the last mentioned, around 650MB.

CD-ROM

A Compact Disc or CD was originally developed for storing digital audio. This is basically an optical disc that are utilized store digital data. Till date the CD, available in the market since late 1982, remains the standard playback medium for commercial audio recordings, though in recent years it has lost ground to MP3 players.



An audio CD consists of one or more stereo tracks stored using 16-bit PCM coding at a sampling rate of 44.1 kHz. Standard CDs configuration is that it has a diameter of 120 mm and can hold approximately 80 minutes of audio.

CD-ROM History

To design an innovative digital audio disc, in 1979, Philips and Sony set up a joint task force of engineers. The CD was initially thought of as a development of the gramophone record, instead of principally as a data storage medium. Sony and Philips in 1990, introduced CD-Recordable and in June 1985, developed the CD-ROM (read-only memory).

Physical details of CD-ROM

A Compact Disc is produced using a 1.2 mm thick disc of relatively pure polycarbonate plastic and weighs around 16 grams. A thin layer of aluminium (or, more rarely, gold, utilized for its longevity, such as in some restricted version-edition audiophile CDs) is applied to the surface which makes it reflective, and is protected by a film of lacquer. The areas between pits are known as "lands". Each pit is approximately 100 nm deep by 500nm wide, and varies from 850 nm to 3.5 μ m in length.

Disc Shapes and Diameters

On a CD the digital data writing starts with the centre of the disc and continues outwards to the edge. It enables adjustment to the diverse size formats accessible. Basically the Standard CD's are accessible in two sizes. By and large the most well-known is 120 mm in diameter, with a 74 or 80-minute audio capacity and a 650 or 700 MB data capacity. Originally 80 mm discs ("Mini CDs") were designed for CD singles and can hold up to 21 minutes of music or 184 MB of data but never been so noticeable or popular.

Logical formats of CD-ROM

Audio CD

In 1980, the logical format of an audio CD (officially Compact Disc Digital Audio or CD-DA) is described in a document. It was given by the joint creators, Sony and Philips who gave the format. The document is known colloquially as the "Red Book" after the colour of its cover. The format is a two-channel 16-bit PCM encoding at a



44.1 kHz sampling rate. Within the Red book format four-channel sound is an allowed option, but has never been implemented.

CD-Text

Compact disc Text is an augmentation of the Red Book specification for audio CD that enables for storage of extra content data (e.g., album name, song name, and artist) on a standard principles agreeable to an audio CD. The data is stored either in the lead-in area of the CD, where there is approximately five kilobytes of room accessible, or in the sub code channels R to W on the disc, which can store around 31 megabytes.

CD + Graphics: [Compact Disc + Graphics (CD+G)] these are a specialized audio compact disc that consists of graphic data apart from the audio data on the disc. To play the disc a regular audio CD player can be used.

CD + Extended Graphics: [Compact Disc + Extended Graphics (CD+EG, also known as CD+XG)] these are an enhanced variation of the Compact Disc + Graphics (CD+G) format. Like CD+G, CD+EG utilizes essential CD-ROM highlights to show content and video data. It can likewise play the music. This additional information is stored in sub code channels R-W.

CD-MIDI: Compact Disc MIDI or CD-MIDI is a kind of audio CD that is used to record sound in MIDI format, other than the PCM format of Red Book audio CD. Utilizing the MIDI format gives considerably more noteworthy capacity in terms of playback duration, however its playback is commonly less sensible than PCM playback.

Video CD: Video CD (otherwise known as VCD, View CD, Compact Disc digital video) is a standard digital format for storing video on a Compact Disc. VCDs are playable in committed VCD players. They can likewise be played in the greater part of the advanced DVD-Video players, and some video game consoles.

Super Video CD: Super Video CD (Super Video Compact Disc or SVCD) is a format basically utilized on standard compact discs for storing video. SVCD was proposed as a successor to Video CD. It is a superior variant to DVD-Video, and falls somewhere close to both regarding to technical capability and picture quality. Over 100 minutes of video onto one SVCD bring about critical quality loss, and numerous hardware players can't play video with a prompt bitrates lower than 300 to 600 kilobits per second.



Photo CD: Kodak designed Photo CD that is basically a system for digitizing and storing photos in a CD. In 1992 the discs were launched; using special proprietary encoding this design could hold nearly 100 scanned prints, high quality images, and slides. Photo CD discs are characterized and defined in the Beige Book and comply with the CD-ROM XA as well as CD-i Bridge specifications. Irrespective of the operating system they are intended to play on CD-i players, Photo CD players and any computer with the suitable software. With a special Kodak machine the images can also be printed out on photographic paper

Picture CD: following on from the earlier Photo CD product, Kodak has developed another is another photo product i.e. Picture CD. Using JPEG compression it holds photos from a single roll of colour film, stored at 1024×1536 resolution. The product is targeted for the consumers.

CD Interactive: For CD-i players Philips "Green Book" designed and specifies the standard for interactive multimedia Compact Discs. This Compact Disc format is not usual as it hides the initial tracks which contain the software and data files utilized by CD-i players by precluding the tracks from the disc's Table of Contents. As a result of which the audio CD player's skip the CD-i data tracks. This is not quite the same as the CD-i Ready format, which puts CD-i software and data into the pre gap of Track 1.

Enhanced CD: Enhanced CD, otherwise called CD Extra and CD Plus, is a of the Recording Industry Association of America issued a certification mark known as Enhanced CD for numerous technologies that combine audio and computer data for both compact disc and CD-ROM players.

Recordable CD: Recordable compact discs or CD-Rs are injection moulded with a "blank" data spiral. The discs are metalized and coated with lacquer after application of photosensitive dye. To allow the read laser of a standard CD player to see the data on the injection moulded compact disc the write laser of the CD recorder changes the colour of the dye. Henceforth the resultant discs can be played in several (but not all) audio CD players and read by most (but not all) CD-ROM drives.

Recordable Audio CD: The Recordable Audio CD is developed to be utilized in a consumer audio CD recorder, which would not (without modification) acknowledge standard CD-R discs. SCMS (Serial Copy Management System) is used by these consumer



audio CD recorders. To conform to the AHRA (Audio Home Recording Act), it is an early form of digital rights management (DRM)

Rewritable CD: CD-RW is a re-recordable medium that uses a metallic alloy instead of a dye. The writelaser in this case is used to heat and alter the properties (amorphous vs. crystalline) of the alloy, and hence change its reflectivity. A CD-RW does not have as great a difference in reflectivity as a pressed CD or a CD-R, and so many earlier CD audio players cannot read CD-RW discs, although later CD audio players and stand-alone DVD players can. CD-RWs follow the Orange Book standard.

DVD: DVD (also known as "Digital Versatile Disc" or "Digital Video Disc") is a popular optical disc storage media format. It is mainly used for video and data storage. Despite of being of same dimensions as compact discs (CDs) most DVDs store more than six times the data.

Variations of the term DVD frequently depict the way information is stored on the discs like:

- DVD-RAM or DVD-RW holds data that can be re-written multiple times.
- DVD-ROM has data which can only be read and not written , and
- DVD-R can be written once and afterward works as a DVD-ROM.



Title :DVD

Attribution :Public Domain Pictures

Source :pexels.com

Link :<https://www.pexels.com/photo/abstract-art-background-blank-270456/>



DVD disc capacity

Physical size	Single layer capacity		Dual/Double layer capacity	
	GB	GiB	GB	GiB
12 cm, single sided	4.7	4.37	8.54	7.95
12 cm, double sided	9.4	8.74	17.08	15.90
8 cm, single sided	1.4	1.30	2.6	2.42
8 cm, double sided	2.8	2.61	5.2	4.84

The 12 cm type is a standard DVD, and the 8 cm variety is known as a mini-DVD. These are the same sizes as a standard CD and a mini-CD.

Example: A disc with 8.5 GB capacity is equivalent to: $(8.5 \times 1,000,000,000) / 1,073,741,824 \approx 7.92$ GB.

DVD recordable and rewritable

To store data for back-up and transport which was a major need HP initially developed recordable DVD media. Even today the DVD recordable is utilized for consumer audio and video recording.

Three formats were created:

- DVD+R/RW (plus),
- DVD-RAM,
- DVD-R/RW (minus/dash).

Dual layer recording

When compared with 4.7 Gigabytes for single layer discs, Dual Layer recording enables DVD-R and DVD+R discs to store comparatively more information, up to 8.5 Gigabytes per side, per



disc. Pioneer Corporation for the DVD Forum developed DVD-R DL, Philips and Mitsubishi Kagaku Media (MKM) for the DVD+RW Alliance developed DVD+R DL

DVD-Video: DVD-Video is a standard for storing video content on DVD media.

Most consumer DVD-Videodiscs use either anamorphic 16:9 or 4:3 aspect ratio MPEG-2 video, stored at a resolution of 720×576 (PAL) or 720×480 (NTSC) at 24, 30, or 60 FPS even if many resolutions and formats are supported. The Digital Theatre System (DTS) or Dolby Digital (AC-3) formats, ranging from 16-bits/48kHz to 24-bits/96kHz format with monaural to 7.1 channel "Surround Sound" presentation, and/or MPEG-1 Layer 2 is utilized to store audio. Many DVD players support all possible formats even after the variations in specifications for video and audio requirements by global region and television system. Many features like menus, selectable subtitles, multiple camera angles, and multiple audio tracks is supported by DVD-Video.

DVD-Audio: In order to deliver high-fidelity audio content on a DVD a special format is developed known as DVD-Audio. At various sampling frequencies (up to 24-bits/192kHz versus CDDA's 16-bits/44.1kHz) it offers many channel configuration options (from mono to 7.1 surround sounds).

Competitors and successors to DVD: There are many conceivable successors to DVD. They are being created by various consortia to fulfill the need to store vast measure of information. Toshiba's HD DVD and 3D optical data storage and Sony/Panasonic's Blue-ray Disc (BD) are being effectively developed.

The up and coming age of DVD will be HD DVD.

Communication devices

The role of a modem is to modulate those digital signals that goes out from a computer or other digital device to analog form for a telephone line and demodulates the analog signal to convert it to a digital signal that is to be inputted in a computer. Most new PCs accompany with 56 Kbps modems. Modems help your PC to interface with a network.



Configuration of a multimedia Computer

A decent multimedia system framework ought to have a Pentium 3.0 GHz (or the one with similar capabilities) onwards processor,

- 1TB onwards hard disk drive,
- 3 button mouse and a touch panel.
- 19 inch onwards LED monitor,
- 1GB VRAM PCI express card (GPU),
- no less than 4GB of RAM,
- Dual Layer DVD Writer,
- a 5:1 or 7:1 bit sound card,
- Standard Multimedia keyboard,
- high wattage sub-woofer speakers,

On the off chance that you wish you can include a scanner, printer, digital camcorder and a video-capture card. Note that, there is no set rule to characterize the correct hardware combination of a decent multimedia computer.

The combination relies on the nature and contents of the multimedia project that is dealt with. Luckily, hardware tools exist for performing performing any activity; one needs to be wise to select and use only that hardware, which satisfies and suits your need.



Unit summary



Summary

In this unit we have explained the applications of different input, output and the storage devices used in multimedia systems. The input devices help you to feed the multimedia data in to the computer systems and the output devices display or print the multimedia data. The RAM is a storage device for temporary storage which is used to store all the application programs under execution. The secondary storage devices are used to store the data permanently. The storage capacity of secondary storage is more compared to RAM. CDs and DVD's are optical storage devices used for storage of multimedia content for distribution purposes.

Assignments



Assignments

1. What is an input device? List any four input devices.
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.....
.....
.....
.....
2. What are the functions of output devices? List any three output devices.
.....
.....
.....
.....
.....
3. List any five storage devices and specify their storage capacity.
.....
.....
.....
.....
.....



4. List the different CD-ROM formats.

.....
.....
.....
.....

5. What are the different storage capacities available in a DVDs:

.....
.....
.....

Resources

Resources



1. Tay Vaughan, "Multimedia Making it work" , Mc Grow Hill, Eighth Edition
2. Jeffcoat , "Multimedia in Practice – Technology and applications" By Jeffcoat.
3. <http://www.wacona.com/input/input.html>
4. www.webopedia.com/TERM/I/input_device.html
5. http://en.wikipedia.org/wiki/Input_device
6. Storage: From Floppy to DVD
7. Steinmetz and Klara Nahrstedt, "Multimedia Computing, Communication and application"
8. Setrag Khoshafian, A. Brad Baker. "Multimedia and Imaging Databases"
9. <http://en.wikipedia.org/wiki/Image:CDTXlogo.svg>
10. <http://www.toptenreviews.com/computers/desktops/best-multimedia-computers>



Unit - 2

Multimedia Software

Introduction

The mix of texts sound, animation, graphics and video refers as Multimedia. Multimedia is a fundamental component in a significant number of the other programming applications. For instance, desktop publishing documents and word processing can be improved with charts, photos and graphics. Presentations can be can be additionally energizing when they incorporate sound and animation.

Multimedia software can be can be engaging and valuable. One while browsing a disc related to zoo can actually view the clipping along with the sound effects of animal, on the computer can play music, one can hear well known recordings or famous speeches, see a video clip related to historic event, can know about the working of a car engine by watching its animation, can hear the exact pronunciation of a phrase or word, see shaded photos of popular masterpieces or scenes from nature, tune in to the sounds of various melodic instruments, hear works of music by prestigious music composers, or watch a film on your PC.

Outcomes

Upon completion of this unit you will be able to:



Outcomes

- Describe the fundamentals of Software
- Differentiate between various types of Software
- Write the basic operation of Software
- Explain the fundamentals of computer Paint Brush
- Analyze the Specification and Design of Multimedia Software Systems
- List the Different types of Animation Software
- Describe the Software Licensure Agreement



Terminology



Terminology

Software:	It consists of computer programs, which are sequences of instructions for the computer. The process of writing (or coding) programs is called programming, and individuals who perform this task are called programmers.
System Software:	It is a set of instructions that serves primarily as an intermediary between computer hardware and application programs, and may also be directly manipulated by users.
Application Software:	It is a set of computer instructions that provide more specific functionality to a user.

In the beginning of computing, a large portion of the data comprised of content or text and numbers. Nonetheless, from that point onwards photograph, video and audio have turned into an essential piece of utilizing PC frameworks. Relatively every site you visit utilizes some type of audio- visuals. A significant number of the posts via web-based networking media utilize imagination or symbolism. Media services, for example, Netflix and YouTube now represent a considerable segment of the world's Internet traffic.

The audio and video software are divided in to two general categories:

- media players that only provide playback options and
- Software that can be used to record and edit audio and video.

Media Players: it is basically an application of the software to playback the multimedia files along with the audio and/or video. Some media players concentrate only one type like either audio players or video players while most of the media players has developed players that can play both audio and video.

Audio Software: For professionals high end audio systems are developed known as digital audio workstations. **Digital audio editor** are the software to edit and record audio.



Audio can comprise of just talked content, for example, the portrayal of this video, or music and other sound impacts. A digital audio editor typically contains normally contains capacities for the accompanying undertakings:

- Mix multiple tracks to get one output track
- Edit sound clips by removing certain parts, exchanging the order of clips, etc.
- Apply effects, such as noise reduction and equalization, to improve quality
- Convert different formats
- Record audio from various input sources

Video Software: Video editing software comprises of the software for video editing for its post-production. The source material is gathered by advanced camcorders, and after that imported into the product for altering and editing.

Apart from these, authoring software is available by using which one can create multimedia applications involving different media. Ex : Author ware professional.

Fundamental Software

Software consists of computer programs, which are sequences of instructions for the computer. The process of writing (or coding) programs is called programming, and individuals who perform these tasks are called programmers.

The computer can only do a certain task when it is instructed by any software. Although computer hardware is, by design, general purpose, software enables the user to instruct a computer system to perform specific functions that adds to the business value.

There are three types of software: System software, Application software and Utility Software.

System software: System software is a set of instructions that serves primarily as an intermediary between computer hardware and application programs, and might get directly manipulated by users. System software provides important self-regulatory functions for computer systems, such as loading itself when the computer is switched on, managing hardware resources such as secondary storage for all applications, and provides for



commonly used sets of instructions for all applications. System programming is either the creation or maintenance of system software.

Few examples of system software are:

- Operating system
- Programming language translators
- Communication software
- Compilers and Interpreters
- Command line shell

Features of system software are as follows:

- Close to system
- Fast in speed
- Difficult to design
- Difficult to understand
- Less interactive
- Smaller in size
- Difficult to manipulate
- Generally written in low-level language

System Control Programs

Operating system is the fundamental system control programme. The main role of the system control programme is to establish control over the utilization of the software, hardware and information resources of the computer system. The entire operation of the PC, including checking the PC's status and booking operations, which incorporate the input and output processes is supervised by the operating system. Apart from this, the operating system assigns CPU time and main memory to programs those running on the computer, and it likewise gives an interface between the hardware and the user. Because of this interface complexity of the hardware is hidden from the user. So that you don't have to enter over the details of how a hard ware works, you will be concerned mainly what the hardware will do and what you are supposed to do to obtain the end results. The operating system gives benefits that incorporate virtual memory, process management, security, file management, adaptation to internal failure, and the user interface.



Process management

The term Process management implies in dealing with the programs (also named as jobs) that runs on the processor at an allocated time. Let's take a simple example (a desktop operating system), here the operating system executes after loading a program into its main memory. The program uses the PC's assets until the point when it surrenders control. More refined types of process management, such as multithreading, multitasking, and multiprocessing are offered by some operating systems.

Multitasking, or multiprogramming is basically in the same time managing two or more jobs running simultaneously on the computer system. The first program is executed until the point that an interference happens, for example, a demand for input. While the input command is dealt with the execution of the second next programs start. Since switching across the programs occurs so rapidly, they appear to be executing at the same time. But, since there is only one processor, at a time only a single program can be executed. Whereas Multi-threading is a type that concentrates on running multiple tasks inside a single application at the same time. For instance, a word processor application while editing one document simultaneously another document is being spell-checked.

Application software: It is a set of computer instructions that executes specific functions for a user. These functions may be broad or narrow, like general word processing and an organization's payroll respectively. Application programming is creation, modification or improvisation of application software. There are various programming applications being used which we will cover them in this part. An application program applies on a computer for specific commands. For an application like marketing, for instance, see the 'Market Intelligence box' on a site.

Few examples of application software are:

- Word processing software
- Spreadsheet software
- Database software
- Education software
- Entertainment software

Features of application software are as follows:



- Close to user
- Easy to design
- More interactive
- Slow in speed
- Generally written in high-level language
- Easy to understand
- Easy to manipulate and use
- Bigger in size and requires large storage space

Utility software: It is a collection of one or more programs that helps the user in performing and maintaining tasks that are routine in nature. Utility programs help the users in disk formatting, data compression, data backup, scanning for viruses etc.

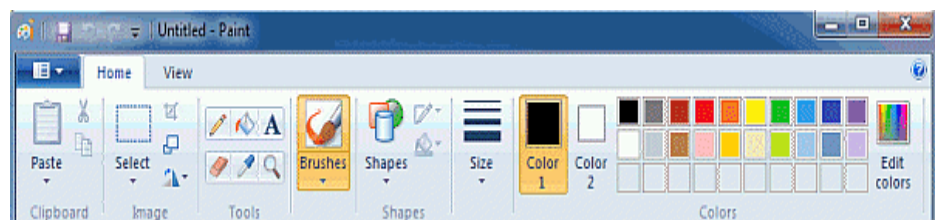
Few examples of utility software are:

- Anti-virus
- Registry cleaners
- Disk defragmenters
- Data backup utility
- Disk cleaners

Basic Unit of Software

Drawing Simple Picture Using Ms-Paint

The Paint Window: You can view this on of the top of the Paint window.



The Title Bar



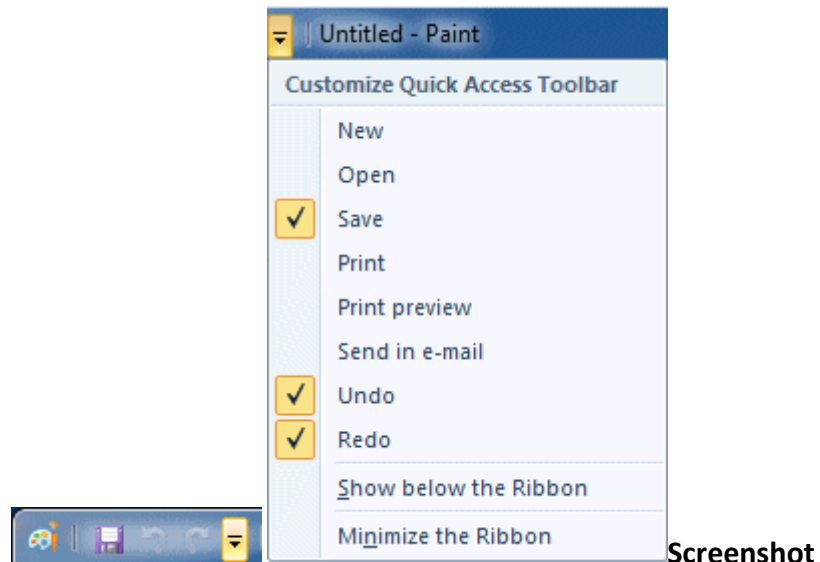
In title bar in its extreme left end the first item visible is a small paint palette. Clicking over this button a standard window



menu will be opened. The window contains options like Restore, Move, Size, Minimize, Maximize and Close.

The other four items make up the **Quick Access Bar**, containing buttons for **Save, Undo, Redo** and **Customize**.

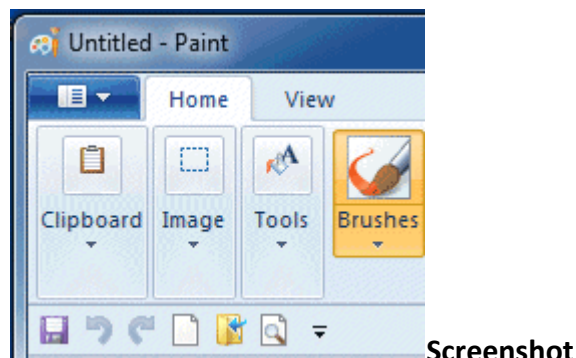
How we are going to move the Quick Access Toolbar to below the Ribbon



Screenshot

If you want that the **Save, Undo** and **Redo** beneath the ribbon, you need to light up the customize icon for this the cursor needs to be moved over the left end of the title bar till the **Customize** icon lights up. Click on **Customize** and you can see an appearance of a menu.

A menu has an option **Show below the Ribbon** which can be seen near the bottom. Click on the **Show below the Ribbon**.



Screenshot

According to your wish you can add other commands also that are there. Suppose I choose to add **New**—for adding a new



Paint page, or **Open**—to open a page that is saved previously and closed picture and **Print Preview** for a pre-view of the picture.

Adding Ribbon items to the Quick Access Toolbar



Many other items can also be added to the Quick Access Toolbar. Right click on items you want to add to the Quick Access Toolbar from the Ribbon and a menu will appear.

You can always unselect or remove the unwanted items from the Ribbon with a right click on the Remove option.

Other things on the Title Bar

Your pictures title that is followed by the name of the program—Paint. But If the picture is not been saved, the title appears as "Untitled."



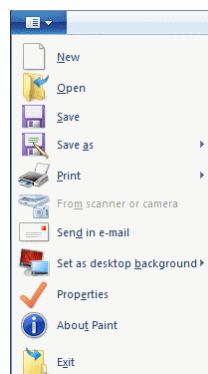
The three usual window buttons, **Minimize**, **Maximize** and **Close** appears at the extreme right end of the Title Bar. If Paint Window is already maximized—taking entire screen—the middle button is restored.

The Menu Bar



The Menu bar consists of three items on the left and a Help button at the far right.

Paint Button



Screenshot

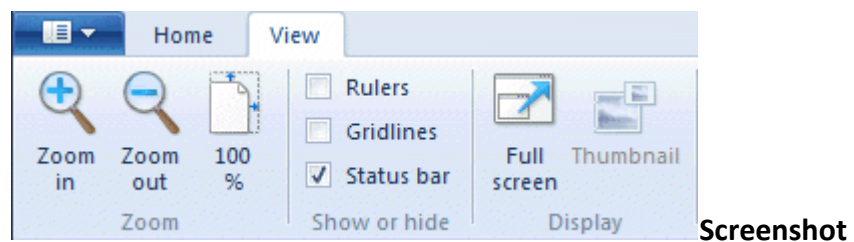


The **Paint Button is on the left** that has a comprehensive menu, as displayed in the figure. It also shows a list of recently saved paint works. Most of these files are self-explanatory; **Save as** is crucial as it helps saving a newer (or compatible) version of the file while retaining the original file.

Home Tab

The **Home** tab comes handy for almost all functions. The Home tab comprises of the Ribbon, from where you can select the tools and colours. If you are using the View tab, you can flip back and forth among the Home and View (tabs) on and often as you require.

View Tab



Paint in Windows 7 has an improved feature of zooming in and out. As you Click on the View tab in front of you an entire set of useful options will be available. Either you can use these options alone or together with the Zoom Tool on the Ribbon or along with the slider present on the Status Bar.

You can click over the **Zoom in** and **Zoom out** continuously in order to get a closer or distant view.

The option 100% is used when your work is finished in a zoomed in view. By clicking over the **100% option** you're back to the original form of the picture.

The **Show or Hide** part of this tab is basically used for hiding the status bar. It is advised not to do that as the status bar could be used many times.

Gridlines are the best thing as it provide the convenience if you need to align shapes accurately.

In order to set alignments **Use Rulers**.

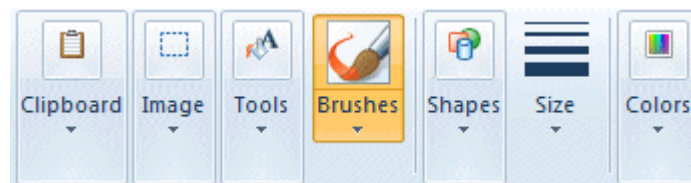


In the **Display** section, click over the **Full Screen View**. A Full Screen View can also be obtained by clicking over F11 key. In both the cases, **on pressing the Esc key you can come back to a normal view.**

Thumbnail is the option that will be available only in the moment when you are in zoom in view. It allows you to visualise that how the changes made by you are affecting your picture in normal view.

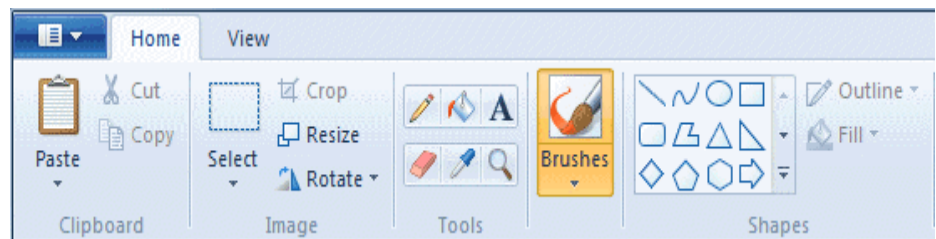
The Ribbon

In the ribbon tools like the color palette, the shapes, brushes and most of the commands are arranged together. With some exceptions such as Save, **Undo** and **Redo**, that can be seen at the **title bar in its left end**, in the **Quick Access Toolbar**.



Screenshot

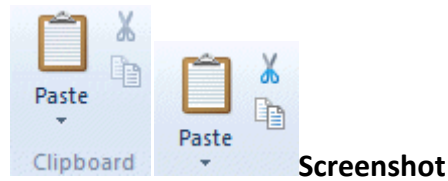
If you are visualising in a smaller window, the ribbon is supposed to appear like this. The Drop-down arrows beneath each item shall provide different options, which can be accessed in their menus.



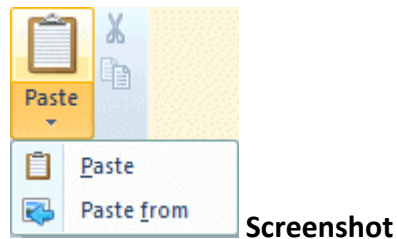
Screenshot

Option to minimize the ribbon makes the ribbon disappear entirely, but you can see it again if you click on the **Home** tab.

The Clipboard Menu

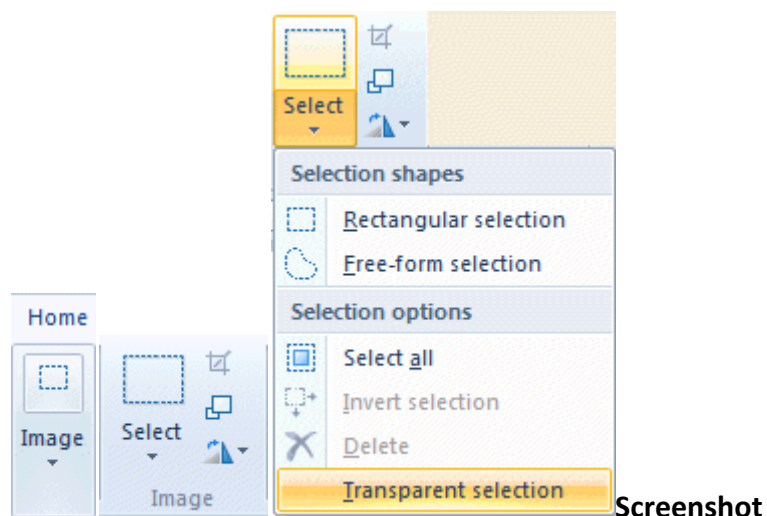


In the clipboard menu three options are offered—**Cut**, **Copy** and **Paste**. Only if a selected picture is active then only the Cut and Copy icons will be shown as ready.



The Paste option is always active, because there is always a probability you would like to **Paste from** a picture from a different file. For example you've earlier drawn and saved a small cartoon and now you want to include it to your present work. You need to click the down arrow under Paste, click **Paste from** and move it to the saved picture in its folder, click its name and then click **Open**.

The Image Menu—Select

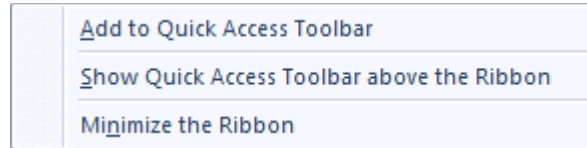


The Image Menu will look like either of these but that depends over the size of the window. Just below the word Image



on clicking the down arrow with a dotted rectangle, a menu will arise that will offer you more choices further.

Transparent selection



At the bottom of the Select menu you'll see **Transparent selection**. If you want to use it frequently, add it to the Quick Access toolbar. To do this, right click on transparent selection and then click on **Add to Quick Access toolbar**. On your Quick Access Toolbar, there will be a checkbox in front of transparent selection. **Transparent selection** While that box is selected the texts will be transparent. To make your selections opaque, just click the unselect the checkbox.


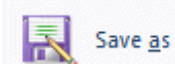
Selection Options

To the right of the selection icon you will see three options, **Crop**, **Resize** and **Rotate flip**.

Crop

A square shape with a line through it, is the icon for crop. It allows you to crop your picture so that only the selected area remains. This has replaced the old **Copy to** option and can be used if you want to save cutouts from a drawing.

How to save a cutout


1. Save the picture from which you want a cutout.
2. Select the part you want to save as a cutout.
3. Click the Crop button.
4.  Go to the Paint button and open the menu.
5.  Click **Save as**

Be very sure that you do click Save **as** and not Save.

6. Give a name for the cutout and click Save.

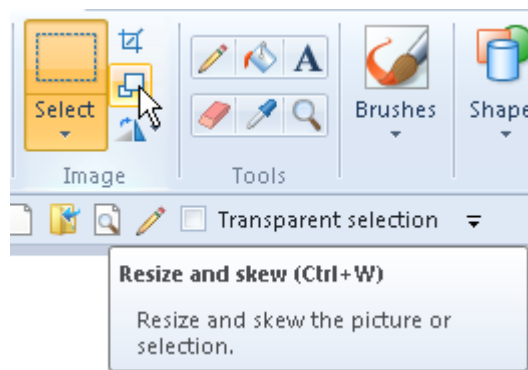
You will see the Paint window with the cutout displayed in it. The name of cutout used while saving it is shown on the Title bar.

7. Click the Open icon on your Quick Access Toolbar or from

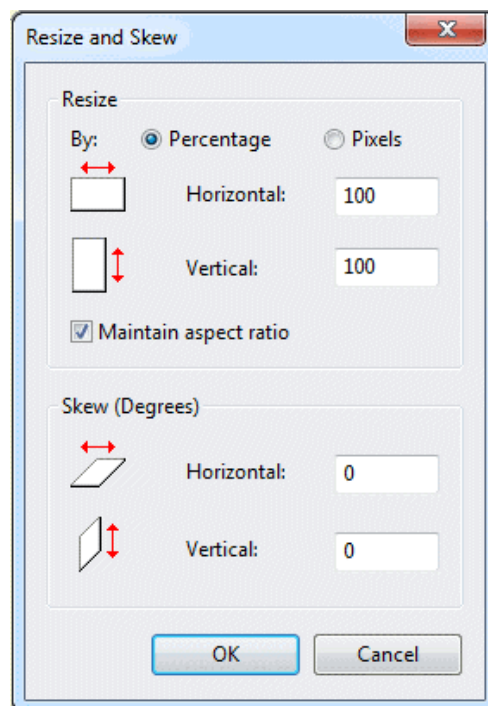
the Paint Button menu.  Open

8. Open the picture with which you wish to continue working.

Resize and Skew



The second button below the crop button will open the Resize and Skew dialogue.






Resize



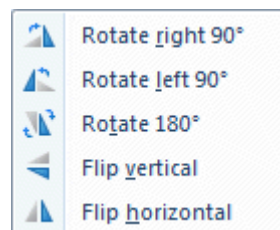
You can resize any selected item by dragging any of the little blocks—or handles—on the selection rectangle. Use your cursor to hover over the handle you want to pull or push until a double-ended arrow appears. Press down your mouse button and adjust the shape to your liking.

Skew



The bottom part of the same dialogue box invites you to skew your selection. When using this option, make your selection including a large border area to avoid having part of the picture chopped off, as has happened here. If this happens, click **Undo**  and make a wider selection before trying again.

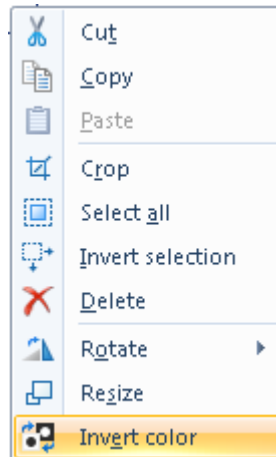
Rotate or flip



This menu lets you make mirror images of selections, either vertically or horizontally, and it also lets you rotate an item 90 degrees.

To make a symmetrical object mirror image comes handy. Just copy half of the picture, flip it and join it to the picture itself.

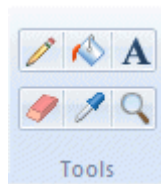
See [Making a Picture the Same on Both Sides.](#)



Invert Color


A different set of options are available if you **right** click on a selection you've made.

The Tools Menu




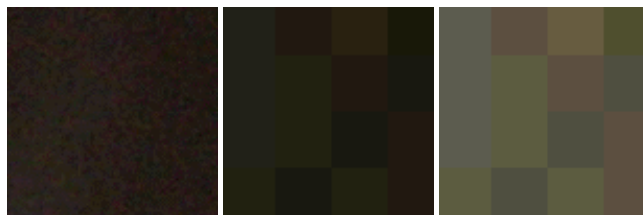
Screenshot

Pencil

 The pencil tool is used for free-hand drawing. It can also be used in a zoomed in view for pixel-by-pixel editing.

Fill with Color


 The Fill with color tool, or the Flood Fill tool, is used to fill **an area of a single color** with a different color. It can hold two different colors; Color 1 will be used if you press the left mouse button on the area to be filled. Color 2 will be used if you press with the right mouse button.

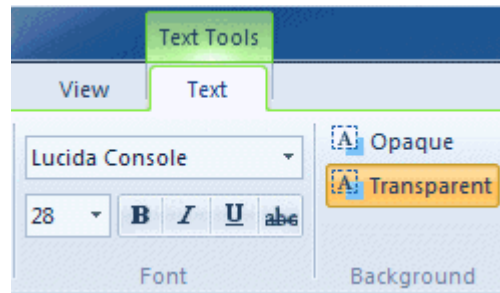


Screenshot



The Text Tool

 The Text tool in Paint for Windows 7 is a great improvement from earlier versions.



The one exception to this is that Paint 7 always anti-aliases text, so the idea of stacking red text on top of black to get a shadowed effect seems to be a thing of the past—unless you turn off **Smooth screen fonts** in the **Performance** section of **Advanced System Settings**.

Instead of using the old technique of inserting text, it is recommended that you open a new document and operate this tool.

To begin inserting text, click on the text tool. Your cursor changes to an insertion bar.


Use the cursor to drag and draw an oblong that you think will be about right to hold your text.

Unless these steps have been followed, **do not click anywhere outside that oblong**.

The **Text Toolbar** appears.

Type your text.

The Eraser

 With the left button depressed, the eraser tool changes whatever it is dragged across to the background color—Color 2.

With the right button pressed, the eraser tool changes pixels of Color 1 to Color 2. It leaves everything else unaffected.



You can use this to quickly and easily change an area, say, red to one of, say, blue.



The left mouse button was clicked while the Eraser has been dragged across the first picture. Color 2: the background color, is white.

For the second picture, Color 1 to blue and Color 2 to white have been set.

Press the right mouse button while dragging the cursor across the picture.

In the third picture, pink has been set as Color 2 to and lie green has been set as Color 1. And in a similar manner we Press the right mouse button while dragging the cursor across the picture.

There's no color tolerance in Paint; only pixels of **exactly** the same color are affected, so it is pretty useless on textured color.

The Color Picker



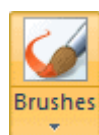
The Color Picker Tool is used to sample and match any color in your picture.

The Magnifier



The Magnifier Tool can be clicked over an area to get a closer view. Left clicks give a closer view. Right clicks zoom out.

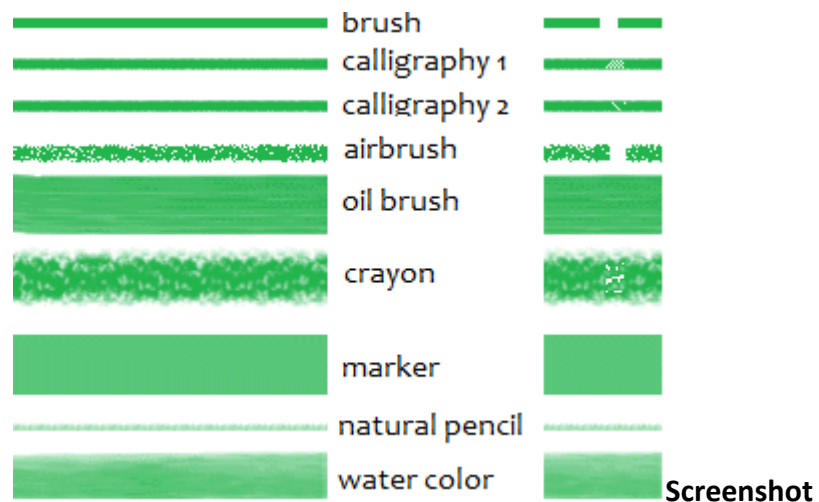
Brushes



Brushes let you paint in various widths and textures.

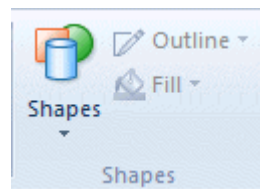


Widths are controlled by the brushes and the Size Tool together, textures with the brushes.



The lines above, has been drawn using the brushes available in the tool box using the same color and the same width. Each line has been labeled according to its tooltip in the gallery.

Shapes



The Line and the Curved Line Tools are concealed in the shapes gallery, along with rectangles, rounded rectangles, ellipses and freehand polygons. There are various shapes: arrows, speech balloons, various stars and others.

Basics for All Shapes



Open the **Shapes Gallery** by clicking the down arrow under the Shapes picture and click the shape you want to draw. Choose a shape before you try to use the Outline or Fill buttons and before you choose a line thickness.



Line Thickness, the Size Tool



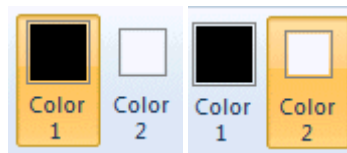
This tool becomes active only **after** you have chosen either a Brush or a Shape, so choose your Brush or Shape and you'll then find out that you can click the down arrow under Size and choose a line thickness.

The line thicknesses often vary according to the brush you have chosen.

Colors

The Color section of the ribbon has three parts: Boxes showing the active colors—Color 1 and Color 2, the Color Palette and the Edit Colors button.

The Color Boxes



Screenshot

Color 1 is the **Foreground Color**, and is always black when you open Paint or open a different Paint page.

Color 2 is the **Background Color**, and is always white when you open Paint or open a different Paint page.



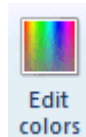
The Color Palette



Screenshot

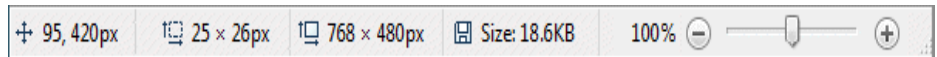
Whenever you are making a picture the two top lines of the Color Palette show all the colors available.

Edit Colors



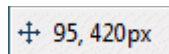
The Edit Colors button takes you into the Edit Colors dialogue. There you can click any color on an extended palette and click the Add to Custom Colors button.

The Status Bar



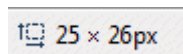
The Status Bar is situated at the bottom of the Paint Window. It offers information and can be used to help as you work. Let's look at its features from left to right.

Cursor Position



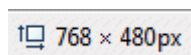
Gives your Cursor Position, which is helpful when you want to position something precisely.

Selection Size



Shows the size of a selection you're making, or of an object you're drawing.

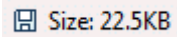
Image Size





Shows the size of your entire picture, even if it is very large and does not contain in the window completely. If you haven't changed the units in the Properties dialogue this measurement will be in pixels, but you do have the option of changing to inches or centimetres.

Disk Size

A small rectangular box with a light blue background and a dark blue border. On the left is a small icon of a floppy disk. To its right, the text "Size: 22.5KB" is displayed in a dark blue font.

Once you've saved a picture, this will show its Size on Disk. In a very small window, this figure may not be shown.

Zoom Slider



The Zoom Slider is convenient if you are working in a zoomed-in view and want to zoom out. However, you cannot zoom **in** on a particular spot, as you can with the Magnifier.

Saving Your Work

When you hit **Save** for the first time, you'll find yourself in a dialogue box where you are invited to type a name for the picture. Do so, and accept the default format, which is in PNG file format—unless, of course, you have a particular reason for choosing some other format. Having typed a name, click the **Save** button and you'll be returned to your picture.

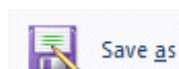
After that, when you click the Save button your work will not be interrupted.

Saving a Copy—Save as

Sometimes you may have made a really good picture, want to add something to it but worry that you might spoil it. The thing to do then is (to) **Save a Copy**.




Go to the Paint button and open the menu.



Click **Save as**



Hit **Ctrl+Z** or click the Undo button  and start over again. It seems that the only way to avoid this is to move your cursor well away before you click to cancel the bounding box.

Requirements for Multimedia Software

Multimedia provides a plethora of media applications. Multimedia subjects include children's learning, artwork, reference work, health and medicine, science, history, geography, hobbies and sports, games and much more. Because of the large storage requirements of this type of media, most multimedia software comes on a compact disk (CD-ROM) format.

To use multimedia software, a system must meet the minimum requirements set forth by the Multimedia Personal Computer (MPC) Marketing Council. These requirements include a CD-ROM drive, hard disk drive with ample storage capacity, an i5 or better central processing unit (CPU), at least 4 to 8 gigabytes of RAM (memory), a 256 color or better video adapter, and a sound card with speakers or headphones. Most new computers far exceed these specifications. A microphone is optional if you want to record your own sounds. While these are suggested minimum requirements, many multimedia programs would run better on computer equipped with a AMD Athlon CPU or intel i5 CPU and 4 or more gigabytes of RAM.

Definition of Software Component

A software component simply cannot be differentiated from other software elements by the programming language used to implement the component. The difference must be in the usage of software components. Software comprises of many abstract, quality features, i.e. the degree to which a component or process meets specified requirement (IEEE Std 610.12-1990). It would be inappropriate, to define a software component as "an efficient unit of functionality." Elements that comprises the following definition of the term, software components are described in the "Terms" sidebar.

These definitions demonstrate the important relationship between a software component and its infrastructure and a component model.



Specification and Design of Multimedia Software Systems

Specification and design of multimedia applications pose new challenges to authoring systems due to temporal and spatial relations. Common designs of hierarchical composition of objects need to be found, thus leading to object-oriented tools. For specification of multimedia software systems a new paradigm is espoused: software engineers will do evolutionary design using an object-oriented architecture description language [Tsai99] of complex systems through:

- 1) Architecture specification
- 2) Design rationale capture
- 3) Architecture V&V
- 4) Architecture transformation

Another recent approach is to extend UML, the Universal Modelling Language, for the modelling of multimedia applications.

Software Licensure Agreement

When installing software via Internet or CD-ROM, users agree to a licensure agreement before they are able to test the software. If this agreement is broken or violated, then the user is guilty of software piracy. The software licensure agreement is a contract between the software user and the software developer. Usually, this agreement has certain terms and conditions the software user must follow. When the user does not follow the rules and regulations, they are guilty of software piracy. Some of these terms and conditions prohibit:

1. Using multiple copies of a single software package on several computers.
2. Passing out copies of software to others without the proper documentation (Not having a multiple site license for more than one computer).
3. Downloading or uploading pieces of software via bulletin boards for others to copy.
4. Downloading and installing shareware without paying for it.

Unless otherwise stated, most software licensure agreements allow you to place one copy on a single computer and make a second copy for backup purposes. Software piracy comes in many different forms. The three most common types are End User Piracy, Internet Piracy and Reseller Piracy.



Unit summary



Summary

In this unit we learnt about the fundamentals of software and different types of software used in multimedia system. Paint is type of software which is basic idea to paint a picture for multimedia software. Through painting, the artist expresses ideas and emotions, as well as a version of the reality he or she perceives, in a two-dimensional visual form. The language of the artist consists of shapes, lines, colors, tone, and textures that are blended in various ways to produce in the viewer sensations of light, space, and movement. Some artists paint concrete forms with which viewers are generally familiar. Others try to create entirely abstract relationships. To study the paintings of any age is to look in on the diverse interpretations of the era in which they are produced.

Assignment



Assignment

1- Write a short note on computer software.

.....

2- What are different types of software?

.....

3- Name any five application software.

.....



.....
4- List the different options available in HOME tab in Paint brush.

.....
.....
.....
.....

5-Write the steps how to fill color of a art using paint brush:

.....
.....
.....
.....

Resources



Reading

1. Shi-Kuo Chang, Timothy K. Shih, Multimedia Software Engineering, Department of Computer Science University of Pittsburgh Pittsburgh, PA 15260 USA, 2000
2. <http://study.com/academy/lesson/multimedia-software-working-with-audio-and-video.html>
3. <http://fay.iniminimo.com/paint7.html>
4. George T. Heineman, Bill Councill, Definition of a Software Component and Its Elements, Chapter-1.
5. <http://www.arena-multimedia.com/softwarecovered.aspx>



Unit-3

Multimedia Operating Systems

Introduction

The main job of the operating system is to make an interface between the computer hardware and software components. It not only guarantees the effective use of the computer hardware but also provides an easy domain for the execution of programs. The operating system offers various services, related to the best utilization of the essential resources of a computer: CPU, main memory, storage and all input and output devices. In case of multimedia production, the Operating System has the great role in processing the multimedia data that needs a lot of computing resources. This is the reason why we need to choose the operating system for efficient management of resources that is essential to increase the multimedia playback and production.

Outcomes



Outcomes

Upon completion of this unit you will be able to:

- Describe the fundamental concepts of Operating System
- Identify different types of Operating systems
- Describe the various generation computers
- Explain the functions of Multimedia Operating System
- Describe various issues related to resources management
- Identify the characteristics of Real Time Operating System
- Explain (concepts) Operating System Process management

Terminology



Operating System:

It is system software that supports a computer's basic functions, such as scheduling tasks and controlling



Terminology

peripherals.

Microsoft Window:

It is a family of graphical operating systems developed by Microsoft. All Windows versions are proprietary closed-source system software.

Linux:

It is an open source freely available, cross-platform operating system based on UNIX that can be installed on PCs, laptops, notebooks, mobile and tablet devices.

What is an Operating system?

An operating system is an important part of every computer system. A computer can be divided into four components: the hardware, the operating system, the application program and the user.

An operating system (OS) is the software component of a computer system that is responsible for the management and coordination of activities and the sharing of the resources of the computer.

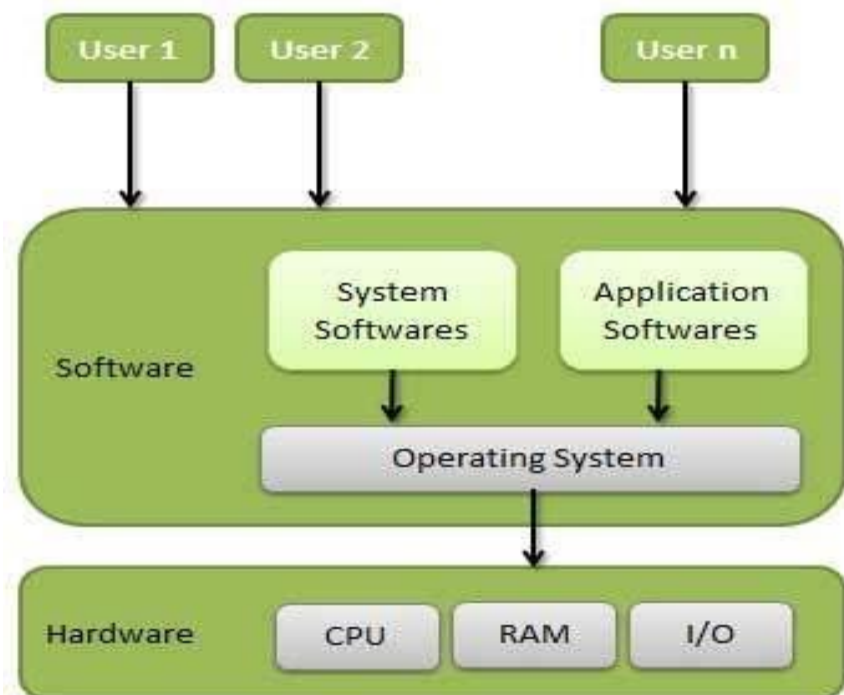
The utilization of hardware among different application programs for different users is controlled and co-ordinated by the operating system. The role of the operating system (OS) is to provide a medium for the best utilization of these resources during the operation of the personal computer. The operating system can be investigated from two perspectives: the user and the system.

User View: The client perspective of the PC fluctuates by the interface being utilized. A computer system comprises of a monitor, keyboard, mouse and system unit. This type of system is basically designed for single user to have monopoly over its resources and to expand the work the user is doing. For this situation, the operating system is basically designed in the way focussing for a simple use by the user, while executing an important factor.

System View: The most important feature of the operating system is its compatibility with the hardware through its program; its job is to allocate the resource. There are numerous resources in a computer system like – hardware and software these help to root



out a problem like file-storage space, memory space, CPU time, I/O devices etc. All these resources are managed by the operating system. In order to operate the computer system in an efficient and fair way the operating system should be very particular about the allocation of resources to users and specific programs.



Title: Organization of Operating System Components

Attribution:

Source:tutorialpoints.com

Link:https://www.tutorialspoint.com/operating_system/os_overview.htm

If we view an operating system in a slightly different way it stress upon the requirement to have a control over different I/O devices and user programs. On and around an operating system is basically a control program. The job of control program is to manage the execution of the programs of users for the prevention of errors and for checking the proper utilization of the computer. It main concern is the control and operation of I/O devices.

An operating system has three main functions:

1. Manage the computer's resources, such as the central processing unit, memory, disk drives, and printers.
2. Establish a user interface, and
3. Execute and provide services for applications software.



Operating System Concepts:

Multi-user and Single-user Operating Systems

Multi-user operating systems allow multiple users to access a computer system simultaneously. Time-sharing can be classified as multi-user systems as they enable multiple user access to a computer by sharing time slot. Single-user operating systems, contradictory to a multi-user operating system, can only be operated by one user at a time. MS-DOS and Windows XP are designed for single user only.

Windows operating system cannot be said as a multi-user system only if it is able to have multiple accounts. Other than this, the real user is the network administrator.

But for an operating system -like Unix, UNIX, LINUX and Windows 2000 Server are some of the examples of multi-user operating systems. The main advantage of these systems is that two users can login at the same time and because of this specific feature of the OS makes it a multi-user operating system.

Multi-tasking and Single-tasking Operating Systems

By Multi-tasking it means that a computer is able to run various programs at the same time. This the operating system do by the allocation of slots of processor time to programs turn by turn, so that the slots can be distributed rapidly so that the programs finally run concurrently. . In such cases where the operating system allows for execution of multiple tasks at a time, it is classified as a multi-tasking operating system.

The system will be grouped under the single-tasking system category, when a single program is allowed to run at a time.

UNIX and Windows 95 are examples of multitasking Operating Systems. In contrast, MS-DOS and Windows 3.1 are "single tasking" Operating Systems.

Multi-tasking can be of two types namely, pre-emptive or co-operative. In pre-emptive multitasking, the operating system slices the CPU time and dedicates each slot to one program. Unix-like operating systems such as Solaris and Linux support pre-emptive multitasking.



Multi-processing Operating System

Operating Systems that are more advanced are capable to spread processing between multiple CPUs. Since this is a complicated task so here the programs are being broken into *threads*. *Grid computing* is a type of design that is available at bigger scale on networks.

UNIX, Windows NT and Windows XP are some of the examples of multi-processing operating systems. Whereas, MS-DOS and Windows 98 are capable of running only on a single processor.

Embedded System

The Operating Systems which are designed for use in embedded computer systems are known as (Embedded Operating Systems). They are designed to operate on small machines like with less autonomy. They can operate with limited number of resources. They are very compact and have extremely efficient design. Windows CE, FreeBSD and Minix 3 are some examples of **embedded operating systems (Embedded Operating Systems)**.

Mobile Operating Systems

Even if the Mobile Operating Systems are not a very different kind of Operating System, but it has an essential specification in the list of types of Operating System. A mobile device is controlled by a mobile OS it's designed such that it supports wireless communication along with mobile applications. It additional has a built-in or default support for mobile multimedia formats. Few examples are Tablet PCs and smart phones that run on mobile Operating Systems. So the main contribution of the Operating Systems is to simplify human interface with the computer hardware. There main responsibility is to link application programs with the hardware, so that an easy user access to computers can be achieved. A portion of the prominent Operating Systems are, Android OS, BlackBerry OS, iOS , Palm OS, Symbian OS so forth.

Command Line Interface (CLI)

With a CLI, the computer is controlled by text instruction given through the keyboard. The Operating System's command shell interprets the given instruction to launch programs or carry out OS processes. CLI is often confusing and difficult to use for many people. UNIX and MS-DOS are examples of Operating Systems based on command-line interface.



Graphical User Interface (GUI)

In 1973 researchers at Xerox's Palo Alto research labs developed the WIMP system for controlling computers. The WIMP system consists of; a Window, Icon, Mouse and Pointer. This graphical interface was much easier for novices and revolutionized the operation of computers but didn't really take off until the mid 1980s. Windows, Mac OS and UNIX's X-Window shell, Ubuntu are examples of Operating Systems featuring GUIs.

Popular operating Systems:

Some popular operating systems are as follows.

- 1. UNIX:** Multi-tasking, multi-processing, multi-user, protected system that derives from the original AT&T **UNIX** developed by Ken Thompson, Dennis Ritchie, and others few scientists in early 1970s at the Bell Labs research center.
- 2. Windows:** Multi-tasking, multi-processing, single-user, unprotected system developed by Microsoft Corporation to run personal computers (PCs). Featuring the first graphical user interface (GUI) for IBM-compatible PCs, the **Windows OS** soon dominated the PC market.
- 3. Mac OS:** It is a series of graphical user interface-based operating systems developed by Apple Inc. for their Macintosh line of computer systems. The original operating system was first introduced in 1984 and was integral to the original Macintosh; it was referred to as the "System".

Windows operating Systems:

The operating system for windows began with the presentation of Windows OS and Windows for the general work force and for networking as well. From that point forward it has made considerable progress. Afterwards Windows 95, 98 and 2000 group of Operating Systems were presented. To the computer user it provided highly integrated and simple to use operating system with all inbuilt facilities. In the Windows family The Windows XP is an infant. It was based on the windows 2000 idea and system. It has more highlights to furnish the client with more



noteworthy steadiness, security and upgraded execution and performance.

Types of Windows operating system

Windows 1.01: Windows 1.0 presents incomplete multi-tasking of the MS-DOS programs and focuses on (providing an interface) generating an interfacial pattern, (which is) an effective replica and a steady API for indigenous programs for the next generation.

Windows 2.03: Windows 2.0 permits functional windows to override on one another, unlike Windows 1.0, which is capable of exhibiting only tiled windows. Windows 2.0 has also brought additional stylish keyboard-shortcuts and the terms like "Maximize" and "Minimize" in place of "Zoom" and "Iconize" in Windows 1.0.

Windows 2.11: After a year of the production of Windows 2.0, Windows/286 2.1 and Windows/386 2.1 were made. These versions contain explicit features of the Intel 80286 and Intel 80386 processors.

Windows 3.0: Windows 3.0 was the 3rd most important production of Microsoft Windows which was released on 22nd May 1990. It turned out to be the 1st broadly used version of Windows.

Windows 3.1

Windows For Workgroups 3.1: Windows 3.1 (also known as Janus), came up on March 18, 1992. This version includes a TrueType inbuilt font system making Windows the only desktop implementing platform for the 1st time. Windows 3.0 could have similar functionality with the use of the Adobe Type Manager (ATM) font system from Adobe.

Windows NT 3.1

Windows For Workgroups 3.11: Microsoft's Windows NT line of server and business desktop operating systems had first released Windows NT. Progress of this windows had started in November 1988 and was officially released on July 27, 1993.

Windows 3.2: This is the 1st version of Windows NT having the names like Windows NT Server and Windows NT Workstation for its different versions.

Windows NT 3.5

Windows NT 3.51: Windows 95 was planned to amalgamate MS-DOS and Windows. It contained an improved version of DOS.



Windows NT 4.0: It is a pre-emptively multitasked, graphical operating system, designed to work with either uniprocessor or symmetric multi-processor computers. It was released after manufacturing on 31 July 1996.

Windows 98: Windows 98 is a modern version of Windows 98. It was released on May 5, 1999.

Windows 98 SE

Windows 2000: Windows 2000 (also called Windows Me) is an extension of the Windows 9x version, but with access to the actual mode MS-DOS, it was limited so as to get a move for the system boot time.

Windows Me

Windows XP: Microsoft developed Windows XP. It is a line of Operating Systems for applying on general functional computer systems which includes business as well as home desktops, media centers and notebook computers. Windows XP was released on 25th October 2001.

Windows XP 64-bit Edition 2003

Windows Server 2003

Windows XP Professional x64 Edition

Windows Fundamentals for Legacy PCs

Windows Vista: After a world-wide success of XP and its service packs Microsoft has designed and created Windows Vista the operating system for use on personal computers, including business and home desktops, Tablet PCs, laptops and media centers.

Windows Home Server

Windows Server 2008

Windows 7: Windows 7 is a popular Operating System developed by Microsoft. It is a part of the Windows NT family of Operating Systems. Windows 7 was released July 22, 2009, and became generally available on October 2009.

Windows 8: It is developed by Microsoft as a part of the Windows NT family of operating systems. It was released on August 2012, and was released for general availability on October 26, 2012.

Windows 10: It is also a popular Operating System developed and released by Microsoft as part of the Windows NT family of Operating Systems. The first version of the Operating System



entered a public beta testing process in October, leading up to its consumer release on July, 2015.

Windows is the most dominant OS in the market today. The two most popular versions of Windows for the desktop are Windows-7 and Windows-10. Windows is all proprietary, closed-source which is much different than Linux license. Most of the popular manufacturers make all their hardware compatible with Windows which makes Windows able to operate almost all kinds of new hardware.

Security

Windows OS^s(are) most vulnerable to attacks. Security software is a must when you are using Windows which is far different than Linux and OS X. It has been criticized for its susceptibility to malware, viruses, Trojan horses, and worms. Security issues are compounded by the fact that users of the Home edition, by default, receive an administrator account that provides unrestricted access to the underpinnings of the system. If the administrator's account is broken into, there is no limit to the control that can be asserted over the PC.

UNIX/Linux Operating Systems

UNIX is a family of multi-tasking, multi-user computer OS) that derive from the original AT&T Unix, developed around the 1970s at the Bell Labs research center by Ken Thompson, Dennis Ritchie, and others.

The term "Linux" is originated from the Linux kernel that began in 1991 by Linus Torvalds. GNU/Linux is so called because the system's utilities and libraries has its basic origin from GNU OS.

Linux is predominantly well known as it's broadly used in server. For a vast number of various computer hardware it's basically used as an operating system, including supercomputers embedded devices desktop computers, video game systems, and such as mobile routers and phones.

Linux is a modular Unix-like OS. During the 1970s and 1980s much of its base specifications or design is derived from principles established in UNIX. Linux utilizes a monolithic kernel which takes care of file system access, networking, peripheral and process control. Within the kernel the device drivers are integrated. In most of Linux's separate projects are used to provide higher level of functionality that intervenes with the kernel.

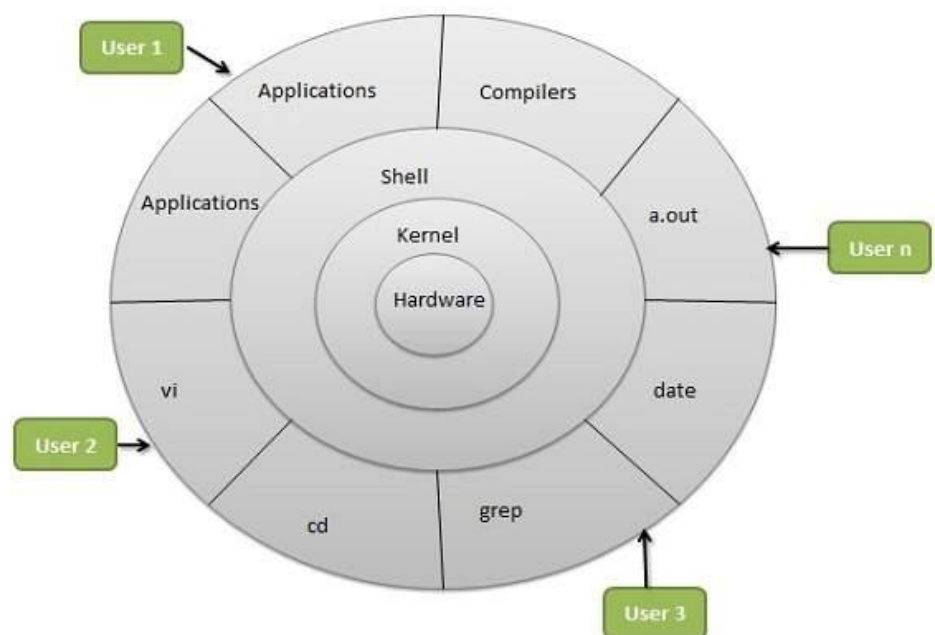


The UNIX/LINUX systems are most commonly portrayed as an onion; several layers surrounding an inner core.

The main concept that unites all the versions of UNIX/LINUX are categorised as four basic components.

Kernel: The kernel is the heart of the OS. It interacts with the hardware and does most of the tasks like memory management, task scheduling and file management.

Shell: The shell is the utility that processes your requests. When you type in a command at your terminal, the shell interprets the command and calls the program that you want. The shell uses standard syntax for all commands. C Shell, Bourne Shell and Korn Shell are famous shells which are available with most of the UNIX variants.



Title: The UNIX/LINUX Systems

Attribution:

Source: tutorialspoint.com

Link: https://www.tutorialspoint.com/operating_system/os_linux.htm

Commands and Utilities: There are various commands and utilities which are put to use in day to day activities; cp, mv, cat and grep, etc. are few examples of commands and utilities. There are over 250 standard commands plus numerous others provided by the 3rd party software. All the commands come along with various options.



Files and Directories: All the data of UNIX are organized into files. All files are then organized into directories. These directories are further organized into a tree-like structure called the file system.

Different Distributions of LINUX Operating System

- **Debian:** It is composed entirely of free software, most of which is under the GNU General Public License and packaged by a group of individuals participating in the **Debian** Project.
- **Ubuntu:** It is based on the Debian **Linux** distribution and distributed as free and open source software, using its own desktop environment. It is named after the Southern African philosophy of **Ubuntu**.
- **RedHat Enterprise Linux (RHEL)** is a distribution of the **Linux** OS developed for the business market. **RHEL** was formerly known as **Red Hat Linux** Advanced Server.
- **CentOS** (Community Enterprise OS) is a **Linux** distribution that attempts to provide a free, enterprise-class, community-supported computing platform functionally compatible with its upstream source, Red Hat Enterprise **Linux** (RHEL).
- **Fedora** (formerly **Fedora Core**) is based on the **Linux** kernel, developed by the community-supported **Fedora** Project and sponsored by Red Hat. **Fedora** contains software distributed under a free and open-source license and aims to be on the leading edge of such technologies.
- **SUSE Linux** is built on top of the open source **Linux** kernel and is distributed with system and application software from other open source projects.
- **Linux Mint** is a community-driven **Linux** distribution based on Debian and Ubuntu that strives to be a modern, elegant and comfortable OS which is both powerful and easy to use.

Multimedia Operating systems

- The OS provides a comfortable environment for the execution of programs. It also ensures effective utilization of the computer hardware.
- The OS offers various services related to the essential resources of a computer: CPU, main memory, storage and all input and output devices.



- In multimedia applications, a lot of data manipulation (e.g. A/D, D/A and format conversion) is required and this involves a lot of data transfer, which consumes many resources.
- The integration of discrete and continuous multimedia data demand additional services from many OS components.
- The major aspect in this context is real-time processing of continuous media data.

Issues concerned:

- Process management: a brief presentation of traditional real-time scheduled algorithms
- File systems: outlines disk access algorithms, data placement and structuring
- Inter-process communication and synchronization
- Memory management
- Database management
- Device management

Process management must take into account the time required for handling multimedia data concerned in process management (Scheduling):

Table: Comparison of Traditional OS and MM OS

Criteria	Traditional OS	Multimedia OS
Timing Requirements	No	Yes
Fairness	Yes	Yes

- Single components are conceived as resources that are reserved prior to execution to obey timing requirements and this resource reservation has to cover all resources on a data path.
- The communication and synchronization between a single process must meet the restrictions of real-time requirements and timing relations among different media.
- Memory management has to provide access to data with a guaranteed time delay and efficient data manipulation



functions. (E.g. should minimize physical data copy operations.)

- Database management should rely on file management services.

Real-time process

- A real-time process is one which delivers the results of the processing in a given time span.
- The main characteristic of real-time systems is the correctness of the computation.
- Errorless computation.
- The time in which the result is presented.
- Speed and efficiency are not the main characteristic of real-time systems, e.g. the video data should be presented at the right time, neither too quickly nor too slowly.
- Timing and logical dependencies among different related tasks, processed at the same time, must also be considered.

Deadlines: Deadline represents the latest acceptable time for the presentation of a processing result.

Soft deadline: A deadline which cannot be exactly determined and which failing to meet does not produce an unacceptable result.

Missing the deadline) may be tolerated as long as (1) not many deadlines are missed and/or (2) the deadlines are not missed by (a long duration as it deems fit to the institution).

Hard deadline:

- A deadline which should never be violated.
- Its violation causes a system failure.
- Determined by the physical characteristics of real-time processes.

Characteristics of real time systems

The necessity of deterministic and predictable behaviour of real-time systems requires processing guarantees for time-critical tasks. A real-time system is distinguished by the following features:

- Predictably, fast response to time-critical events and accurate timing information.
- A high degree of accountability: to meet the deadlines.
- Stability under transient overload: critical task first.)



- The real-time requirements of traditional real-time scheduling techniques usually have a high demand for security and fault-tolerance (most of them involve system control).

Real-time requirements of multimedia systems are as follows,

- The fault-tolerance requirements of multimedia systems are usually less strict than those of real-time systems that have a direct physical impact.
- For many multimedia system applications, missing a deadline is not a severe failure, although it should be avoided. (e.g. playing a video sequence)
- In general, all time-critical operations are periodic and considering the schedule for periodic tasks are much easier.
- The bandwidth demands continuous media which is usually negotiable and the media is usually scalable.

Resource management

- Multimedia systems with integrated audio and video processing are at the limit of their capacity even with data compression and utilization of new technology (their demand increases drastically).
- No redundancy of resource capacity can be expected in the near future.
- In a multimedia system, the given timing guarantees for the processing of continuous media must be adhered to along the data path.
- The actual requirements depend on (1) the type of media and (2) the nature of the application it supports.
- The shortage of resources requires careful allocation.
- The resource is first allocated and then managed.
- At the connection establishment phase, the resource management ensures that the new connection; does not violate performance guaranteed as promised to existing connections.
- Applied to OS, resource management covers the CPU (including process management), memory management, and the file system and device management.



- The resource reservation is identical for all resources, whereas the management is different for each of them.

Resources

- A resource is a system entity required by tasks for manipulating data.
- A resource can be active or passive.
- Active resource: e.g. the CPU or a network adapter for protocol processing.
- It provides a service.
- Passive resource: e.g. main memory, communication bandwidth or file systems.
- It denotes some system capability required by active resources.
- A resource can be either used exclusively by one process at a time or shared between various processes.
- Active ones are often exclusive while passive ones can usually be shared.
- Each resource has a capacity in a given time-span. (E.g. processing time for CPU, the amount of storage for memory and etc.)
- For real-time scheduling, only the temporal division of resource capacity among real-time processes is of interest.

Requirements

- The requirements of multimedia applications and data streams must be served.
- The transmission/processing requirements of local and distributed multimedia applications can be specified according to the following characteristics:

Throughput: Determined by the needed data rate of a connection to satisfy the application requirements.

Delay "at the resource" (local): The maximum time span for the completion of a certain task at this resource.

End-to-end delay (global): The total delay for a data unit to be transmitted from the source to its destination.

Jitter: Determines the maximum allowed variance in the arrival of data at the destination.



Reliability: Defines error detection and error correction mechanisms used for the transmission and processing of multimedia tasks.

- How to handle errors: Ignored, indicated and/or corrected.
- Retransmission may not be acceptable for time critical data.
- These requirements are known as Quality of Service (QoS) parameters.

Components and phases

- Resource allocation and management can be based on the interaction between clients and their respective resource managers.
- The client selects the resource and requests a resource allocation by specifying its QoS specification.
- The resource manager checks their own resource utilization and decides if the reservation request can be served or not.
- Performance can be guaranteed once it is accepted.

Phases of the resource reservation and management process are:

1. Schedule

The resource manager checks the given QoS parameters (e.g. throughput and reliability).

2. QoS Calculation

The resource manager calculates the best possible performance (e.g. delay) the resource can guarantee for the new request.

3. Resource reservation

Allocates required capacity to meet the QoS standards guaranteed for each request.

4. Resource scheduling

Incoming messages (i.e. LDUs) from connections are scheduled according to the given QoS standards.

Allocation Scheme

Reservation of resources can be made either in a pessimistic or optimistic way:



- The pessimistic approach avoids resource conflicts by making reservations for the worst case (its conservative).
- The optimistic approach reserves resources according to an average workload only.

Table: Comparison of Resources allocation Schemes

	Pessimistic approach	Optimistic Approach
Account for	Worst Case	Average Case
QoS	Guaranteed	Best effort
Utilization	Low	High
Remarks		May need a monitor to detect overload situation and act

Continuous Media resources Model

A model is frequently adopted to define QOS parameters and the characteristics of the data stream. It is based on the model of linear bounded arrival process (LBAP). A distributed system is decomposed into a chain of resources traversed by the messages on their end-to-end path. The data stream consists of LDUs (messages).

- Various data streams are independent of each other.
- The model considers a 'burst of messages' (is a steady flow of messages) that arrived ahead of (its) schedule.
- LBAP is a message arrival process at a resource defined by 3 parameters:

M = maximum message size (byte/message)

R = maximum message rate (message/second)

B = maximum burst (message)

Example: Single channel audio data are transferred from a CD player attached to a workstation over the network to another computer

- As CD audio is handled, the bit rate is constant.



- The audio signal: sampled at 44.1 kHz, each sample is coded with 16 bits.
- Samples are grouped into 75 frames of equal size (corresponds to messages) in a second and transmitted in CD-format standard.
- Assume up to 12000 bytes are assembled into 1 packet and transmitted over the LAN.

Then, we have data rate = $44100 \times 16 / 8 = 88200$ bytes/s
 $R = 75$ messages/second
 $M = 88200 / 75 = 1176$ bytes/message
 $B = 10$ messages $\leq 12000 / 1176$

That $B = 10$ means we receive 1 packet at a time and each of them carries 10 messages, which implies we receive no more than 10 messages at a time.

Burst:

Bursts are generated, (Burst occurs) when data is transferred from disk in a bulk transfer mode, when messages are assembled into larger packets and traffic congestion is experienced. In the model, it is assumed that, during a time interval of length t , the maximum number of messages arriving at a resource must not exceed $t \times R$ (message)

Maximum buffer size:

Messages arriving ahead must be queued in a buffer. • The buffer size is $1 + \lambda \times B$ (bytes)

Logical backlog:

Logical backlog is the number of messages which have already arrived "ahead of schedule" at the arrival of message m .

Guaranteed logical delay:

The guaranteed logical delay of a message m denotes the maximum time between the logical arrival time of m and its latest valid completion time i.e. its deadline.

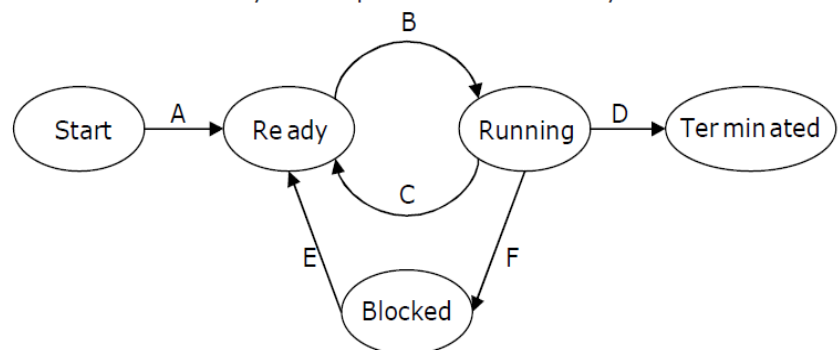
Work ahead messages:

- If a message arrives "ahead of schedule" and the resource is in an idle state, the message can be processed immediately and it's called a work ahead message.
- If a message is processed 'ahead of schedule' the logical backlog is greater than the actual backlog.



Operating System Process management

- In the context of an OS, a process is a program in execution.
- Processes are the individual entities to execute the user programs or tasks or a job allocated to the processor.
- The task of process management is handled by the OS module called process manager.
- The process manager maps single processes onto resources according to a specified schedule policy such that all processes meet their requirements.
- A process under control of the process manager can be in one of the 4 states:



Title: Process State Transition Diagram

Attribution:

Source: gateoverflow.in

Link: <https://gateoverflow.in/1318/gate2009-32>

1. **Idle state:** No process is assigned to the program.
2. **Blocked state:** The process is waiting for an event, i.e., it lacks one of the necessary resources for processing.
3. **Ready-to-run state:** All necessary resources except the processor are assigned to the process.
4. **Running state:** A process is running as long as the system processor is assigned to it.
 - The process manager is the scheduler.
 - The scheduler transfers a process into the ready-to-run state by assigning it a position in the respective queue of the dispatcher.
 - Dispatcher is the essential part of the OS kernel.



- The next process to run is chosen according to a priority policy.
- The process with the longest ready time is chosen if more than one process have equal priority.

Real-time processing requirements

The real-time process manager determines a schedule for the resource CPU that allows it to make reservations and to give processing guarantees.

- Each of them can meet its deadlines.
- In a multimedia system, continuous and discrete media data are processed concurrently.
- There are two conflicting goals for scheduling of multimedia tasks.
- An uncritical process should not become stagnant because time-critical processes get executed. (E.g. should handle text while handling video.)
- A time-critical process must never be subject to priority inversion.
- One should minimize
 - (1) The overhead caused by the schedule ability test and the connection establishment
 - (2) The costs for the scheduling of every message. The latter is more critical because they occur periodically.

Traditional real-time Scheduling

The goal of traditional scheduling on time-sharing computers is optimal throughput, optimal resource utilization and fair queuing. The main goal of real-time tasks is to provide a schedule that allows all, respectively, as many time-critical processes as possible, to be processed in time, according to their deadline.

Two basic algorithms for solving real-time scheduling problems: Earliest deadline first algorithm and Rate monotonic scheduling.

File Systems

Files are stored in secondary storage, so they can be used by different applications. The life-span of files is usually longer than the execution of a program.

In traditional file systems, the information types stored in files are sources, objects, libraries and executables of programs, numeric data, text payroll records, etc. In multimedia systems, the stored



information also covers digitized video and audio with their related real-time “read” and “write” demands. Therefore, additional requirements in the design and implementation of file systems must be considered.

Multimedia File systems

Compared to the increased performance of processors and networks, storage devices have become only marginally faster. The effect of this increasing speed mismatch is the search for new storage structures, and storage and retrieval mechanisms with respect to the file system. Continuous media data are different from discrete data in:

Real Time Characteristics

As mentioned previously, the retrieval, computation and presentation of continuous media is time-dependent. The data must be presented (read) before a well-defined deadline with small jitter only.

File Size

Compared to text and graphics, video and audio have very large storage space requirements. Since the file system has to store information ranging from small, unstructured units like text files to large, highly structured data units like video and associated audio, it must organize the data on disk in a way that efficiently uses the limited storage.

Multiple Data Streams

A multimedia system must support different media at one time. It does not only have to ensure that all of them get a sufficient share of the resources; it also must consider tight relations between streams arriving from different sources.

There are different ways to support continuous media in file systems. Basically there are two approaches. With the first approach, the organization of files on disk remains as is. The necessary real-time support is provided through special disk scheduling algorithms and sufficient buffer to avoid jitter. In the second approach, the organization of audio and video files on disk is optimized for their use in multimedia systems. Scheduling of multiple data streams still remains an issue of research.



Operating System Functions

Inter process Communication and Synchronization:

In multimedia systems, inter process communication refers to the exchange of different data between processes. This data transfer must be very efficient because continuous media require the transfer of a large amount of data in a given time span. For the exchange of discrete media data, the same mechanisms are used as in traditional OSs. Data interchange of continuous media is close related to memory management and is discussed in the previous section.

Synchronization guarantees timing requirements between different processes. In the context of multimedia, this is an especially interesting aspect.

Memory Management:

The memory manager assigns physical resource memory to a single process. Virtual memory is mapped onto memory that is actually available. With paging, less frequently used data is swapped between main memory and external storage. Pages are transferred back into the main memory when data on them is required by a process. Note, continuous media data must not be swapped out of the main memory.

Device Management

Device management and the actual access to a device allow the OS to integrate all hardware components. The physical device is represented by an abstract device driver. The physical characteristics of devices are hidden. In a conventional system, such devices include a graphics adapter card, disk, keyboard and mouse. In multimedia systems, additional devices like cameras, microphones, speakers and dedicated storage devices for audio and video must be considered. In most existing multimedia systems, such devices are not often integrated by device management and the respective device drivers.



Unit summary



Summary

In this unit we have explained the fundamental concepts of OSs and the different types of OSs. We have discussed various OS software are developed in different generations. Among them popular and contemporary OSs include Microsoft Windows, Mac OS X, and Linux. We have also discussed the characteristics of Multimedia OSs that provide access and control functions for the storage and retrieval of files, resources allocation strategies and some OS Issues. Requirements of multimedia OS and Files are usually organized in directories. Most of the current OS's has tree-structured directories.

Assignment



Assignment

Choose the appropriate answer from the options given in each of the following questions.

1. User-Friendly Operating Systems are:
 - a. Required for Multimedia processing
 - b. Easy to develop
 - c. Common among traditional mainframe OSs
 - d. Becoming more common and popular
 - e. None of the above
2. An OS Process is
 - a. Program in High level language kept on disk
 - b. Contents of main memory
 - c. A program in execution
 - d. A job in secondary memory
 - e. None of the above
3. Which of the following are loaded into main memory when the computer is booted?
 - a. Internal command instructions
 - b. External command instructions
 - c. Utility programs
 - d. Word processing instructions
 - e. None of the above
4. The organized collection of software that controls the overall operation of a computer is called _____.



- a. Working system
- b. Peripheral system
- c. Operating system
- d. Controlling system
- e. None of the above

Assessment



Assessment


1. What is an Operating System? List any three popular Operating systems.
.....
.....
.....
.....
2. Mention any three popular versions of Ms-Windows operating System.
.....
.....
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.....
3. List any three versions of LINUX operating System.
.....
.....
.....
.....
4. What is a process? Discuss different states of a process during its life cycle.
.....
.....
.....
.....
5. Write short notes on the following.
 - a. Multitasking
 - b. Device Management
 - c. Memory Management

a).....
.....
.....



- b).....
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- c).....
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Resources

 <p>Readings</p>	<ol style="list-style-type: none"> 1. Atul Puri, Tsuhan Chen, "Multimedia Systems, Standards, and Networks" 2. Stephen Mc Gloughlin, "Multimedia: Concepts and Practice" 3. Steinmetz and Klara Nahrstedt, "Multimedia Computing, Communication and application" 4. http://osr507doc.xinuos.com/en/OSUserG/_The_design_of_the_u1_Operating_System.html 5. Argonne National Laboratory, Mathematics and Computer Science Division 6. Henry. C. Lucas, Jr. (2001) ' Information Technology'; Tata McGraw Hill Publication Company Limited, New Delhi. 7. http://www.indiabix.com 8. https://en.wikipedia.org/wiki/Operating_system 9. http://openbookproject.net/courses/intro2ict/system/os_intro.html <p>Source: https://www.tutorialspoint.com/operating_system</p>
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Unit-4

Multimedia Communication Systems

Introduction

Multimedia communication deals with components and mechanisms to transfer multimedia data (such as text and graphics, audio and video) over the digital networks. Such a communication requires all involved components to be capable of handling a well-defined quality of service.

The multimedia applications such as kiosks, multimedia mail, collaborative work systems, virtual reality applications and others require high-speed network with a high transfer rate and communication systems with adaptive, lightweight transmission protocols on top of the networks.

Outcomes



Outcomes

Upon completion of this unit you will be able to:

- Name different types of multimedia data representation
- Identify the various types of networks that are used to provide multimedia communication services
- Describe the various layers of communication subsystem
- Examine the group communication architecture
- Explain the concepts of multimedia conferencing
- Compare the terms that are associated with multimedia communications

Terminology



Terminology

ISO/OSI:

ISO/OSI stands for **International Organization of Standardization**. This is a model for **Open System Interconnection (OSI)** and is commonly known as OSI model.

LAN:

It is a group of computers and associated devices that share a common



communications line or wireless link to a server.

WAN: This is a telecommunications network or computer network that extends over a large geographical distance. Wide area networks are often established with leased telecommunication circuits.

MAN: **Metropolitan area network (MAN)** is a computer **network** that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area **network** (LAN) but smaller than the area covered by a wide area **network** (WAN).

ISDN: **Integrated Services Digital Network (ISDN)** is a set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the public switched telephone network.

QOS: **Quality of Service (QOS)** refers to the capability of a network to provide better service to selected network traffic over various technologies, including Frame Relay, Asynchronous Transfer Mode (ATM), Ethernet and 802.1 networks, SONET, and IP-routed networks that may use any or all of these underlying technologies.

Multimedia Communication Systems

Multimedia systems have attracted much attention during the past years in the society as a whole and in the information technology field in particular. Multimedia communication comprises the techniques needed for communication between multimedia systems. To enable the access to information such as audio and video data, techniques must be developed which allow for the handling of audiovisual information in computer and communication systems.



Multimedia information/data that are being transferred over the network may be composed of one or more of the following types: Text, images, audio and video.

Two main objectives of Multimedia Communication Systems are:

- person-to-person communications (e.g. email)
- person-to-system communications (e.g. web-browsing)

In this unit, we are going to discuss, representation of different media types and different types of networks that are used to provide multimedia communication services. We will also discuss the criteria of selection of the applications that these networks support and familiarize with the meaning of a range of terms that are associated with multimedia communications.

Basic concept of Communication Systems

Computer Network

A Computer Network may be defined as an interconnection of two or more autonomous computers. Two computers are said to be interconnected if they can share or exchange information and data.

A computer network system is often confused with a distribution system. A distribution system, like a computer network system, is also interconnection of computers which are geographically dispersed or distributed over a network. In a computer network each computer operates independently on separate tasks. Each computer is an autonomous unit itself with its own CPU, memory and other peripheral devices. They can start and stop of their own in the way as the user wants.

Typically all networks consist of the following components:

Server - A server is a computer (known as master computer) that provides resources to the other computers present on the network.

Client - Client refers to the set of computers that access shared network resources provided by the server.

Media - Media is the way of connecting the computers to share information.



Resources - Resources are other hardware devices like files, printers etc. used by network users.

Benefits of computer networks

Computer Networks have highly benefited various fields of educational sectors, business world, and many organizations. They can be seen widely connecting a huge number of masses from different sectors.

There are some major advantages which computer networks has provided making the human file more relaxed and easy, some of them are listed below:

- (i) **Sharing of information or data:** This is one of the largest benefit that is provided via by the computer networks. **Various and nearly all type of data information and** resources, such as reports, documents, , accounts information, multi media files etc. could be shared by using the computer network.
- (ii) **Instant and Multiple Accesses:** the can be processed in a multiple basis, such that a same information can be accessed by numerous clients or users at the same time from different computers.
- (iii) **High Reliability:** A computer network can be highly reliable and this is accomplished by reproducing critical information or documents data or files on two or more systems. This is helpful in the event that one machine goes down, the user can access the data through some other different machines on the network.
- (iv) **Video Conferencing:** LAN and WAN have made it workable for associations and business parts to have essential dialogs and meeting over live video conferencing.
- (v) **Internet Service:** All the computer the network will encounter to the work load distribution, fast processing and high speed internet.
- (vi) **Broad Casting:** News and vital messages can be communicated just in the matter of seconds that spares a great deal of time and exertion of the work.



Over the network, Individuals, can exchange messages quickly round the clock.

- (vii) **Cost Saving:** Computer networks spare cost for any organizations in various ways. Linkage building via the computer networks promptly exchanges documents and message to the next individuals which lessen transportation and correspondence cost.
- (viii) **Remote Access and Login:** Individuals working in the same organization and are inter connected via the network can have access to the network by basically through the network remote IP or web remote IP.
- (ix) **Flexibility:** Computer networks are very adaptable the greater part of its topologies and networking strategies supports expansion of additional segments and terminals to the network.
- (x) **Communication:** Computer systems fills in as an intense medium of correspondence between individuals who are isolated by geological separation. Communication is one of the greatest points of interest of computer network.

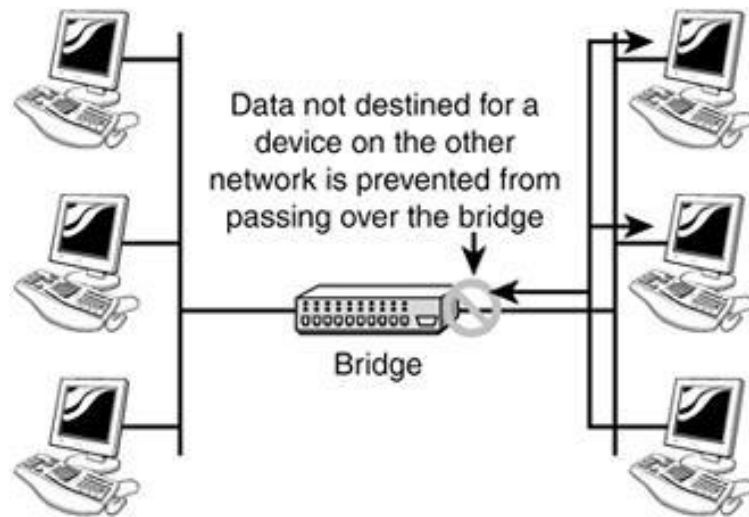
Computer network devices

Computer networking devices are units that are capable of sharing or exchanging data in a computer network. Network devices are parts used to interface PCs or other electronic gadgets with the goal that they can share documents or assets like printers or fax machines. Devices that are utilized to setup a Local Area Network (LAN) are the most widely recognized sort of system gadgets utilized by the general population. A LAN requires a hub, switch, and router. Computer networking devices are also known as communication devices and they constitute a data communication network.

The normal fundamental computer networking devices are:

Bridge: Network sections that commonly utilize a similar communication protocol utilize extensions or bridges to pass data

starting with one network segment then onto the next.



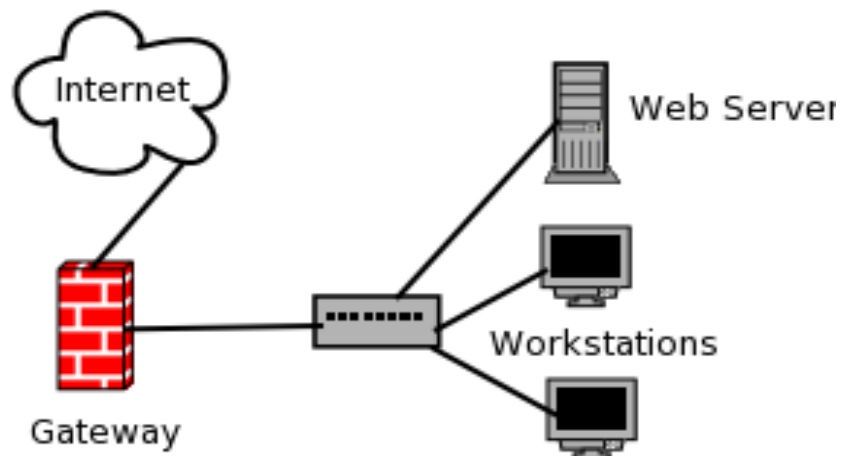
Title : Bridge Network

Attribution : [RedEagle](#) at English Wikibooks

Source : [wikimedia.org](#)

Link : <https://commons.wikimedia.org/wiki/File:Bridge.JPG>

Gateway: When different communication protocols are used by networks then gateways are used to convert the data from the sender's site to the receiver's site.



Title : Gateway

Attribution : [Andrew Weber](#)

Source : [beginlinux.wordpress.com](#)

Link : <https://beginlinux.wordpress.com/tag/gateway/>

Hub: Another name for a hub is a concentrator. Hubs reside in the core of the LAN cabling system. The hub connects workstations and it transmits the data to all the connected workstations.



Title :Hub

Attribution :

Source :pixabay.com

Link:<https://www.pexels.com/photo/white-switch-hub-turned-on-159304/>

Media Dependent Adapter: A MDA is a plug-in module allowing selection among fiber-optic, twisted pair, and coaxial cable.



Title:Media dependent Adapter

Attribution:

Source:officeworks.com.au



Link: <http://www.officeworks.com.au/shop/officeworks/p/d-link-usb3-0-to-gigabit-ethernet-adaptor-dub-1312-dldub1312>

Media Filter: When the electrical characteristics of various networks are different, media filter adapter connectors make the connections possible.

Multi-station Access Unit: MAUs are special concentrators or hubs for use in Token Ring networks instead of Ethernet networks.

Network Interface Card: NICs are printed circuit boards that are installed in computer workstations. They provide the physical connection and circuit required to access the network.

Repeater: Connectivity device are used to regenerate and amplify weak signals, thus extending the length



of the network. Repeaters perform no other action on the data.

Title: Repeater

Attribution:

Source: settopsurvey.com

Link: http://www.settopsurvey.com/settop_website/product/settop-repeater

Router: Links two or more networks together, such as an Internet Protocol network. A router receives packets and selects the optimum path to forward the packets to other networks.



Title:Router

Attribution:

Source:pcmag.com

Link:<https://www.pcmag.com/review/352074/tp-link-archer-c7-ac1750-wireless-dual-band-gigabit-router>

Switch: It is connecting device in a network that functions much like a bridge, but directs transmissions to specific workstations rather than forwarding data to all workstations on the network.

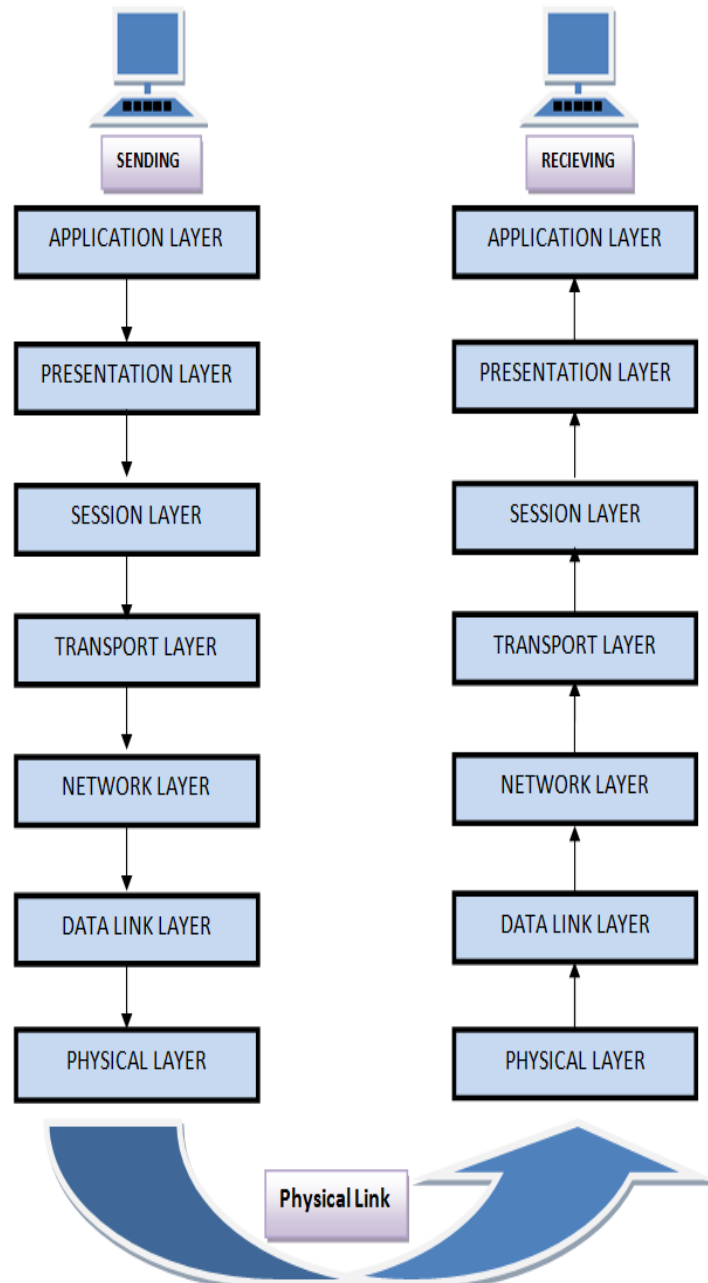
Transceiver: The name transceiver is derived from the combination of the words transmitter and receiver. It is a device that both transmits and receives signals and connects a computer to the network. A transceiver may be external or located internally on the NIC.

ISI/OSI Model in communication networks

There are numbers of users of computer network and are located in different part of the world. So to ensure, national and worldwide data communication, systems must be developed which are compatible to communicate with each other. ISO has developed a model as an open system for interconnectivity. ISO stands for **International Organization of Standardization**. This is called a model for **Open System Interconnection (OSI)** and is commonly known as OSI model.



The ISO-OSI model is seven layer architecture. It defines seven layers or levels in a complete communication system.



Title:ISO/OSI Model in communication networks

Attribution:

Source: nhprice.com

Link:<http://nhprice.com/what-is-ios-model-the-overall-explanation-of-ios-7-layers.html>



Features of OSI Model:

1. Big picture of communication over network can be understood through this OSI model.
2. We see how hardware and software work together.
3. We can understand new developing technologies.
4. Troubleshooting is easier by separate networks.
5. Can be used to compare basic functional relationship on different networks.

Functions of Different Layers:

Layer 1: The Physical Layer:

1. It is the lowest layer of the OSI Model.
2. It is responsible for activation and deactivation, as well as the maintenance of the physical connection.
3. It transmits and receives the unstructured raw data over a network.
4. Voltage and data rates needed for transmission is defined in the physical layer.
5. It converts the digital/analog bits into electrical signal or optical signals.

Layer 2: Data Link Layer:

1. Data link layer synchronizes the information which is to be transmitted from the physical layer.
2. The main function of this layer is to make sure data transfer is error free from one node to another, in the physical layer.
3. Transmitting and receiving data frames sequentially is managed by this layer.
4. This layer sends and accepts acknowledgements for frames received and sent respectively. Resending of non-acknowledged received frames is also handled by this layer.
5. This layer establishes a logical layer between two nodes and also manages the Frame traffic control over the network. It signals the transmitting node to stop, when the frame buffers are full.



Layer 3: The Network Layer:

1. It routes the signal through different channels from one node to other.
2. It acts as a network controller. It manages the Subnet traffic.
3. It decides the route data should take to travel from one network to another.
4. It divides the outgoing messages into packets and assembles the incoming packets into messages from higher levels.

Layer 4: Transport Layer:

1. It decides if data transmission should be on parallel path or single path.
2. Functions such as Multiplexing, Segmenting or Splitting on the data are done by this layer
3. It receives messages from the Session layer above it, converts the message into smaller units and passes it on to the Network layer.
4. Transport layer can be very complex, depending upon the network requirements.

Transport layer breaks the message (data) into small units so that they are handled more efficiently by the network layer.

Layer 5: The Session Layer:

1. Session layer manages and synchronizes the conversation between two different applications.
2. During transfer of data from source to destination in session layer, streams of data are marked and are resynchronized, so that the ends of the messages are not cut prematurely and data loss is avoided.

Layer 6: The Presentation Layer:

1. Presentation layer takes care of sending of data. Data should be sent in such a way that the receiver will understand the information (data) and will be able to use the data.
2. While receiving the data, presentation layer prepares the data for the application layer.



3. Language (syntax) of the two communicating system scan be different. Under this condition presentation layer plays a role of translator.
4. It performs Data compression, Data encryption, Data conversion etc.

Layer 7: Application Layer:

1. It is the topmost layer.
2. Transferring of files, distribution of the results to the user is also done in this layer. Mail services, directory services, network resource etc are services provided by application layer.
3. This layer mainly holds application programs to act upon the received and sent data.

Multimedia Communication Systems

There are 5 types of communication network that are used to provide multimedia communication services:

- Telephone network
- Data network
- Broadcast television network
- Integrated services digital network (ISDN)
- Broadband multiservice network

Telephone network

A telephone network is a telecommunication network used for telephone calls between two or more parties. There are a number of different types of telephone network: A landline network where the telephones must be directly wired into a single telephone exchange.

The telephone network transmits analog signals and hence a modem is required whenever a computer or terminal is connected to the telephone line. The modem then converts digital data from a computer to analog signal that can be transmitted via a



telecommunication line and converts the analog signal received to computer data.

There are a number of different types of telephone network:

- A landline network where the telephones must be directly wired into a single telephone exchange. This is known as the public switched telephone network or PSTN.
- A wireless network where the telephones are mobile and can move around anywhere within the coverage area.
- A private network where a closed group of telephones are connected primarily to each other and use a gateway to reach the outside world. This is usually used inside companies and call centers and is called a private branch exchange (PBX).

Data Network

A **data network** is a type of telecommunications **network** whose main role is to enable nodes to share resources. In a computer **network**, a data link is used to exchange **data** with each other by networked computing devices. The nodes are interconnected using either wired or cable media or wireless media.

The Seven Types of Data Network

- **Local Area Network (LAN)** – LAN can be defined as a network of computers that are present in a localized territory, such as in an office or in a campus. Every one of the PCs are associated with each other through the LAN by means of a hub or a switch. The bigger the quantity of PCs on the LAN, the slower the LAN works.
- **Wide-Area Network (WAN)** – A wide-area network covers a huge geographic zone and normally comprises of numerous computer networks. For example Internet is a kind of WAN that depends on a huge global network of service providers who utilizes routers, switches, modems, and servers to provide connectivity to users and organizations around the



globe. It is a network of interconnected computers that carries data, media, and Webpages.

- **Public Switched Telephone Network (PSTN)** – The public switched network is basically the telephone's version of the Internet. It is a network of public circuit-switched telecommunication. Today's network is mostly digital and includes services for both cellular and landline phones. Telecommunication is the transmission of signals over a large distance, usually by electromagnetic waves. It is used by radio and telephones. Computer data transmission is also a form of telecommunication.
- **Metropolitan Area Network (MAN)** – A MAN is a network that uses technology designed to extend over an entire city. For example, a company could employ a MAN to connect the LANs in all its offices throughout a city.
- **Wireless Networks** – Wireless networks provide transmission and network connectivity to devices without cables or wires. Wi-Fi is a wireless network for computers and cellular devices that have remote access to the network. Bluetooth, which connects with a nearby mobile phone, is a shorter-range version of a wireless network and supports transmission of voice and data. It works only at a distance of a few feet from the communication device that it connects with.
- **Cellular and PCS** – These systems use several radio communications technologies for cellular and PCS devices. The systems divide the region covered into multiple geographic areas. Each area has a low-power transmitter or radio relay antenna device to relay calls from one area to the next area.
- **Satellite Networks** – Satellite networks are offered in a number of configurations. Telephone operating companies use satellites for data and voice transmission to mobile phones on the ground. Some satellite networks provide



navigation information, military surveillance, and weather data. Some others provide television programming, radio broadcasts, and even broadband Internet service.

Broadcast Television Network

A broadcast television network is a group of radio stations, television stations, or other electronic media outlets, that form an agreement to broadcast content from a centralized source. For example, PBS (U.S.) and BBC (U.K.) are TV networks that provide programming for local TV station affiliates to air using signals that can be picked up by the home television sets of local viewers.

Integrated services digital network (ISDN)

Integrated Services Digital Network (ISDN) is a set of communication standards for digital telephone connection and the transmission of voice and data over a digital line. These digital lines are commonly telephone lines and exchanges established by the government. Before ISDN, it was not possible for ordinary telephone lines to provide fast transportation over a single line.

ISDN was designed to run on digital telephone systems that were already in place. As such, it meets telecom's digital voice network specifications. However, it took so long for ISDN to be standardized that it was never fully deployed in the telecommunications networks it was intended for.

Broadband multiservice networks

Airport systems require a network for voice and data transmission, inside and across buildings, allowing connectivity between heterogeneous systems. This network requires an extensive virtualization and is composed by wire and wireless systems (including Wi-Fi infrastructure). Multi Service Networks must be designed with high availability, reliability and simplicity in O&M to support airport operations.

From the perspective of communication, we divide the higher layers of the Multimedia Communication System (MCS) into two architectural subsystems: an application subsystem and a transport subsystem.



Application subsystem

Collaborative Computing

The current infrastructure of networked workstations and PCs and the availability of audio and video at these end-points makes it easier for people to cooperate and bridge space and time. In this way, network connectivity and end-point integration of multimedia provides users with a collaborative computing environment. Collaborative computing is generally known as Computer-Supported Cooperative Work (CSCW).

Tools for Collaborative Computing

There are many tools for collaborative computing, such as electronic mail, bulletin boards (e.g., Usenet news), screen sharing tools (e.g., Show Me from Sunsoft), text-based conferencing systems (e.g., Internet Relay Chat, CompuServe, American Online), telephone conference systems, conference rooms (e.g., Video Window from Bellcore), and video conference systems (e.g., M Bone tools nv, vat). Further, there are many implemented CSCW systems that unify several tools, such as Rapport from AT&T, MERMAID from NEC and others.

Collaborative Dimensions

Electronic collaboration can be categorized according to three main parameters: time, user scale and control, thus, partitioned into a three-dimensional space.

Time

With regard to time, there are two methods of cooperative work: asynchronous and synchronous. Asynchronous cooperative work indicates processing exercises that don't occur in the meantime the synchronous cooperative work occurs in the meantime.

User Scale

The user scale parameter indicates whether a solitary user teams up with another user or a group of users collaborate and work together. Groups can be again categorized as below:



- During its lifetime a group might be static or dynamic. A gathering is static if its part taking individuals are pre-decided and participation does not change amid the completion of the activity. A gathering is dynamic if the quantity of gathering individuals changes during the collaborative activity, i.e., group individuals can join or leave the activity at any time.

- Group members may have diverse parts in the CSCW, e.g.,
 - a member of a group (if he or she is listed in the group definition),
 - a participant of a group activity (if he or she successfully joins the conference),
 - a conference initiator,
 - a conference chairman,
 - a token holder or an observer.

- Groups may comprise of individuals who have homogeneous or heterogeneous attributes and necessities of their shared condition environment.

Control

A collaborative control can be centralized or decentralized. By Centralized control means that the collaborative work is controlled by a chairman (e.g., main manager) and all the group members (e.g., user agent) reports to him or her. Decentralized control implies that each group member has control over his/her own assignments in the cooperative work and appropriated control conventions are set up to give predictable joint effort.

Group Communication Architecture

Group communication (GC) includes the correspondence of different multiple users in a synchronous or asynchronous mode with centralized or decentralized control.

Group communication architecture comprises of a support model, system model and interface model. The GC support model



incorporates group correspondence specialists that convey through a via a multi-point multicast communication network

Group communication agents may utilize the following or their coordinated effort:

Group Rendezvous

Group rendezvous denotes indicates a strategy which enables one organize meeting, and to get data about the group, progressing meetings and other static and dynamic data.

Shared Applications

Application sharing signifies methods which enable one to imitate data to numerous users at the same time. The remote users may reveal or point some facts (e.g., by means of tele-pointing)) of the data and adjust it with the goal so that all users can promptly observe the updated information (e.g., joint editing). Shared applications are basically have a place in collaboration transparent applications.

Conferencing

Conferencing is a basic type of collaborative computing. This service gives the administration of different multiple users for communicating or corresponding with each other utilizing numerous multiple media. Conferencing applications have a place in collaboration-aware applications.

Application Sharing Approach

Sharing applications is perceived as an indispensable instrument for supporting group communication activities. Sharing applications implies that when a mutual shared application program (e.g., editor) executes any input from a participant, all execution results are performed on the shared object (e.g., document text) are disseminated among all the participants. Shared objects are shown, by and large, in shared windows.

Issue in Application Sharing



An essential issue in application sharing is shared control. The essential outline choice decision in sharing applications is to decide if they ought to be centralized or replicated:

Centralized Architecture

In a centralized architecture, first of all a single copy of the shared application runs at one site. After that all participants' input to the application is then circulated to all destinations. The benefit of the centralized approach is easy and simple maintenance as there is just a single copy of the application through which the shared object is updated. The hindrance is high network traffic in light of the fact that the yield of the application should be conveyed every time without fail.

Replicated Architecture

In a repeated design or in a replicated architecture, at each site a copy of the shared application runs locally. Input events to each application are disseminated to all destinations and each duplicate is executed locally at each site.

The main benefits of this design or architecture are reduced network congestion or traffic, because as only input events are disseminated to all destinations, and reduced reaction times, as all participants get their yield from local copies of the application. The impediments are the necessity of a similar execution condition for the application at each site, and the trouble in looking after consistency.

Conferencing

Conferencing is an administration service that controls the communication among various multiple users via multiple media, such as video and audio, in order to accomplish synchronous face-to-face communication. All the more unequivocally, video and sound have the accompanying purposes in a tele-conferencing framework:

- Video is utilized as a part of technical discussions to show view-graph and to demonstrate what number of users are still physically present and attending the conference. For visual support, workstations, PCs or video walls can be utilized.



- Establishing a conference, where the conference participants agree upon a common state, such as identity of a chairman (moderator), access rights (floor control) and audio encoding. Conference systems may perform registration, admission, and negotiation services during the conference establishment phase, but they must be flexible and allow participants to join and leave individual media sessions or the whole conference. The flexibility depends on the control model.
- Closing a conference.
- Adding new clients and expelling clients who leave the meeting or conference.
- Conference states can be stored (located) either on a central machine (*centralized control*), where a central application goes about as the storehouse for all data identified with the meeting, or in an appropriated form.

Multimedia Application

- A Multimedia Application is an Application which utilizes an accumulation of various media sources e.g. text, graphics, images, sound/audio, animation and/or video. Hypermedia can be considered as one of the multimedia applications.
- Multimedia discovers its application in different territories including, yet not constrained to, advertisements, art, education, entertainment, engineering, medicine, mathematics, business, scientific research and spatial, temporal applications.



Category	Media	Application descriptions
Interpersonal communications	Speech	Telephony, voice-mail, teleconferencing
	Image	Facsimile
	Text	Electronic mail
	Text and images	Computer-supported cooperative working
	Speech and video	Video telephony, video mail, videoconferencing
	Text, image, audio and video	Multimedia electronic mail, multiparty video games etc.
Interactive applications over the Internet	Text, image, audio and video	Information retrieval (news, weather, books, magazines, video games, product literature etc.)
		Electronic commerce
Entertainment services	Text, image, audio and video	Audio/CD-on-demand
		Movie/video-on-demand
		Analog and digital television broadcasts
		Interactive television

Multimedia Communication Network Terminologies

We review some of the terminology used in relation to the different media types and operational characteristics of the different type of communication channels provided by different networks.

Media types

The information flow associated with the different applications can be either continuous or block mode.

In the case of continuous media:

- Mode of operation: streaming
- The information stream is generated by the source continuously in a timely-dependent way and played out directly as it is received at the destination. e.g. audio, video
- The continuous media is called real-time media as it's generated in a time-dependent way.



- The source stream can be generated at a constant bit rate (CBR) or a variable bit rate (VBR).
- In the case of block-mode media:
- Mode of operation: downloading
- The source information comprises a single block of information that is created in a time-independent way. E.g. text, image
- The delay between the request being made and the contents of the block being outputted at the destination is called round-trip delay. (should be < few seconds)

Communication Modes

The transfer of the information streams associated with an application can be 1 of the 5 modes:

- **Simplex:** 1 direction only
- **Half-duplex:** flows in both directions but alternately
- **Full-duplex:** flows in both directions simultaneously (1-to-1 transmission)
- **Broadcast:** 1-to-all transmission
- **Multicast:** 1-to-many transmission
- In duplex communications, if the flows in the 2 directions are equal, the information flow is symmetric. Otherwise, it's asymmetric.

Network types

There are 2 types of communications channel associated with the various network types: circuit-mode & packet mode.

Channels in circuit-mode: Operates in a time-dependent way. Also known as a synchronous communications channel since it provides a constant bit rate service.

Channels in packet-mode: Operates in a time-varying way. Also known as an asynchronous communications channel since it provides a variable bit rate service.

Circuit-mode: This type of network is also known as a circuit switched network. A circuit-mode network comprises an interconnected set of switching offices/exchanges to which the



subscribers/computers are connected. Prior to sending any information, the source must first set up a connection through the network. The bit rate associated with the connection is fixed. The messages associated with the setting up and clearing of a connection are known as signaling messages. There is a call/connection setup delay. Examples: PSTN and ISDN.

Packet-mode: There are 2 types of packet-mode networks: connection-oriented (CO) and connectionless (CL). This type of network is also known as a packet

switched network.

A connection-oriented network: A connection-oriented network comprises an interconnected set of packet-switching exchanges (PSEs). Prior to sending any information, a connection is first set up through the network. The connection utilizes only a variable portion of the bandwidth of each link and hence it's known as a virtual connection or a virtual circuit (VC). Each PSE has a routing table which defines a packet coming from which input link will be delivered to which output link. Examples: X.25, ATM network

Connectionless network: The establishment of a connection is not required and the two communicating terminals/computers can communicate and exchange information as and when they wish. Each packet must carry the full source and destination addresses in its header in order for each PSE to route the packet onto the appropriate outgoing link. The term router is normally used rather than PSE. Example: Internet

Basic mode of operation (Common to PS networks):

When a packet is forwarded to a PSE/router, it's stored in a buffer, checked, discarded if there is any problem (due to congestion or error), or else forwarded to next PSE/router if the outgoing link is available.

Each PSE/router has a routing table and it's used to determine the outgoing link to which a packet from a particular incoming link should forward.

This mode of operation is called store-and-forward as a packet has to wait in a PSE/router until the outgoing link is available. The service offered by a packet-switched network is said to be a best-effort service as the transmission of a packet is not guaranteed to



be successful. **Mean packet transfer delay:** The mean of overall transfer delay of a packet across the network.

Delay variation or jitter: the variation about the mean packet transfer delay.

Multipoint conferencing

- It's implemented in one of the 2 ways: centralized and decentralized.
- The centralized mode is used with circuit-switched networks such as a PSTN or an ISDN.
- The decentralized mode is used with packet-switched networks which support multicast communications. (e.g. LAN, intranet and the Internet)
- A third mode known as the hybrid mode can be used.

Network QOS

The networks Quality of Service (QoS) parameters are the operational parameters associated with a communications channel through a network, and collectively determine the suitability of the channel in relation to its use for a particular application.

Circuit-switched network: (CBR network)

The QoS associated with a CBR channel that is set up through a circuit-switched network include:

- The bit rate
- The mean bit error rate
- The transmission delay

The mean bit error rate (BER) of a channel is the probability of a bit being corrupted during its transmission across the channel in a defined time interval.

Issue of the block size: In practice, most networks provide an unreliable service (best-effort service). Information is partitioned into blocks during its transmission so as to minimize the propagation of error. Any blocks containing bit errors will be discarded. A reliable service can be offered by using error detection and block retransmission, which results in high transmission overheads and additional delay. The choice of the



block size is a compromise between the delay and the overhead in this case.

The transmission delay associated with a channel is determined by the bit rate, the codec delay and the propagation delay. The propagation delay is determined by

- (i) The physical separation of the 2 communicating devices and
- (ii) The velocity of propagation of a signal across the transmission medium.

Packet-switched network

The QOS parameters associated with a packet-switched network include:

- The maximum packet size
- The mean packet transfer rate
- The mean packet error rate
- The mean packet transfer delay
- The worst-case jitter
- The transmission delay

Mean packet transfer rate is a measure of the average number of packets that are transferred across the network per second

- Mean bit rate of the channel = mean packet transfer rate x mean packet size
- Mean packet error rate (PER) is the probability of a received packet containing bit errors.
- Mean packet transfer delay is the summation of the store-and-forward delay that a packet experiences when it travels along the route.

The transmission delay

Includes the codec delay and the signal propagation delay is the same whether the network operates in a packet mode or a circuit mode

Application QOS

The application QOS parameters that relate to the network include:

- The required bit rate or mean packet transfer rate
- The maximum start up delay
- Maximum delay variation/jitter



- Maximum round-trip delay

Start up delay defines the amount of time that elapses between an application making a request to start a session and the confirmation being received from the application at the destination.

A circuit-switched network would be most appropriate for applications that involve the transfer of a constant bit rate stream.

1. The call setup delay is not important.
2. The channel provides a constant bit rate service of a known rate.

A connectionless packet-switched network would be more appropriate for interactive applications.

1. There is no network call setup delay
2. Any variations in the packet delay are not important.

When packet-switched network is used:

A technique known as buffering is used to overcome the effect of jitter in a packet-switched network. The effect of jitter is overcome by retaining a defined number of packets in a memory buffer at the destination before play out of the information bit stream is started. Buffering delay plus the time for playing a packet must be larger than the worst-case jitter. Packetization delay is the delay incurred at the source to packetize the information. The larger the size of a packet, the larger the packetization delay is some other concerns when determining the packet size:

- Is retransmission required?
- Is the destination buffer larger enough to handle the worst-case jitter?



Unit summary



Summary

Multimedia communication has been used by various centralized and distributed multimedia applications: Video-conferencing, retrieval systems and video-on-demand will address all network types, LANs (e.g., in-house information systems), MANs (e.g., city information systems, campus networks) and WANs (e.g., distributed over the Internet).

QoS is of particular concern for the continuous transmission of high-bandwidth video and multimedia information. Transmitting this kind of content dependably is difficult in public networks using ordinary "best effort" protocols.

So a communication system has to provide a complete multimedia communication infrastructure that is needed to support distributed multimedia applications with more user control and interactivity. Faster processors and hardware, higher network bandwidth and data compression ratios as well as improvements in a variety of related technologies are necessary this purpose. For the communication system to be commercially viable, two considerations are very important: quality of service and cost.

Assessment



Assessment

1. List the advantages of setting up Computer Networks.

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2. Outline the functions of Network Layer of OSI Model.

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3. List the types of communication network that are used to provide multimedia communication services

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4. Name the Seven Types of Data Networks.

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5. State the different data communication modes?

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Resources



- Tay Vaughan, "Multimedia Making it work" , Mc Grow Hill, Eighth Edition
- Jeffcoat "Multimedia in Practice – Technology and applications"
- https://en.wikipedia.org/wiki/Telephone_network
- <http://www.ingrammicroadvisor.com/unified-communications-and-collaboration/the-seven-types-of-data-networks-youll-probably-come-across>
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