NATIONAL OPEN UNIVERSITY OF NIGERIA

# CIT 742

## Multimedia Technology

## Module 2

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# Module 2 Multimedia Systems Technology

# Unit 1 Media and Signals

## 1.0 Introduction

Media and signals are at the heart of every multimedia system. In this unit, we'll discuss the concept of synchronization and highlight typical examples of discrete and continuous media.

## 2.0 Objectives

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

- distinguish between discrete and continuous media
- explain the concept of synchronization
- Identify analog and digital signals.

## 3.0Main Content

### 3.1 Media and Signals

In this unit, we shall treat the concepts of media and signals distinctly to facilitate a deeper understanding.

#### 3.1.1 Discrete vs. Continuous Media

Multimedia systems deal with the generation, manipulation, storage, presentation, and communication of information in digital form. This implies that the data may be in a variety of formats: ***text, graphics, images, audio, and video***.

A good number of this data is large and the different media may need *synchronization*, i.e. the data may have temporal relationships as an integral property.

Some media is time independent or ***static*** or ***discrete*** media: normal data, text, single images, graphics are examples.

Video, animation and audio are examples of ***continuous*** media.

#### 3.1.2 Analog and Digital Signals

The world we sense is full of analog signals. Electrical sensors such as transducers, thermocouples, microphones etc convert the medium they sense into electrical signals. These are usually continuous and still analog.

These analog signals must be converted or *digitized* into discrete digital signals that computer can readily deal with. Special hardware devices called *Analog-to-Digital* converters perform this task.

For playback *Digital-to-Analog* must perform a converse operation.

Note that Text, Graphics and some images are generated directly by computer and *do not* require digitizing: they are generated directly in binary format.

Handwritten text would have to be digitized either by electronic pen sensing of scanning of paper based form.

### Self-Assessment Exercise

List at least 3 common types of static media

## 4.0 Conclusion

We discovered that data may be in a variety of formats: ***text, graphics, images, audio, and video***. We equally saw typical examples of static and discrete signals.

## 5.0 Summary

In this unit, we learnt about discrete and continuous media. We equally described the term 'synchronization' and examined analog and digital signals. Be assured that the facts gathered from this unit will be valuable for exploring multimedia applications. OK! Let us attempt the questions below.

## 6.0 Self-Assessment Exercise

1. Distinguish between discrete and continuous media

2. Explain the concept of synchronization

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# Unit 2 Media Sources and Storage Requirements

## 1.0 Introduction

In this unit we will consider each media and summarise how it may be input into a Multimedia system. The unit will equally analyse the basic storage requirements for each type of data.

## 2.0 Objectives

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

- state 2 common sources of text and static data
- describe the terms graphics and images
- describe the common procedure for capturing audio signals
- explain the concept of a raw video.

## 3.0 Main Content

### 3.1 Texts and Static Data

The sources of this media are the keyboard, floppies, disks and tapes. Text files are usually stored and input character by character. Files may contain raw text or formatted text e.g HTML, Rich Text Format (RTF) or a program language source (C, Pascal, etc.

The basic storage of text is 1 byte per character (text or format character). For other forms of data e.g. Spreadsheet files some formats may store format as text (with formatting) others may use binary encoding.

### 3.2 Graphics

Graphics are usually constructed by the composition of primitive objects such as lines, polygons, circles, curves and arcs. Graphics are usually generated by a graphics editor program (**e.g.** Freehand) or automatically by a program (**e.g.** Postscript usually generated this way). Graphics are usually editable or revisable (unlike Images).

Graphics input devices include: keyboard (for text and cursor control), mouse, trackball or graphics tablet.

Graphics files may adhere to a graphics standard (OpenGL, PHIGS, GKS) Text may need to stored also. Graphics files usually store the primitive assembly and do not take up a very high overhead.

### Self-Assessment Exercise

How are graphics constructed?

### 3.2 Images

Essentially, images are still pictures which (uncompressed) are represented as a bitmap (a grid of pixels). They may be generated by programs similar to graphics or animation programs. But images may be scanned for photographs or pictures using a digital scanner or from a digital camera. Some Video cameras allow for still image capture also. Analog sources will require digitizing.

In general, images may be stored at 1 bit per pixel (Black and White), 8 Bits per pixel (Grey Scale, Colour Map) or 24 Bits per pixel (True Colour). Thus a 512x512 Grey scale image takes up 1/4 Mb, a 512x512 24 bit image takes 3/4 Mb with no compression. This overhead soon increases with image size so compression is commonly applied.

### 3.3 Audio

Audio signals are continuous analog signals. They are first captured by microphones and then digitized and stored -- usually compressed as CD. Quality audio requires 16-bit sampling at 44.1 KHz. Thus, 1 Minute of Mono CD quality audio requires 60*44100*2 Bytes which is approximately 5 Mb.

### 3.4 Video

Analog Video is usually captured by a video camera and then digitized. There are a variety of video (analog and digital) formats.

Raw video can be regarded as being a series of single images. There are typically 25, 30 or 50 frames per second. Digital video clearly needs to be compressed.

## 4.0 Conclusion

We've been able to spot basic input and storage of text and static data. We discovered that, graphics are usually constructed by the composition of primitive objects such as lines, polygons, circles, curves and arcs. Images can be referred to as still pictures which (uncompressed) are represented as a bitmap. Audio signals are continuous analog signals. Raw video can be regarded as being a series of single images. explorer.

## 5.0 Summary

In summary, this unit looked at the basic input and storage of text and static data. We also considered how graphics, images, audio and video are represented. You can now attempt the questions below.

## 6.0 Self-Assessment Exercise

1. State 2 common sources of text and static data

2. Describe the common procedure for capturing audio signals

3. Explain the concept of a raw video

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# Unit 3 Output Devices and Storage Media

## 1.0 Introduction

Now that you have been introduced to common types of media, we will now consider output devices and storage units for multimedia systems.

## 2.0 Objectives

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

- list output devices for a basic multimedia system
- describe the common modes of storage
- identify the key issues I/O performance
- state the difference between DVD-Video and DVD-ROM
- list the key components of a RAID System
- give the storage parameters that affect how data is stored.

## 3.0 Main Content

### 3.1 Output Devices

Usually, multimedia systems require output devices. The output devices for a basic multimedia system include:

- A High Resolution Colour Monitor
- CD Quality Audio Output
- Colour Printer
- Video Output to save Multimedia presentations to (Analog) Video Tape, CD-ROM DVD.
- Audio Recorder (DAT, DVD, CD-ROM, (Analog) Cassette)
- Storage Medium (Hard Disk, Removable Drives, CD-ROM)

### 3.2 High Performance I/O

Before proceeding, let us consider some key issues that affect storage media:

- Large volume of data
- Real time delivery

- Data format
- Storage Medium
- Retrieval mechanisms

First two factors are the real issues that storage media have to contend with. Due to the volume of data, compression might be required. The type of storage medium and underlying retrieval mechanism will affect how the media is stored and delivered. Ultimately any system will have to deliver high performance I/O. We will discuss this issue before going on to discuss actual Multimedia storage devices.

There are four factors that influence I/O performance:

**Data**

Data is high volume, maybe continuous and may require contiguous storage. Direct relationship between size of data and how long it takes to handle. Compression and also distributed storage.

**Data Storage**

The strategy for data storage depends of the storage hardware and the nature of the data. The following storage parameters affect how data is stored:

- Storage Capacity
- Read and Write Operations of hardware
- Unit of transfer of Read and Write
- Physical organisation of storage units
- Read/Write heads, Cylinders per disk, Tracks per cylinder, Sectors per Track
- Read time
- Seek time

**Data Transfer**

Depends on how data generated and written to disk, and in what sequence it needs to retrieved. Writing/Generation of Multimedia data is usually sequential *e.g.* streaming digital audio/video direct to disk. Individual data (*e.g.* audio/video file) usually streamed.

RAID architecture can be employed to accomplish high I/O rates by exploiting parallel disk access

**Operating System Support**

Scheduling of processes when I/O is initiated. Time critical operations can adopt special procedures. Direct disk transfer operations free up CPU/Operating system space.

**Self-Assessment Exercise**

What are the storage parameters that affect how data is stored?

## 3.3 Basic Storage

Basic storage units have problems dealing with large multimedia data

- Single Hard Drives -- SCSI/IDE Drives. So called *AV* (Audio-Visual) drives, which avoid thermal recalibration between read/writes, are suitable for desktop multimedia. New drives are fast enough for direct to disk audio and video capture. But not adequate for commercial/professional Multimedia. Employed in RAID architectures.

- Removable Media -- Jaz/Zip Drives, CD-ROM, DVD. Conventional (dying out?) floppies not adequate due 1.4 Mb capacity. Other media usually ok for backup but usually suffer from worse performance than single hard drives.

## 3.4 Redundant Array of Inexpensive Disks (RAID)

The concept of ***RAID*** has been developed to fulfill the needs of current multimedia and other application programs which require fault tolerance to be built into the storage device.

Raid technology offers some significant advantages as a storage medium:

- Affordable alternative to mass storage

- High throughput and reliability

The cost per megabyte of a disk has been constantly dropping, with smaller drives playing a larger role in this improvement. Although larger disks can store more data, it is generally more power effective to use small diameter disks (as less power consumption is needed to spin the smaller disks). Also, as smaller drives have fewer cylinders, seek distances are correspondingly lower.

Following this general trend, a new candidate for mass storage has appeared on the market, based on the same technology as magnetic disks, but with a new organisation. These are arrays of small and inexpensive disks placed together, based on the idea that disk throughput can be increased by having many disk drives with many heads operating in parallel. The distribution of data over multiple disks automatically forces access to several disks at one time improving throughput. Disk arrays are therefore obtained by placing small disks together to obtain the performance of more expensive high end disks.

The key components of a RAID System are:

- Set of disk drives, disk arrays, viewed by user as one or more logical drives.

- Data may be distributed across drives
- Redundancy added in order to allow for disk failure

## 3.5 Optical Storage

Optical storage has been the most popular storage medium in the multimedia context due its compact size, high density recording, easy handling and low cost per MB.

CD is the most common and we discuss this below. Laser disc and recently DVD are also popular.

## 3.6 CD Storage

CDs (compact discs) are thin pieces of plastic that are coated with aluminum and used to store data for use in a variety of devices, including computers and CD players. The main or standard type of CD is called a CD-ROM; ROM means read-only memory. This type of CD is used to store music or data that is added by a manufacturer prior to sale. It can be played back or read by just about any CD player as well as most computers that have CD drives. A consumer cannot use this type of CD to record music or data files; it is not erasable or changeable.

If consumers want to purchase recordable CDs to record music store data files, they usually have some options available to them. One is the CD-R, which is the typical choice for an individual who only wants to add data files or music to a CD once. An individual uses a CD burner, which is a component of many modern computer systems, to record to these discs.

Some recordable CDs are classified as CD+R. This type of disc allows consumers to record music or data to it, but provides nearly twice the amount of space that is available with a CD-R. A CD-RW also has a place among the recordable CDs. This one is a bit different, because it allows consumers to erase it and record over it again. Otherwise, it can be used in the same manner as CD-Rs and CD+Rs.

## 3.7 DVD

DVD, which stands for *Digital Video Disc*, *Digital Versatile Disc*, is the next generation of optical disc storage technology. This disc has become a major new medium for a whole host of multimedia system:

It's essentially a bigger, faster CD that can hold video as well as audio and computer data. DVD aims to encompass home entertainment, computers, and business information with a single digital format, eventually replacing audio CD, videotape, laserdisc, CD-ROM, and perhaps even video game cartridges. DVD has widespread support from all major electronics companies, all major computer hardware companies, and most major movie and music studios, which is unprecedented and says much for its chances of success (or, pessimistically, the likelihood of it being forced down our throats).

It's important to understand the difference between DVD-Video and DVD-ROM. DVD-Video (often simply called DVD) holds video programs and is played in a DVD player hooked up to a TV. DVD-ROM holds computer data and is read by a DVD-ROM drive

hooked up to a computer. The difference is similar to that between Audio CD and CD-ROM. DVD-ROM also includes future variations that are recordable one time (DVD-R) or many times (DVD-RAM). Most people expect DVD-ROM to be initially much more successful than DVD-Video. Most new computers with DVD-ROM drives will also be able to play DVD-Videos.

There's also a DVD-Audio format. The technical specifications for DVD-Audio are not yet determined.

## 4.0 Conclusion

To wrap up, recall that the type of storage medium and underlying retrieval mechanism will affect how the media is stored and delivered. RAID architecture can be employed to accomplish high I/O rates. Basic storage units have problems dealing with large multimedia data. CDs (compact discs) are thin pieces of plastic that are coated with aluminum and used to store data for use in a variety of devices. DVDs are essentially optical storage discs that can hold video as well as audio and computer data. Typically, they are bigger and faster than CDs

## 5.0 Summary

This unit provided an overview of output devices for a basic multimedia system. We also highlighted the common modes of storage, key issues affecting storage media as well as factors that affect I/O performance. However, to assess your level of assimilation, you would need to attempt the questions below.

## 6.0 Self-Assessment Exercise

1. What are the key components of a RAID System?
2. List at least 4 output devices for a basic multimedia system
3. Describe the common modes of storage
4. Identify the key issues I/O performance
5. State the difference between DVD-Video and DVD-ROM

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