

SHEPHERD COLLEGE

Multimedia System & Communication MMS2401

SUBJECT LECTURER
PRATIK MAN SINGH PRADHAN

MMS – 2401 – Multimedia Systems & Communications – 3 Credits

Course Description

This course introduces technologies for multimedia communications. We will address how to efficiently represent multimedia data, including video, image and audio, and how to deliver them over a variety of networks. In the coding aspect, state of the art compression technologies will be presented.

Emphasis will be given to a number of standards, including H.26x, MPEG, and JPEG. In the networking aspect, special considerations for sending multimedia over ATM, wireless, and IP networks, such as error resilience and quality of service, will be discussed.

Internal Examination	20% (80 Marks)
Practical Project	20% (50 Marks)
Final Examination	60% (80 Marks)
Total	100% (100 Marks)

Reference Books:

Multimedia System Design – Prentice Hall – Andliegh

Multimedia Systems – Addison-Wesley – Koegel-Buford

Multimedia: Computing, Communications & Applications – Pearson Education Asia – Steinmenz

Multimedia Making it Work – Tara McGraw-Hill –Tay Veyghan

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Chapter 1 - Multimedia Fundamentals

Introduction

- ▶ Multimedia is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media
- ▶ Every type of information can be represented, stored, transmitted and processed digitally.

Concept and Structure

Multimedia may be broadly divided into linear and non-linear categories.

- ▶ **Linear** active content progresses often without any navigational control for the viewer such as a cinema presentation.
- ▶ **Non-linear** uses interactivity to control progress as with a video game or self-paced computer based training.

Definition of Multimedia

- ▶ Multi = Numerous | Media = Medium | Multimedia = Multiple Modes of Mediums
- ▶ Multimedia is content that uses a combination of different content forms such as:
 - ▶ Text
 - ▶ Audio
 - ▶ Images
 - ▶ Animation
 - ▶ Video
 - ▶ Interactive Content
- ▶ These may also be referred to as digital multimedia.
- ▶ Multimedia contrasts with media that use only rudimentary computer displays such as text-only or traditional forms of printed or hand-produced material.

Characteristics of Multimedia Systems

- ▶ Multimedia systems must be computer controlled
- ▶ They are integrated
- ▶ The information they handle must be represented digitally
- ▶ The information to the final user may permit interactivity

Multimedia Data Elements

- ▶ Text
- ▶ Facsimile (Fax)

- ▶ Document Images
- ▶ Photographic Images
- ▶ Geographic Information System Maps (GIS Maps)
- ▶ Voice Command and Synthesis
- ▶ Audio Messages
- ▶ Music
- ▶ Graphics
- ▶ Moving Graphics (Animation)
- ▶ Full motion stored and Live Videos
- ▶ Holographic Images
- ▶ Fractals (Digital Computer Generated Patterns)

Classification of Multimedia Data

- ▶ Captured versus Synthesized
 - ▶ Media captured from real-world
 - ▶ Synthesized by computers
- ▶ Discrete versus continuous media
 - ▶ Discrete space-based only
 - ▶ Continuous space-based and time-based E.g. Animation, Motion Video

Traditional Media Data Stream

- ▶ Traditional data stream of media used separate devices instead of one and use analog signals, reels and films to store in information.
- ▶ TV, Radio, Film and Print are considered as traditional Medias

Traditional Media Data Stream Characteristics

- ▶ Separate storage mediums for separate medias
- ▶ Separate playback devices for each media
- ▶ Fully based on analog or mechanical signals
- ▶ Losses quality over time
- ▶ Linear method of storage
- ▶ Takes of more space compares to digital media

Benefits of Multimedia System

- ▶ Easy to understand and easy to use
- ▶ Integrated and interactive
- ▶ Conductive and cooperative work environment
- ▶ Flexible
- ▶ Supportive of large audience

Challenges of Multimedia System Design

- ▶ Host computing power requirement
- ▶ Data storage and management requirements
- ▶ Human Interface usability requirements
- ▶ Network latency and throughput requirements

Forms of Multimedia

- ▶ Text
- ▶ Graphics
- ▶ Audio
- ▶ Video/Animation

Text

- ▶ Text in multimedia refers to the alphanumeric characters that you see in a screen while opening simple documents or while surfing the web. It is a basic element in any multimedia system which may be a part of the interface or a file.

Graphics

- ▶ Graphics in multimedia are the image files that may be pictures, buttons, cursor, icons and other designed elements such as logos or banners. They may be raster or vector graphics.

Audio

- ▶ Audio in multimedia refers to sound files that may be music, voice or sound effects. They are recorded via audio capturing devices and are stored digitally.

Video/Animation

- ▶ Video is a collection of moving images with or without sound that give the viewer an illusion that the image is moving on screen. Video in multimedia refers to recorded videos such as film, documentaries and computer generated animations.

Video

- ▶ Videos in specific refers to recorded footages that may be from a camera or webcam and is not digitally produced.

Animation

- ▶ Animations in specific refers to visually produced moving graphics that may be cartoons or motion graphics. The animation may be hand drawn or computer based.

Computer Based Animation

- ▶ Computer based animations are fully produced using computers. These days, this has become the standard.
- ▶ These types of animation are produced using digital Motion Graphics, 2D and 3D animation Engines.

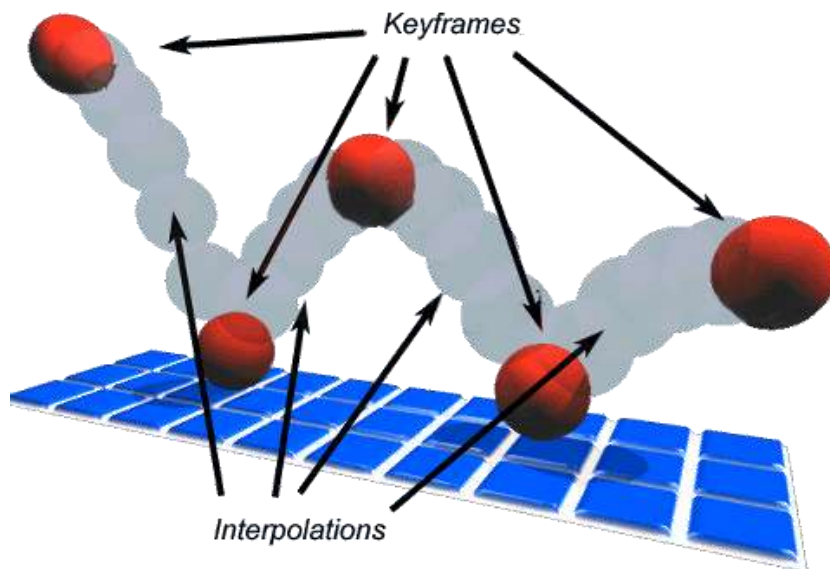
Computer Based Animation Steps

1. Concept Design
2. Story Outline
3. Script
4. Storyboard
5. Animatic
6. Design/Model
7. Texture/Shadows
8. Lighting
9. Camera Setup
10. Key frames
11. Refining
12. Render
13. Edit
14. Export

Key-frames

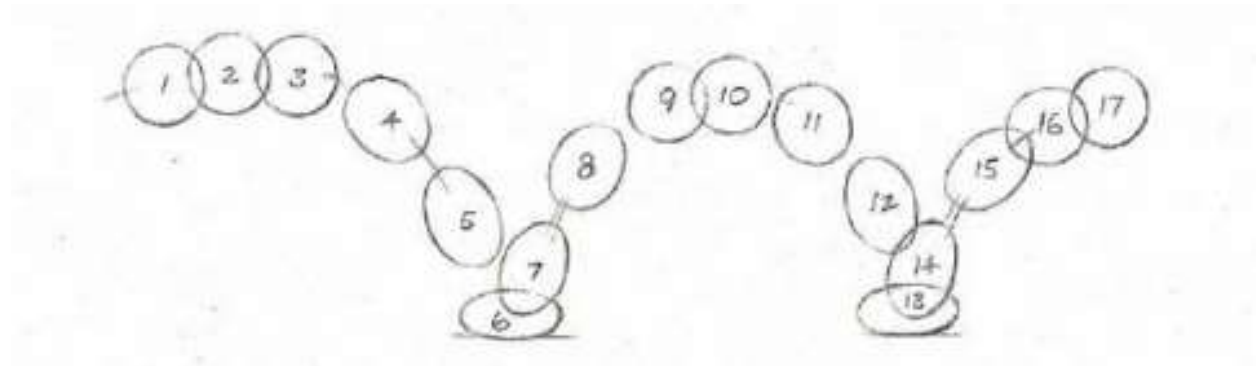
- ▶ A key frame in animation and filmmaking is a drawing that defines the starting and ending points of any smooth transition.
- ▶ The drawings are called "frames" because their position in time is measured in frames on a strip of film.
- ▶ A sequence of key frames defines which movement the viewer will see, whereas the position of the key frames on the film, video, or animation defines the timing of the movement.

- ▶ Because only two or three key frames over the span of a second do not create the illusion of movement, the remaining frames are filled with in-betweens.



In-between Frames

- ▶ In-betweening or tweening is the process of generating intermediate frames between two images to give the appearance that the first image evolves smoothly into the second image.
- ▶ In-betweens are the drawings between the key frames which help to create the illusion of motion.
- ▶ In-betweening is a key process in all types of animation, including computer animation.



Visual Effects Motion

- ▶ In filmmaking, visual effects (abbreviated VFX) are the processes by which imagery is created and/or manipulated outside the context of a live action shot.
- ▶ Visual effects involve the integration of live-action footage and generated imagery to create environments which look realistic, but would be dangerous, expensive, impractical, or simply impossible to capture on film

- ▶ Visual effects using computer generated imagery have recently become accessible to the independent filmmaker with the introduction of affordable and easy-to-use animation and compositing software.
- ▶ The possibility of smooth Visual effects motion came with the development of high end multi-core Graphics Cards.

Different Methods of Controlling Animation

- ▶ **Key Framing**
 - ▶ Using key poses for shapes and characters.
 - ▶ This is the most simple way for animation
- ▶ **Motion Paths**
 - ▶ Uses an animation technique that uses a pathway for the animation to follow
 - ▶ Used for a bit more complex movements
- ▶ **Parametric Motion Control**
 - ▶ By using programming languages
 - ▶ Such as MEL/Python for Autodesk Maya, Expressions for Adobe After Effects
 - ▶ Initially hard to use but saves a lot of time for complex motions

Chapter 2 - Multimedia Communications

What is Multimedia?

- ▶ Multimedia is the use of computers to present text, graphics, video, animations, and sound in an integrated way.
- ▶ The term Multimedia describes a number of diverse technologies that allow visual and audio media to be combined in new ways for the purpose of communication.
- ▶ Its application include entertainment, education, medicine, advertising etc.

Principles of Communications

- ▶ Communication is the transfer of information
- ▶ The transfer needs a Channel (E.g. Air, Cable, Fiber Optics, etc.)
- ▶ Multimedia communication uses multiple channels.
- ▶ The principles of communication deals with
 - ▶ Standards
 - ▶ Protocols
 - ▶ Error Control, Redundancy(Repetition) and Accuracy
 - ▶ Channel
 - ▶ Context
 - ▶ Coding

Multimedia Communication

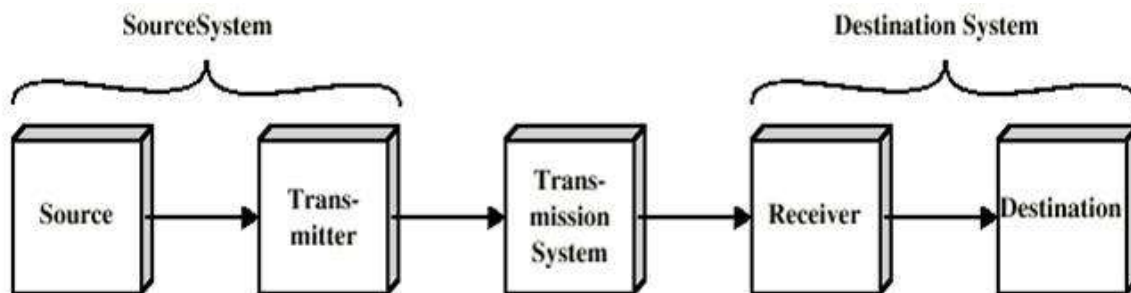
- ▶ **Multimedia communication involves showing information in multiple media formats.** Images, video, audio and text all are part of multimedia communication. A single instance of multimedia communication does not have to have all four components.
- ▶ Examples: Websites, Information Kiosks and Interactive Media

Multimedia Communication Network

◆ Interactive Multimedia Networks



Data Communication Model

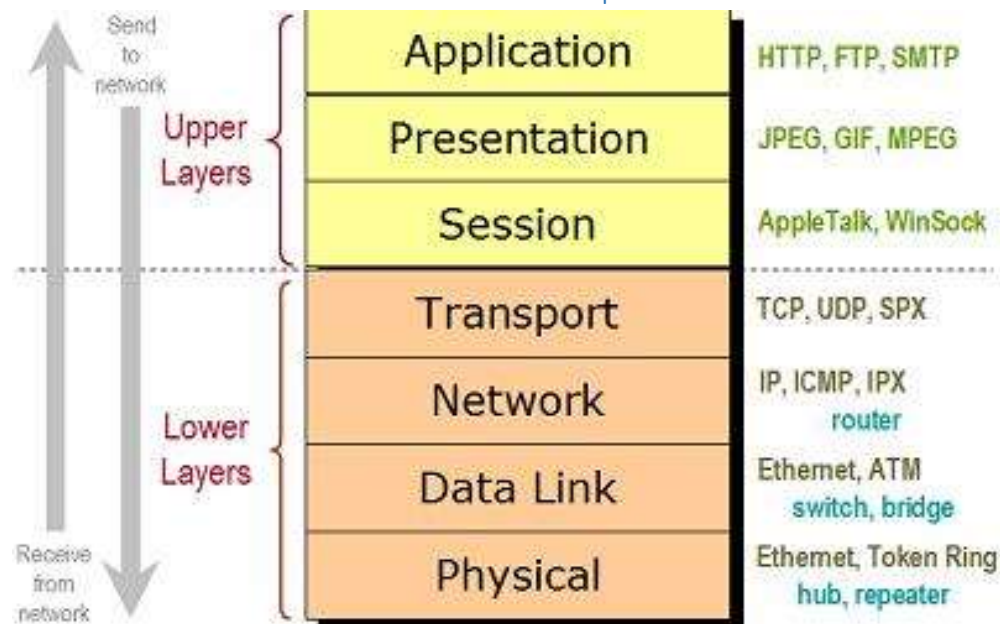


(a) General block diagram



(b) Example

Multimedia Communication Network Components



Channels / Mediums

- ▶ A communication channel refers either to a physical transmission medium such as a wire, or to a logical connection over a multiplexed medium such as a radio channel.
- ▶ A channel is used to convey an information signal, for example a digital bit stream, from one or several senders (or transmitters) to one or several receivers.
- ▶ A channel has a certain capacity for transmitting information, often measured by its bandwidth in Hz or its data rate in bits per second.

Medium Types and Classification

There are 2 multimedia transmission mediums

- ▶ **Wired**
 - ▶ Co-axial Cable
 - ▶ Twisted Pair Cable
 - ▶ Shielded Twisted Pair Cable
 - ▶ Unshielded Twisted Pair Cable
 - ▶ Fiber Optics Cable
 - ▶ Single Thread
 - ▶ Multi Thread
- ▶ **Wireless**
 - ▶ Microwave (Satellite Waves)

- ▶ Radio wave (FM, AM, Bluetooth, Wi-Fi, Cellular Network)
- ▶ Light Waves (Infrared, Li-Fi)

Choice of Channels

- ▶ We choose wireless mediums if we require just a limited amount of speed. For e.g. for a home or office connection where we use the network for personal file sharing and for streaming multimedia contents. Also it covers a limited reason of space.
- ▶ Wired medium are used if we need a very high connection speed, this is usually true in case we want to transfer over an Exabyte of data. It also allows for a reliable long distance connection between computers.
- ▶ Choice of channels depends on
 - ▶ Availability of channel
 - ▶ Availability of equipment
 - ▶ Ability to use the channel
 - ▶ Ability to understand message
 - ▶ Economic considerations
 - ▶ Time problems

Media Types and Classification

- ▶ Audio (MP3, WAV, AIFF)
- ▶ Video (MPEG, AVI, MP4)
- ▶ Graphics (JPEG, PNG, TIFF, GIF)
- ▶ Text (HTML, TXT, RTF)

Media Types and Their Use

- ▶ Audio – Used for Podcasts, Music and VoIP
- ▶ Video – Used for Video Streaming, Films and Video Conferencing
- ▶ Graphics – Used for Images, Icon, Infographics, Charts and Visual Representation
- ▶ Text – Used to display computer text in Human Readable Format

Concept of Information

- ▶ Information is that which informs.
- ▶ When raw data are well arranged, they become information that gives meaning
- ▶ Example: Graphs, Charts, Articles, Graphics, Movies etc.

Information Structure

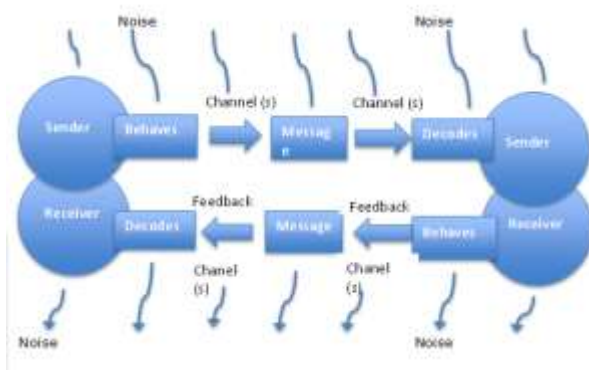
- ▶ Information structure refers to how data are arranged in order to give a related useful meaning as information.
- ▶ Information Structures can be:
 - ▶ Tabular Structure
 - ▶ Spatial or temporal structure
 - ▶ Trees, network or graphs
 - ▶ Text and documentation
 - ▶ Combination of multiple strategies

Communication of Information

- ▶ Raw data can be converted into an information structure of choice and then we may use the medium of communication of our choice.
- ▶ Communication may involve errors
- ▶ In digital communication where binary of used errors cause 1 to become 0 and 0 to become 1
- ▶ To detect or correct errors requires extra information (Redundancy)

Model of Communication

- ▶ Models of communication are conceptual models used to explain the human communication process.
- ▶ The first major model for communication came in 1949 and was conceived by Claude Elwood Shannon and Warren Weaver for Bell Laboratories.



Modes of Media Transmission

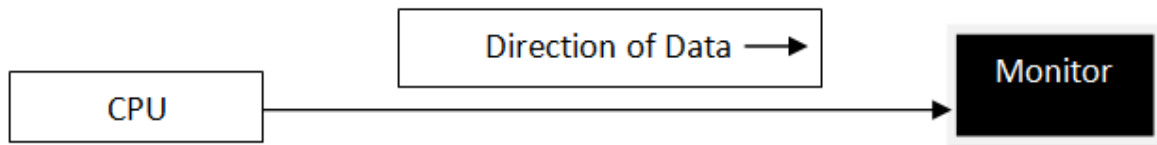
Simplex

Half-Duplex

Full-Duplex

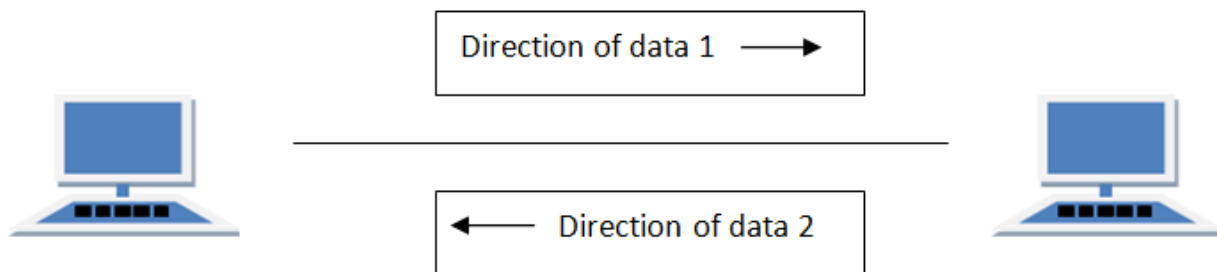
Simplex Mode of Media Transmission

- ▶ In this type of transmission mode data can be sent only through one direction i.e. communication is unidirectional. We cannot send a message back to the sender. Unidirectional communication is done in Simplex Systems.
- ▶ Examples of simplex Mode is loudspeaker, television broadcasting, television and remote, keyboard and monitor etc.



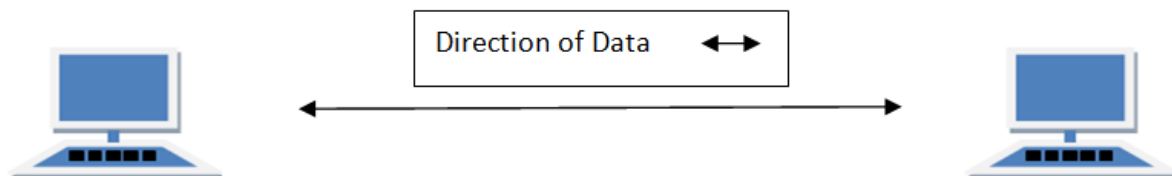
Half-Duplex Mode of Media Transmission

- ▶ In half duplex system we can send data in both directions but it is done one at a time that is when the sender is sending the data then at that time we can't send the sender our message. The data is sent in one direction.
- ▶ Example of half duplex is a walkie-talkie in which message is sent one at a time and messages are sent in both the directions.



Full-Duplex Mode of Media Transmission

- ▶ In full duplex system we can send data in both directions as it is bidirectional. Data can be sent in both directions simultaneously. We can send as well as we receive the data.
- ▶ Example of Full Duplex is a Telephone Network in which there is communication between two persons by a telephone line, through which both can talk and listen at the same time.



Role of Media Transmission

- ▶ The data is coded as binary numbers at the sender end

- ▶ A carrier signal is modulated as specified by the binary representation of the data
- ▶ At the receiving end, the incoming signal is demodulated into the respective binary numbers
- ▶ Decoding of the binary numbers is performed

Chapter 3 - Multimedia System Design

Multimedia System

- ▶ A **Multimedia System** is a **system** capable of processing **multimedia** data and applications. A
- ▶ **Multimedia System** is characterized by the processing, storage, generation, manipulation and rendition of **Multimedia** information.

Multimedia Communication System

Some multimedia applications:

- Multimedia Mail
- Virtual Reality Applications
- Video Conferencing
- CSCW (Computer Supported Cooperative Work)

} Application Subsystems

Communication Requirements:

- Highspeed networks with high transfer rates
e.g.: FDDI, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, DQDB, ATM, ...
- High performance transport protocols
e.g.: TCP, XTP, RTP,...

} Transport Subsystems

Multimedia System Application Areas

- World Wide Web
- Multimedia Authoring (Adobe/Autodesk based applications)
- Hypermedia courseware
- Video-on-demand
- Interactive TV
- Computer Games
- Virtual Reality
- Digital Video Editing and Production Systems
- Multimedia Database Systems

Multimedia Document

- ▶ A multimedia document is a natural extension of a conventional textual document in the multimedia area.
- ▶ It is defined as a digital document that is composed of one or multiple media elements of different types (text, image, video, etc.) as a logically coherent unit.

Multimedia Document Architecture and Structure

- ▶ Multimedia document architecture and structure refers to the base data storage system in a multimedia document.

Data Type	Symbols
Binary Numbers	0 1
Decimal Numbers	0 1 2 3 4 5 6 7 8 9
English Alphabets	a b c d e f g h i j k l m n o p q r s t u v w x y z

- ▶ Symbols may be different for each data type but represents similar information

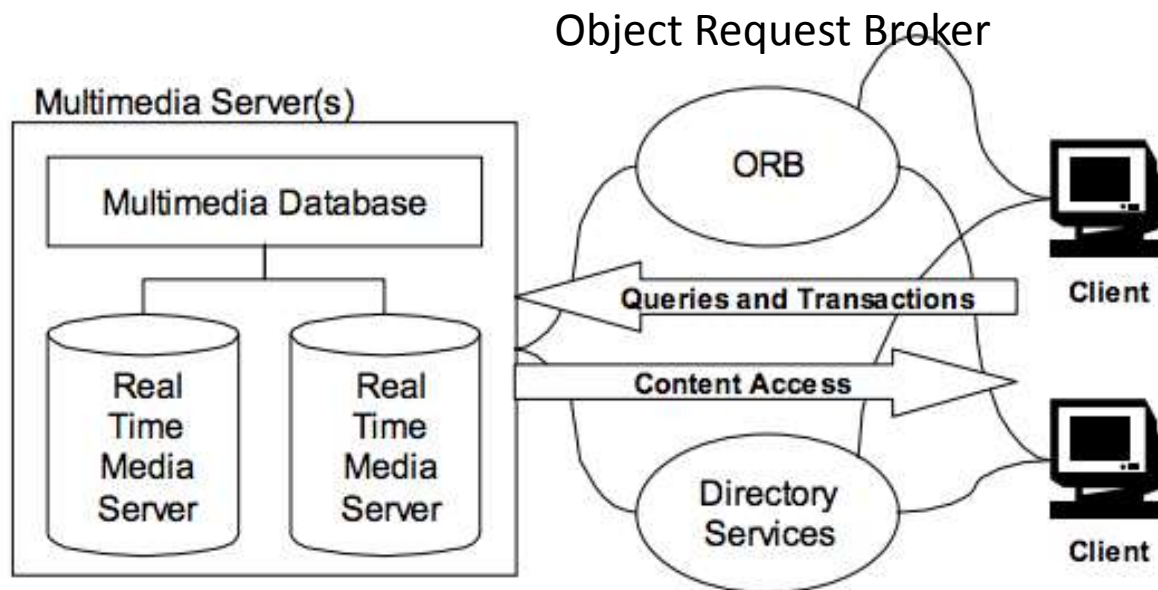
Multimedia Document Imaging

- ▶ Document Imaging means the conversion of paper files (of any size or description) or microfilm / fiche to digital images.
- ▶ Document imaging is a form of enterprise content management.

Properties of Multimedia System

- ▶ Independency
- ▶ Integrated
- ▶ Computerized
- ▶ High Data Throughput
- ▶ Real Time Synchronization

Global Structure of Multimedia System



Challenges of Multimedia System Design

- ▶ Host computing power requirement
- ▶ Data storage and management requirements
- ▶ Human Interface usability requirements
- ▶ Network latency and throughput requirements

Issues of Multimedia System Design

- ▶ Bandwidth - capacity of the transfer mechanism between source and destination.
- ▶ Delay - the time a **multimedia unit** spends in transmission from source to destination.
- ▶ Delay Jitter - Variation in delay delivery of data
- ▶ Loss Probability - the ratio of units of information that an application can afford to lose.

Digital Representation

- ▶ Digital representation of multimedia means the digital representation of the multimedia elements.
- ▶ Digital Audio is played back through audio player, speaker, audio card and MP3 Player.
- ▶ Digital Images are displayed in computer monitors and printed form printers.
- ▶ Digital Videos are played back from Computer Video Players, Portable DVD/Blu-Ray Players in Computer Monitors or TV Screens

Text

- ▶ *Digital Text* or e-text is a electronic version of a written text. *Digital Text* can be found on the internet or on your computer or on a variety of hand-held electronic devices.

RTF (Rich Text Format)

- ▶ The **Rich Text Format** (often abbreviated **RTF**) is a proprietary document file **format** with published specification developed by Microsoft Corporation from 1987 until 2008 for cross-platform document interchange with Microsoft products.
- ▶ Most word processors are able to read and write some versions of **RTF**.

Key Information in RTF (Rich Text Format)

- ▶ Object
- ▶ Picture
- ▶ Font
- ▶ Annotations (Comments)
- ▶ Drawn Objects (Computer Generated Graphics)
- ▶ Security Information (Password/Encryption)

Text Representation

- ▶ ANSI - American National Standards Institute
- ▶ Unicode – Universal Code
- ▶ UTF-8 - Unicode Transformation Format - 8 Unicode Characters
- ▶ ASCII – American Standard Code for Information Interchange
- ▶ RTF – Rich Text Format

Text Representation Hardware and Software

- ▶ Computer Processor
- ▶ Font Faces

Image

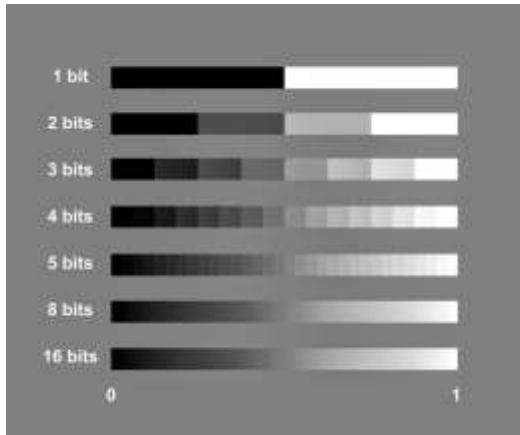
- ▶ A representation of the external form of a person or thing in art.

Digital Image

- ▶ A **digital image** is a numeric representation (normally binary) of a two-dimensional **image**.
- ▶ Depending on whether the **image** resolution is fixed, it may be of vector or raster type.
- ▶ By itself, the term "**digital image**" usually refers to raster **images** or bitmapped **images**.

Pixel Bit Depth – 2/4/8/16/32 Bits

- Color depth, also known as bit depth, is either the number of bits used to indicate the color of a single pixel, in a bitmapped image or video frame buffer, or the number of bits used for each color component of a single pixel

*Resolution*

- Image resolution is the detail an image holds. The term applies to raster digital images, film images, and other types of images.
- Higher resolution means more image detail.

Image Representation

- In computer graphics, a raster graphics image is a dot matrix data structure representing a generally rectangular grid of pixels, or points of color, viewable via a monitor, paper, or other display medium. Raster images are stored in image files with varying formats.

Image Representation Hardware and Software

- Graphics Card
- Processor
- Graphics Card Driver

Color

- The **RGB** color model in a computer monitor display that is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors.

Luminance and Chrominance Components

- **Luminance** is a photometric measure of the luminous intensity per unit area of light travelling in a given direction. It describes the amount of light that passes through, is emitted or reflected from a particular area, and falls within a given solid angle.
- **Chrominance** (chroma or C for short) is the signal used in video systems to convey the color information of the picture, separately from the accompanying luma signal (or Y for short). **Chrominance** is usually represented as two color-difference components: $U = B' - Y'$ (blue – luma) and $V = R' - Y'$ (red – luma)

Colour Representation

- ▶ Colors are represented using Hexadecimal values in computers.

Color Representation Hardware and Software

- ▶ Computer Monitor Pixels
- ▶ Graphics Card
- ▶ Color Profile
- ▶ Graphics Driver

Graphics

- ▶ **Vector graphics** is the use of polygons to represent **images** in computer **graphics**.
- ▶ **Vector graphics** are based on **vectors**, which lead through locations called control points or nodes.

Graphics Representation

- ▶ Any particular vector file format supports only some kinds of primitive objects. Nearly all vector file formats support simple and fast-rendering primitive objects:
- ▶ Lines, polylines and polygons
- ▶ Bézier curves and bezigons
- ▶ Circles and ellipses

Graphics Representation Hardware and Software

- ▶ Graphics Card
- ▶ Processor
- ▶ Graphics Driver
- ▶ Graphics Renderer

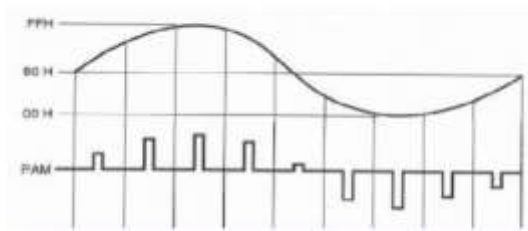
Sound

- ▶ **Digital** audio is technology that can be used to record, store, generate, manipulate, and reproduce **sound** using audio signals encoded in **digital** form.

Pulse Amplitude Modulation

- ▶ **Pulse Amplitude Modulation (PAM)** is the simplest form of **pulse modulation**. This technique transmits data by varying the voltage or power **amplitudes** of individual **pulses** in a timed sequence of electromagnetic **pulses**.
- ▶ In other words, the data to be transmitted is encoded in the **amplitude** of a series of signal **pulses**.

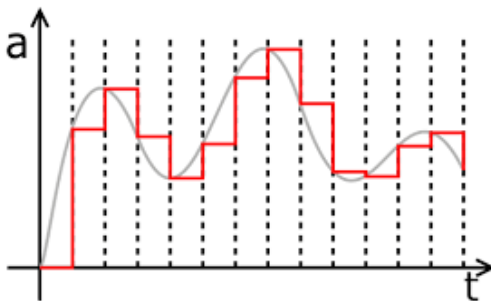
Signal shown of PAM Signal



In the noise aspect, this type of signal is **EASILY EFFECTED by noise**
This is type of **flat-top sampling signal**

Audio Sampling Process

- ▶ A **sample** is a value or set of values at a point in time and/or space.
- ▶ A **sampler** is a subsystem or operation that extracts samples from a [continuous signal](#).
- ▶ A theoretical **ideal sampler** produces samples equivalent to the instantaneous value of the continuous signal at the desired points.



Audio Sampling Rate

- ▶ Sample rate is the number of samples of audio carried per second, measured in Hz or kHz (one kHz being 1 000 Hz).
- ▶ For example, **44 100 samples per second** can be expressed as either **44 100 Hz**, or **44.1 kHz**.
- ▶ Bandwidth is the difference between the highest and lowest frequencies carried in an audio stream.

Audio Quantization

- ▶ **Quantization**, in mathematics and [digital signal processing](#), is the process of mapping a large set of input values to a (countable) smaller set.

Sound Representation

- ▶ Digital Sound is represented using Bit Depth and Frequencies

Sound Representation Hardware and Software

- ▶ Processor

- ▶ Sound Card
- ▶ Sound Driver
- ▶ Sound Renderer

Video

- ▶ **Digital video** is a representation of moving visual images in the form of encoded [digital data](#).
- ▶ This is in contrast to [analog video](#), which represents moving visual images with analog signals.

Video Representation

- ▶ An example video can have a **duration (T)** of 1 hour (3600sec), a frame size of 640x480 (*WidthxHeight*) at a color depth of 24bits and a frame rate of 25fps. This example video has the following properties:
- ▶ **pixels per frame** = $640 * 480 = 307,200$
- ▶ **bits per frame** = $307,200 * 24 = 7,372,800 = 7.37Mbits$
- ▶ **bit rate (BR)** = $7.37 * 25 = 184.25Mbits/sec$
- ▶ **video size (VS)** = $184Mbits/sec * 3600sec = 662,400Mbits = 82,800Mbytes = 82.8Gbytes$

Video Representation Hardware and Software

- ▶ Processor
- ▶ Sound Card
- ▶ Graphics Card
- ▶ Graphics Driver
- ▶ Sound Driver
- ▶ Video Player

Latency

- ▶ *Latency* is a time interval between the stimulation and response, or, from a more general point of view, a time delay between the cause and the effect of some physical change in the system being observed.

Seek Latency

- ▶ Seek time is the time taken for a hard disk controller to locate a specific piece of stored data.
- ▶ Other delays include transfer time (data rate) and rotational delay (latency).

Chapter 4 - Introduction of International Standards

International Multimedia Standards

- ▶ Modern multimedia devices are designed to support almost every kind of multimedia data out their.
- ▶ They are mostly in form of audio and video.
- ▶ As multimedia content creators we are to follow the set standards according to the target audience we choose.

Sound Standards

Architectural Standards

- ▶ Mono
- ▶ Stereo
- ▶ 2.1
- ▶ 5.1 (Surround Sound)
- ▶ 7.1 (Surround Sound)

Format Standards

- ▶ WAV
- ▶ AIFF
- ▶ PCM
- ▶ MP3
- ▶ AAC
- ▶ Ogg Vorbis
- ▶ WMA
- ▶ M4A

Video Standards

Architectural Standards

- ▶ Mobile
- ▶ SD
- ▶ HD (Level 1, Level 2, Level 3)
- ▶ UHD
- ▶ Interlaced/Progressive

Format Standard

- ▶ MPEG
- ▶ MPEG2
- ▶ MPEG4
- ▶ H.264
- ▶ WebM
- ▶ FLV
- ▶ F4V
- ▶ Ogg Theora
- ▶ GIF
- ▶ M4V
- ▶ 3GP

Reasons for why International Standards are Important

- ▶ Better compatibility
- ▶ Follow current trend and demand
- ▶ Wider reach
- ▶ Better sharing ability
- ▶ Keeping up with the market

Chapter 5 - Data Compression

Compression

- ▶ **File compression** is the practice of packaging a **file** or **files** to use less disk space.
- ▶ The **File Compression** category includes software programs that will archive your **files** and extract archived **files** such as ZIP and RAR **files**.
- ▶ Many products in this category let you manage **files** and protect them with encryption.

Data Compression

- ▶ In signal processing, **data compression**, source coding, or bit-rate reduction involves encoding information using fewer bits than the original representation.
- ▶ **Compression** can be either lossy or lossless. Lossless **compression** reduces bits by identifying and eliminating statistical redundancy.

Need for Data Compression

- ▶ Bit rates required for uncompressed PAL Video
 - ▶ $720 \times 576 = 414720$ Pixels in each frame
 - ▶ Frame Rate = 60 (for regular displays)
 - ▶ Bit Rate = More than 160 Mbps
- ▶ Bit rates required for uncompressed High Definition Video
 - ▶ $1920 \times 1080 = 2073600$ Pixels in each frame
 - ▶ Frame Rate = 60 (for regular displays)
 - ▶ Bit Rate = More than 2 Gbps
- ▶ Bit rates required for uncompressed audio data stream
 - ▶ Telephone Quality = 60 Kbps
 - ▶ CD Quality = 1.4 Mbps

Fundamentals of Multimedia Data Compression Coding Technique

- ▶ Audio, image and video require vast amounts of data
 - ▶ $320 \times 240 \times 8$ bits grayscale image: 77Kb
 - ▶ $1100 \times 900 \times 24$ bits color image: 3MB
 - ▶ $640 \times 480 \times 24 \times 30$ frames/sec: 27.6 MB/sec
- ▶ Low network's bandwidth doesn't allow for real time video transmission
- ▶ Slow storage devices don't allow for fast playing back → Compression reduces storage requirements

Modes of Compression

- ▶ Lossless Compression
 - ▶ Only redundancies or repetition are removed
 - ▶ Data is not altered or lost in the process
 - ▶ E.g. Computer file compression
- ▶ Lossy Compression
 - ▶ Redundancies as well as some unessential information in the data are removed
 - ▶ E.g. Image and video compression

Lossy DCT-Based Compression

- ▶ A **discrete cosine transform (DCT)** expresses a finite sequence of [data points](#) in terms of a sum of [cosine](#) functions oscillating at different [frequencies](#).
- ▶ DCTs are important to numerous applications in science and engineering, from [lossy compression](#) of [audio](#) (e.g. [MP3](#)) and [images](#) (e.g. [JPEG](#)) (where small high-frequency components can be discarded), to [spectral methods](#) for the numerical solution of [partial differential equations](#).
- ▶ The use of [cosine](#) rather than [sine](#) functions is critical for compression, since it turns out (as described below) that fewer cosine functions are needed to approximate a typical [signal](#), whereas for differential equations the cosines express a particular choice of [boundary conditions](#).

Two Types of Compression

- ▶ Entropy Encoding
 - ▶ Does not take into account the nature of information to be compressed
 - ▶ Treats all data as sequence of data
 - ▶ Is lossless
- ▶ Source Encoding
 - ▶ Makes use of transformations dependent on the type of original data E.g. Suppression of silence for audio, and exploring motion redundancies for video.
 - ▶ Is either lossy or lossless

Compression Efficiency

- ▶ Compression ratio – (size of the original data) / (size of compressed data)
 - ▶ Positive compression if ratio > 1; negative compression otherwise
- ▶ Figure of Merit = (size of compression data) / (size of original data)
 - ▶ Reciprocal of compression ratio

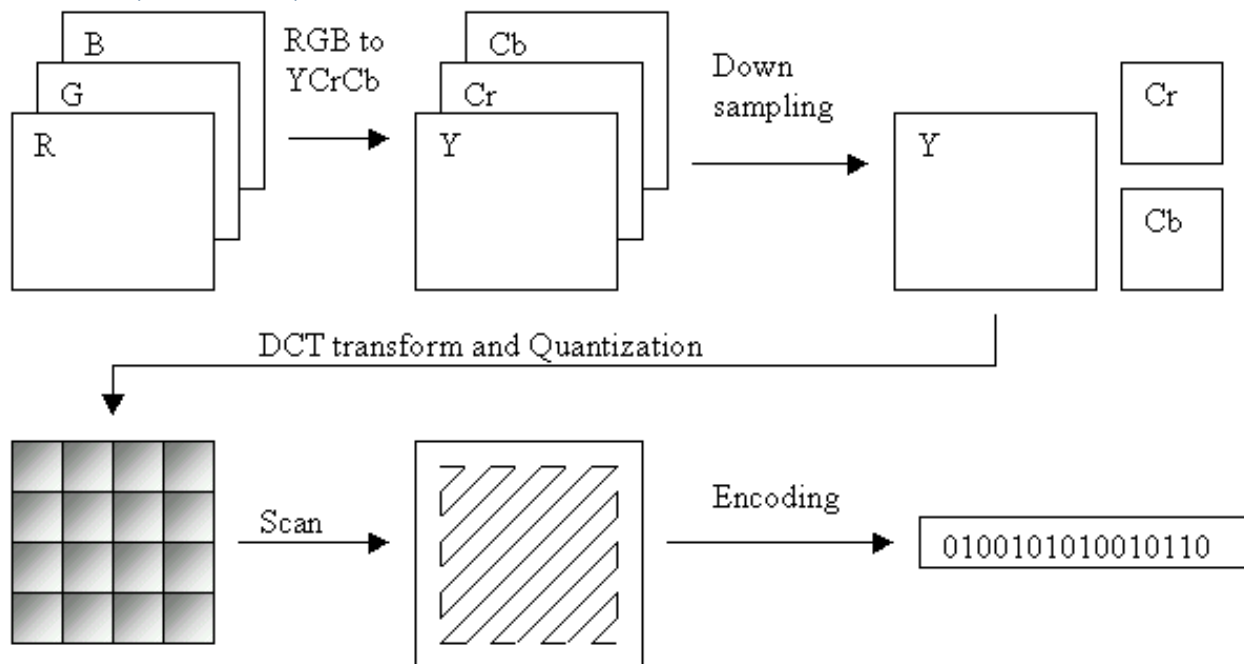
Compression Coding Standards

- ▶ JPEG
- ▶ ITU-T
- ▶ H.261
- ▶ H.264
- ▶ MPEG
- ▶ Motion Compensation
- ▶ Huffman Code
- ▶ Hybrid Encoding

JPEG

- ▶ "Joint Photographic Expert Group" -- an international standard in 1992.
- ▶ **JPEG** is a lossy compression technique for color images.
- ▶ Although it can reduce files sizes to about 5% of their normal size, some detail is lost in the compression.

JPEG Compression Steps



ITU-T

- ▶ The **ITU** Telecommunication Standardization Sector (**ITU-T**) is one of the three sectors (divisions or units) of the International Telecommunication Union (**ITU**); it coordinates standards for telecommunications.

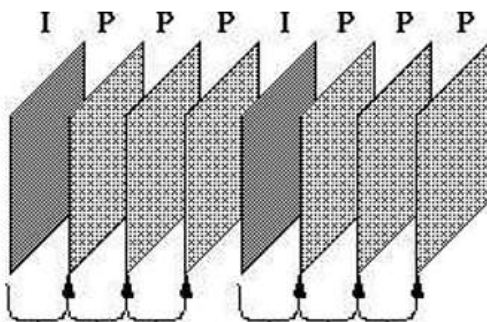
- ▶ The **Video Coding Experts Group** or **Visual Coding Experts Group (VCEG)** is the informal name of Question 6 (*Visual coding*) of Working Party 3 (Media coding) of Study Group 16 (Multimedia coding, systems and applications) of the [ITU-T](#). Its abbreviated title is ITU-T Q.6/SG 16. It is responsible for standardization of the "H.26x" line of video coding standards, the "T.8xx" line of image coding standards, and related technologies.

H.261 (px64)

- ▶ The basic approach to H.261 Compression is summarized as follows:
- ▶ H.261 Compression has been specifically designed for video telecommunication applications:
 - ▶ Developed by CCITT in 1988-1990
 - ▶ Meant for videoconferencing, videotelephone applications over ISDN telephone lines.
 - ▶ Baseline ISDN is 64 kbits/sec, and integral multiples (px64)

H.261 (px64) Compression Steps

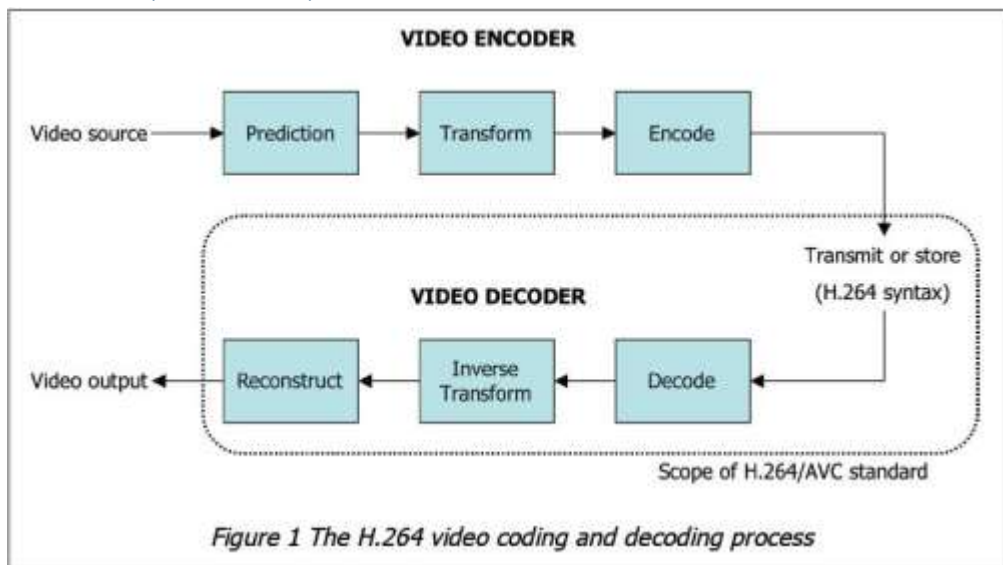
- ▶ We typically have a group of pictures — one I-frame followed by several P-frames — a group of pictures
- ▶ Number of P-frames followed by each I-frame determines the size of GOP — can be fixed or dynamic. Why this can't be too large?



H.264

- ▶ **H.264** or MPEG-4 Part 10, Advanced Video Coding (MPEG-4 AVC) is a video coding format that is currently one of the most commonly used formats for the recording, compression, and distribution of video content.

H.264 Compression Steps



MPEG

- The Moving Picture Experts Group (**MPEG**) is a working group of authorities that was formed by ISO and IEC to set standards for audio and video compression and transmission.

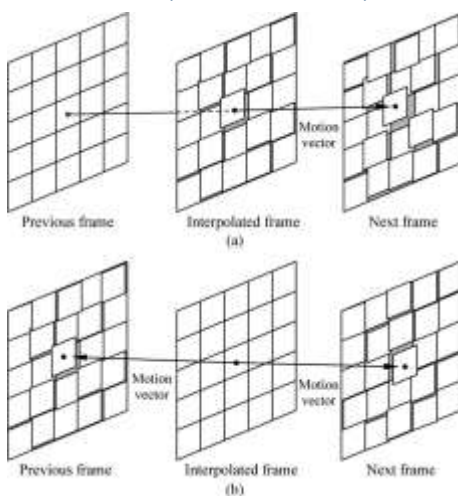
MPEG Compression Steps

- MPEG compression is essentially an attempt to overcome some shortcomings of H.261 and JPEG: Recall H.261 dependencies:

Motion Compensation

- Uses the motion vectors to compensate the picture.
- Parts of a previous (or future) picture can be reused in a subsequent picture.
- Individual parts spatially compressed — JPEG type compression

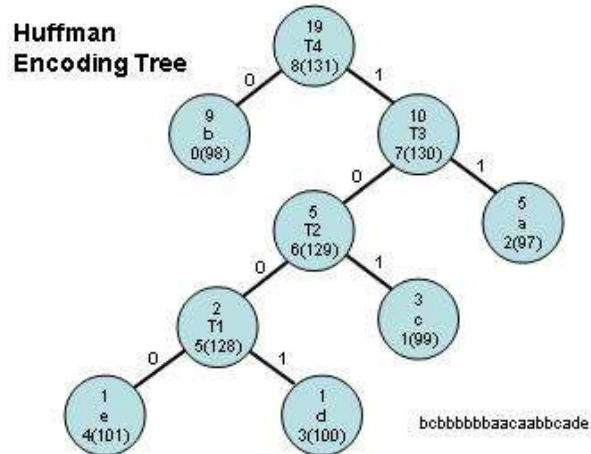
Motion Compensation Compression Steps



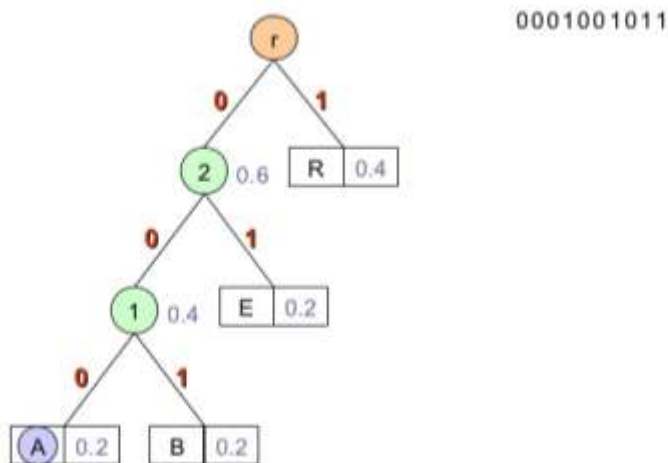
Huffman Code

- In computer science and information theory, a **Huffman code** is a particular type of optimal prefix **code** that is commonly used for lossless data compression.

Huffman Code Encoding



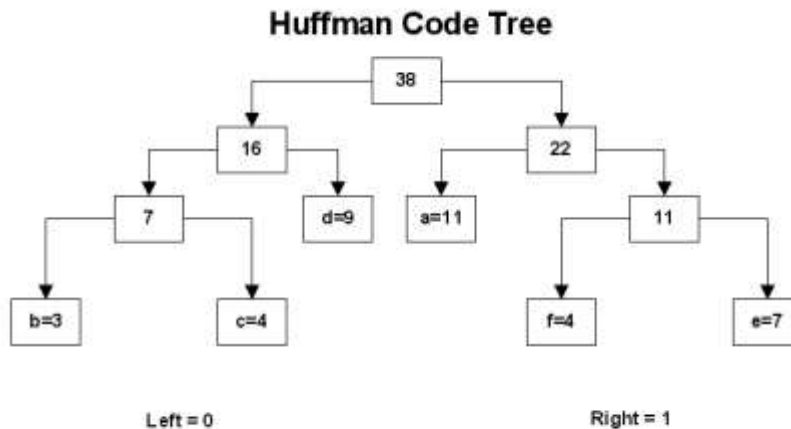
Huffman Code Decoding



Huffman Code Compression Ratio

The Huffman encoding saves 20 bits.

The compression ratio is **1.21 to 1**.



Huffman Code Relative Redundancy

Letter	Probability	Codeword
a_2	0.4	1
a_1	0.2	01
a_3	0.2	000
a_4	0.1	0010
a_5	0.1	0011

The average codeword length for this code is

$$l = 0.4 \times 1 + 0.2 \times 2 + 0.2 \times 3 + 0.1 \times 4 + 0.1 \times 4 = 2.2 \text{ bits/symbol.}$$

The redundancy is 0.078 bits/symbol.

Hybrid Encoding

- ▶ A hybrid encoding method is used to assemble the double-random phase-encoding technique and the binary encoding method.
- ▶ Because the double-random phase-encoding technique is robust for noises and the binary encoding method is free of using external keys, the proposed hybrid encoding method has their advantages.
- ▶ The hybrid encoding method first encodes a covert image to form a complex-number matrix by using the double-random phase-encoding technique, where two random real-number matrices are used to increase the security of the encoding work.
- ▶ Then the elements of the two random real-number matrices and the elements of the complex-number matrix are encoded to form a binary-bit string by using the binary encoding method.
- ▶ Finally, the binary data in the binary-bit string are encoded into a host image to form an overt image with hidden information by using a gray-value modulation method. The decoding work is easy for authorized people, but it is very difficult for unauthorized people. Therefore, the proposed hybrid encoding method is a very useful encoding method.

Chapter 6 - Multimedia Over IP

IP (Internet Protocol)

- ▶ The **Internet Protocol (IP)** is the principal communications **protocol** in the **Internet protocol** suite for relaying datagrams across network boundaries.
- ▶ Its routing function enables internetworking, and essentially establishes the **Internet**.

Multimedia over IP

- ▶ MoIP is an expression used to describe the transport of various types of media as a payload of an IP datagram. Typical media examples include voice, messaging and video.

Multimedia Conferencing

- ▶ Multimedia conferencing is to interact with people across the world.
- ▶ It uses certain tools like cameras, computers and internet.
- ▶ Adobe Connect is one of the tool to broadcast the events interactively to the web.
- ▶ Polycom video conferencing system supports meetings with peers all over the world.
- ▶ The interactive conferencing includes certain gadgets like audio speakers, LCD projectors.
- ▶ Adobe Connect need to configure to access the multimedia.
- ▶ Polycom is one of the video conferencing tools.

Multimedia Conferencing Process

- ▶ Make sure that the conferencing software are installed at both the client computers.
- ▶ Make sure both of the clients are connected to the server using the internet.
- ▶ Make sure all the input and output devices such as microphone, speakers, monitors are well connected.
- ▶ Start the conferencing from the conferencing software.

Multicast

- ▶ IP **multicast** is a method of sending Internet Protocol (IP) datagrams to a group of interested receivers in a single transmission.
- ▶ It is often employed for streaming media applications on the Internet and private networks.
- ▶ The method is the IP-specific version of the general concept of **multicast** networking.

RTP/RTCP

- ▶ The RTP Control Protocol (RTCP) is a sister protocol of the Real-time Transport Protocol (RTP).
- ▶ RTCP provides out-of-band statistics and control information for an RTP session.
- ▶ It partners with RTP in the delivery and packaging of multimedia data, but does not transport any media data itself.

- ▶ The primary function of RTCP is to provide feedback on the quality of service (QoS) in media distribution by periodically sending statistics information to participants in a streaming multimedia session.

RSVP

- ▶ RSVP is the network control protocol that allows data receiver to request a special end-to-end quality of service for its data flows.
- ▶ Real-time applications use RSVP to reserve necessary resources at routers along the transmission paths so that the requested bandwidth can be available when the transmission actually takes place.
- ▶ RSVP is a main component of the future Integrated Services Internet which can provide both best-effort and real-time service.

RTP

- ▶ The Real-time Transport Protocol (RTP) is a network protocol for delivering audio and video over IP networks.
- ▶ RTP is used extensively in communication and entertainment systems that involve streaming media, such as telephony, video teleconference applications, television services and web-based push-to-talk features.

RTP Work Process

- ▶ RTP is designed for end-to-end, real-time, transfer of streaming media. The protocol provides facilities for jitter compensation and detection of out of sequence arrival in data, which are common during transmissions on an IP network.
- ▶ RTP allows data transfer to multiple destinations through IP multicast.
- ▶ RTP is regarded as the primary standard for audio/video transport in IP networks and is used with an associated profile and payload format.

Packetization

- ▶ A network **packet** is a formatted unit of **data** carried by a **packet**-switched network.
- ▶ Computer communications links that do not support **packets**, such as traditional point-to-point telecommunications links, simply transmit **data** as a bit stream. The process of breaking down the data in smaller packets for easy transmission is known as packetization.

Streaming

- ▶ Streaming media is multimedia that is constantly received by and presented to an end-user while being delivered by a provider.
- ▶ The verb "to stream" refers to the process of delivering media in this manner; the term refers to the delivery method of the medium, rather than the medium itself, and is an alternative to downloading.

Chapter 7 - Multimedia Networking Issues

Network Issues

- ▶ **Cable Problem**
- ▶ **Connectivity Problem**
- ▶ **Excessive Network Collisions**
- ▶ **Software Problem**
- ▶ **Duplicate IP Address**

Multimedia Network Issues

- ▶ Over Buffering
- ▶ Slow Server Issues
- ▶ Video and Audio Latency
- ▶ Frame Drops
- ▶ Freezing Issues

Error Resilience

- ▶ Error Resilience decides how the decoder behaves if some value in the input is against the specification: whether it assumes it is a minor encoder mistake and "extends" the standard to give a meaning to that input or whether it assumes the input is corrupted and it should apply error concealment, i.e. assuming this and surrounding data have no relation with what the video really should look like and thus will try to reconstruct something reasonable-looking e.g. from the previous frame.
- ▶ This is not a speed related option (while error concealment is very slow that is not relevant, if it is used when it shouldn't be or the other way round the result will look very horrible).

Networking Characteristics

- ▶ **Availability.**
Availability is typically measured in a percentage based on the number of minutes that exist in a year. Therefore, uptime would be the number of minutes the network is available divided by the number of minutes in a year.
- ▶ **Cost**
includes the cost of the network components, their installation, and their ongoing maintenance.
- ▶ **Reliability**
defines the reliability of the network components and the connectivity between them. Mean time between failures (MTBF) is commonly used to measure reliability.
- ▶ **Security**
includes the protection of the network components and the data they contain and/or the data transmitted between them.

- ▶ **Speed**
includes how fast data is transmitted between network end points (the data rate).
- ▶ **Scalability**
defines how well the network can adapt to new growth, including new users, applications, and network components.
- ▶ **Topology**
describes the physical cabling layout and the logical way data moves between components.

Quality of Service (QoS)

- ▶ **Quality of Service (QoS)** is a feature of routers and switches which prioritizes traffic so that more important traffic can pass first.
- ▶ The result is a performance improvement for critical network traffic.
- ▶ **QoS** equipment is useful with VoIP phones or in LANs with high volumes of local traffic.

Importance of Quality of Service (QoS)

- ▶ Quality of service is particularly important for the transport of traffic with special requirements.
- ▶ In particular, much technology has been developed to allow computer networks to become as useful as telephone networks for audio conversations, as well as supporting new applications with even stricter service demands.

Measurement of Quality of Service (QoS)

- ▶ In packet-switched networks, quality of service is affected by various factors, which can be divided into “human” and “technical” factors.
- ▶ Human factors include: stability of service, availability of service, delays, user information.
- ▶ Technical factors include: reliability, scalability, effectiveness, maintainability, grade of service, etc.

Chapter 8 - Multimedia Storage and Retrieval

Storage and Retrieval

- ▶ A **data storage** device is a device for recording (storing) information (**data**).
- ▶ Recording can be done using virtually any form of energy, spanning from manual muscle power in handwriting, to acoustic vibrations in phonographic recording, to electromagnetic energy modulating magnetic tape and optical discs.
- ▶ **Data retrieval** means obtaining **data** from a database management system such as ODBMS.
- ▶ In this case, it is considered that **data** is represented in a structured way, and there is no ambiguity in **data**.
- ▶ In order to **retrieve** the desired **data** the user present a set of criteria by a query.

Multimedia Storage

- ▶ Multimedia can be stored in mediums such as Optical Disks, Hard Drives, Magnetic Storage Media and such.

Multimedia Retrieval

- ▶ Multimedia retrieval depends on the type of multimedia file it is which may be continuous or discrete.
- ▶ **Continuous media** is data where there is a timing relationship between source and destination. Video, animation and audio are examples of continuous **media**.
- ▶ Some **media** is time independent or static or **discrete media**: normal data, text, single images, graphics are examples.

Disc and Disk

- Disc refers to optical media whereas Disk refers to magnetic media.

Magnetic Media

- ▶ **Magnetic** storage or **magnetic** recording is the storage of data on a magnetised **medium**.
- ▶ **Magnetic** storage uses different patterns of magnetisation in a magnetisable material to store data and is a form of non-volatile memory.

Optical Media

- ▶ **Optical media** - such as the compact **disk** (CD) - are storage **media** that hold content in digital form and that are written and read by a laser; these **media** include all the various CD and DVD variations, as well as **optical** jukeboxes and autochangers.

Disk Spanning

- ▶ **Disk spanning** is a feature of CD and DVD burning software that automatically spreads a large amount of data across many data discs if the data set's size exceeds the storage capacity of an individual blank **disc**.

RAID Storage

- ▶ **RAID** is a technology that is **used** to increase the performance and/or reliability of data storage.
- ▶ The abbreviation stands for Redundant Array of Inexpensive Disks.
- ▶ A **RAID** system consists of two or more disks working in parallel.

RAID Levels

- ▶ Raid Level 0
- ▶ Raid Level 1
- ▶ Raid Level 2
- ▶ Raid Level 3
- ▶ Raid Level 4
- ▶ Raid Level 5
- ▶ Raid Level 6

RAID Level 0

- ▶ RAID 0 (also known as a stripe set or striped volume) splits ("stripes") data evenly across two or more disks, without parity information, redundancy, or fault tolerance.
- ▶ Since RAID 0 provides no fault tolerance or redundancy, the failure of one drive will cause the entire array to fail; as a result of having data striped across all disks, the failure will result in total data loss.
- ▶ This configuration is typically implemented having speed as the intended goal.
- ▶ RAID 0 is normally used to increase performance, although it can also be used as a way to create a large logical volume out of two or more physical disks.

RAID Level 1

- ▶ RAID 1 consists of an exact copy (or mirror) of a set of data on two or more disks; a classic RAID 1 mirrored pair contains two disks.
- ▶ This configuration offers no parity, striping, or spanning of disk space across multiple disks, since the data is mirrored on all disks belonging to the array, and the array can only be as big as the smallest member disk.
- ▶ This layout is useful when read performance or reliability is more important than write performance or the resulting data storage capacity.

RAID Level 2

- ▶ RAID 2, which is rarely used in practice, stripes data at the bit (rather than block) level, and uses a Hamming code for error correction.
- ▶ The disks are synchronized by the controller to spin at the same angular orientation (they reach index at the same, so it generally cannot service multiple requests simultaneously).

- ▶ Extremely high data transfer rates are possible.

RAID Level 3

- ▶ RAID 3, which is rarely used in practice, consists of byte-level striping with a dedicated parity disk.
- ▶ One of the characteristics of RAID 3 is that it generally cannot service multiple requests simultaneously, which happens because any single block of data will, by definition, be spread across all members of the set and will reside in the same location.
- ▶ Therefore, any I/O operation requires activity on every disk and usually requires synchronized spindles.

RAID Level 4

- ▶ RAID 4 consists of block-level striping with a dedicated parity disk.
- ▶ As a result of its layout, RAID 4 provides good performance of random reads, while the performance of random writes is low due to the need to write all parity data to a single disk.

RAID Level 5

- ▶ RAID 5 consists of block-level striping with distributed parity.
- ▶ Unlike in RAID 4, parity information is distributed among the drives.
- ▶ It requires that all drives but one be present to operate.
- ▶ Upon failure of a single drive, subsequent reads can be calculated from the distributed parity such that no data is lost.
- ▶ RAID 5 requires at least three disks.

RAID Level 6

- ▶ RAID 6 extends RAID 5 by adding another parity block; thus, it uses block-level striping with two parity blocks distributed across all member disks.

Chapter 9 - Multimedia on the Internet

Multimedia on the Internet

- ▶ Digital media are any media that are encoded in a machine-readable format.
- ▶ Digital media can be created, viewed, distributed, modified and preserved on digital electronics devices.
- ▶ Computer programs and software; digital imagery, digital video; video games; web pages and websites, including social media; data and databases; digital audio, such as mp3s; and e-books are examples of digital media.
- ▶ Digital media are frequently contrasted with print media, such as printed books, newspapers and magazines, and other traditional or analog media, such as pictures, film or audio tape.

Multimedia Applications (Scopes)

- ▶ Interactive Multimedia System Development
- ▶ Game Development
- ▶ Filmmaking and Animation
- ▶ Visual Effects
- ▶ Sound Design
- ▶ Application UI/UX Design
- ▶ Graphics Design

Social Media (Me Media)

- ▶ Social media are computer-mediated tools that allow people or companies to create, share, or exchange information, career interests, ideas, and pictures/videos in virtual communities and networks.
- ▶ Social media is defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content."
- ▶ Furthermore, social media depend on mobile and web-based technologies to create highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content.

Personal Selling

- ▶ **Personal selling** is where businesses use people (the "sales force") to **sell** the product after meeting face-to-face with the customer.
- ▶ The sellers promote the product through their attitude, appearance and specialist product knowledge.
- ▶ They aim to inform and encourage the customer to buy, or at least trial the product.

Personal Selling Advantages and Disadvantages

Advantages

- ▶ Convey detailed information
- ▶ Create a good impact

Disadvantages

- ▶ Limited reach
- ▶ Expensive

Websites

- ▶ A website, also written as web site, or simply site, is a set of related web pages typically served from a single web domain.
- ▶ A website is hosted on at least one web server, accessible via a network such as the Internet or a private local area network through an Internet address known as a uniform resource locator (URL).
- ▶ All publicly accessible websites collectively constitute the World Wide Web.

Webpages

- ▶ A web page (or webpage) is a web document that is suitable for the World Wide Web and the web browser.
- ▶ A web browser displays a web page on a monitor or mobile device. The web page is what displays, but the term also refers to a computer file, usually written in HTML or comparable markup language.
- ▶ Web browsers coordinate the various web resource elements for the written web page, such as style sheets, scripts, and images, to present the web page.

Hypertext

- ▶ Hypertext is text displayed on a computer display or other electronic devices with references (hyperlinks) to other text which the reader can immediately access, or where text can be revealed progressively at multiple levels of detail (also called StretchText).
- ▶ The hypertext pages are interconnected by hyperlinks, typically activated by a mouse click, keypress sequence or by touching the screen.
- ▶ Apart from text, hypertext is sometimes used to describe tables, images and other presentational content forms with hyperlinks.
- ▶ Hypertext is the underlying concept defining the structure of the World Wide Web, with pages often written in the Hypertext Markup Language (HTML).
- ▶ It enables an easy-to-use and flexible connection and sharing of information over the Internet.

Hypermedia

- ▶ Hypermedia, an extension of the term hypertext, is a nonlinear medium of information which includes graphics, audio, video, plain text and hyperlinks.
- ▶ This contrasts with the broader term multimedia, which may include non-interactive linear presentations as well as hypermedia.
- ▶ The World Wide Web is a classic example of hypermedia, whereas a non-interactive cinema presentation is an example of standard multimedia due to the absence of hyperlinks.

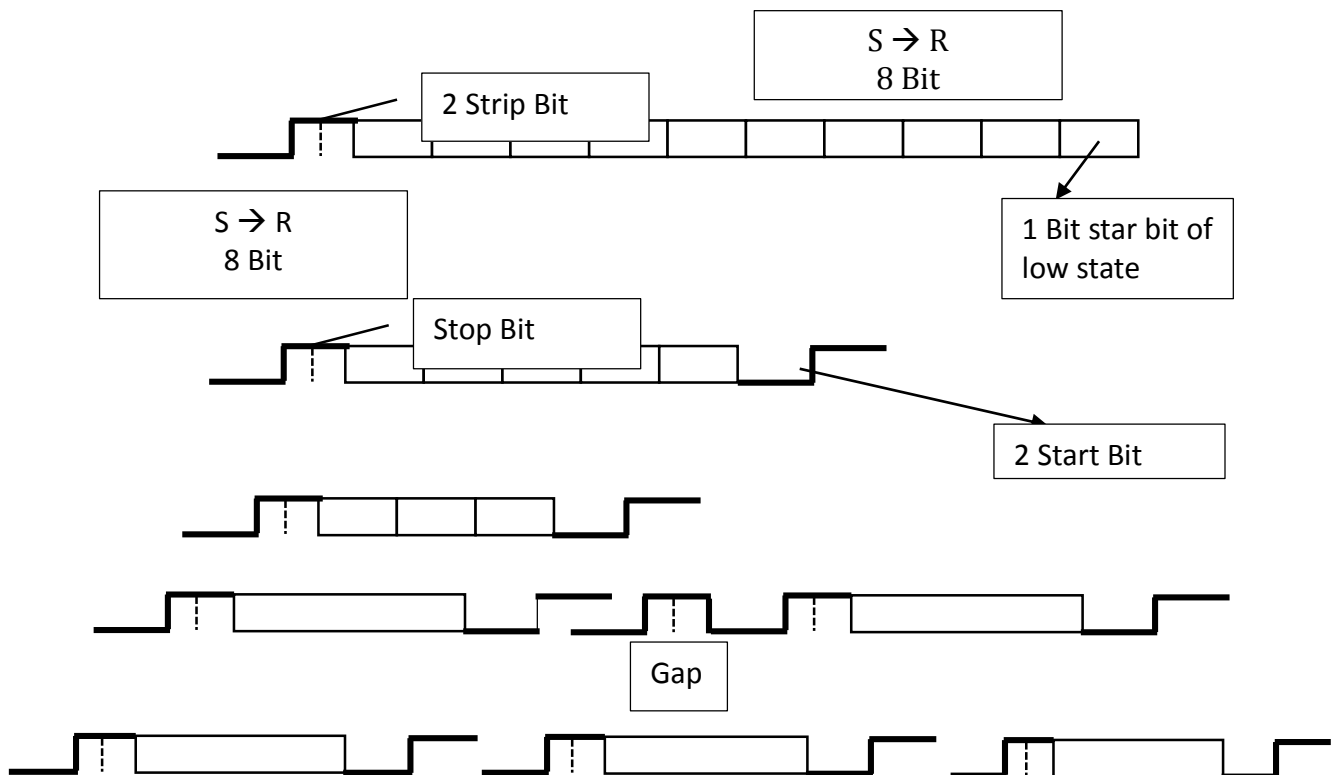
Hypertext and Hypermedia Types

- ▶ Hypertext or Hypermedia documents can either be static (prepared and stored in advance) or dynamic (continually changing in response to user input, such as dynamic web pages).
- ▶ **Static Hypertext/Hypermedia** can be used to cross-reference collections of data in documents, software applications, or books on CDs.
- ▶ **Dynamic Hypertext/Hypermedia** can develop very complex and dynamic systems of linking and cross-referencing which can change with the system and user preference.

Chapter 10 - Multimedia over ATM

ATM (Asynchronous Transfer Mode)

- ▶ **ATM (asynchronous transfer mode)** is a type of data transmission system where data transmission rates vary and the data is not transmitted at the same rate of interval. Although data rates may vary, the mode of sending data is very accurate and does not cause much data loss.
- ▶ Common examples are SMS and Emails.



Multimedia over ATM

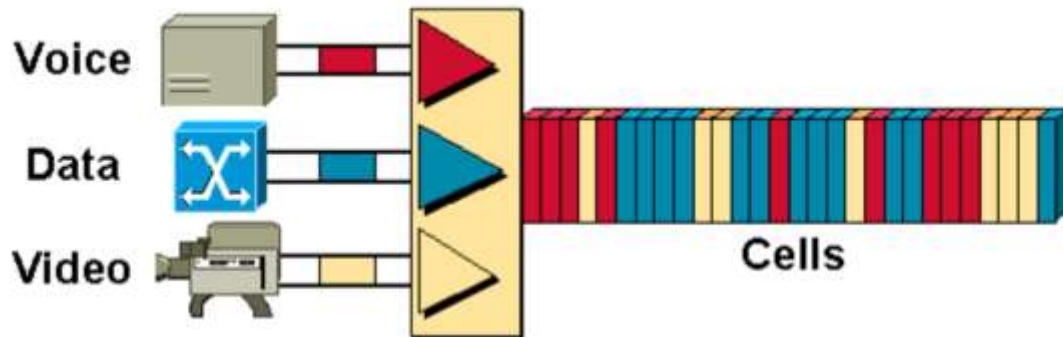
- ▶ Multimedia is an emerging service which integrates voice, video and data in the same service.
- ▶ With the progress made in high speed large capacity multimedia servers, high speed networks, cost effective QoS, acceptable service category and cost effective set top boxes, it is currently possible to carry multimedia over high speed networks cost effectively and efficiently.
- ▶ This paper surveys the progress made and the future of efficiently carrying multimedia over ATM networks.

Real-Time Multimedia over ATM

- ▶ ATM is becoming increasingly ubiquitous in the core of service provider networks" for multimedia communication.
- ▶ The QoS guarantees of ATM surpass the best-effort guarantee offered by Internet Protocol

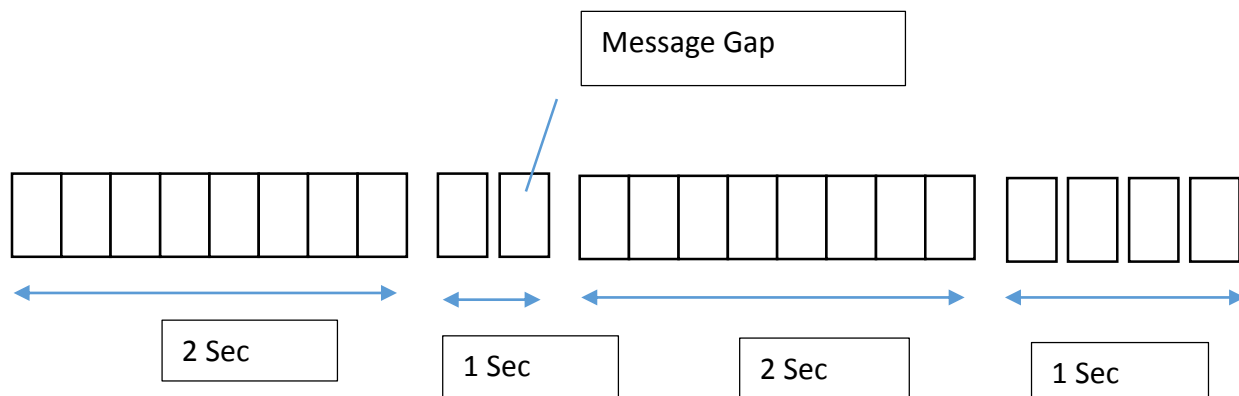
- Real time high quality linear audio over ATM has been standardized by the AES and this is known as AES47 that has been used by contractors providing the wide area broadcast contribution and distribution links between production centers for the BBC in the UK.

Multimedia over ATM Method/Process



STM (Synchronous Transfer Mode)

- STM (Synchronous Transfer Mode) is a common method of transferring multimedia data over the internet in a constant data speed rate.
- This may have a constant speed but may result in loss of data during transfer.
- E.g. Video Streaming, Video Conferencing and VoIP



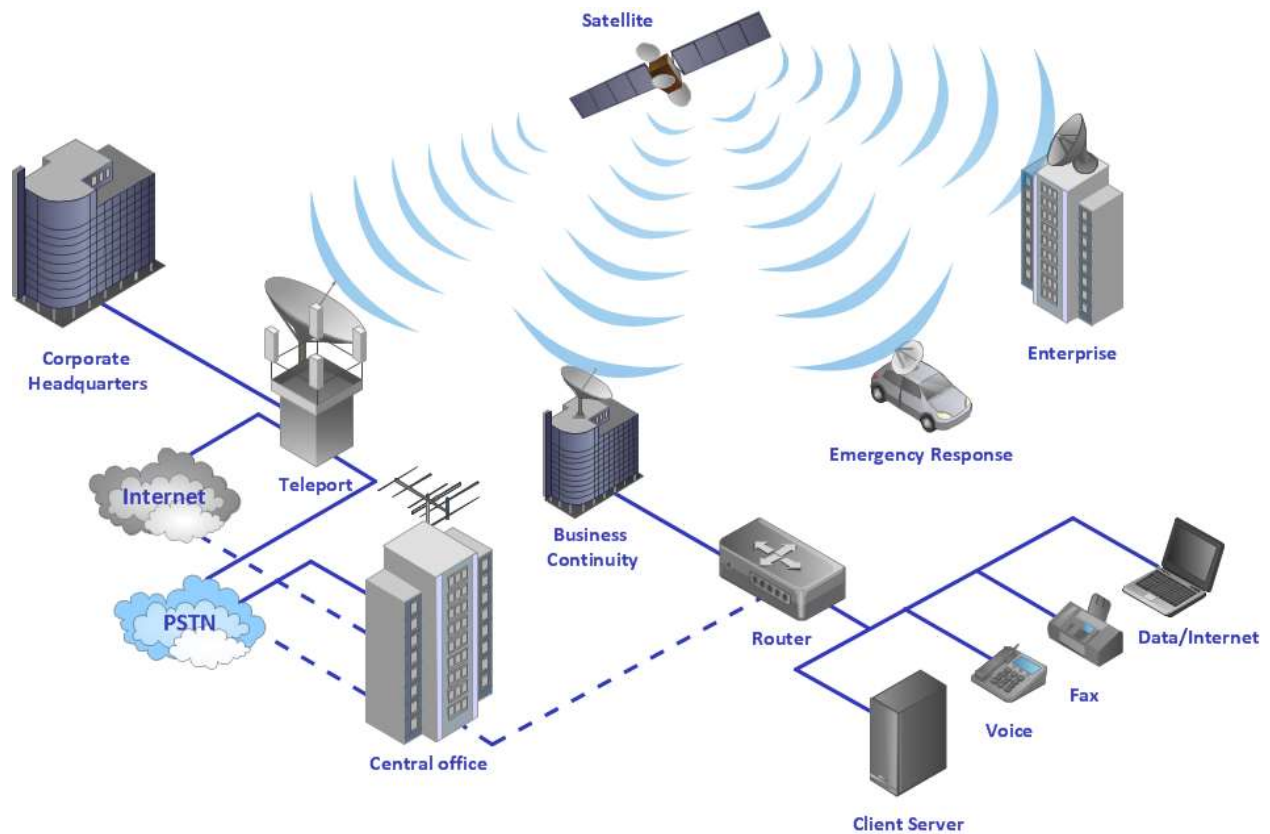
Wireless Networks

- **Wireless networking** is a method by which homes, telecommunications **networks** and enterprise (business) installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations.

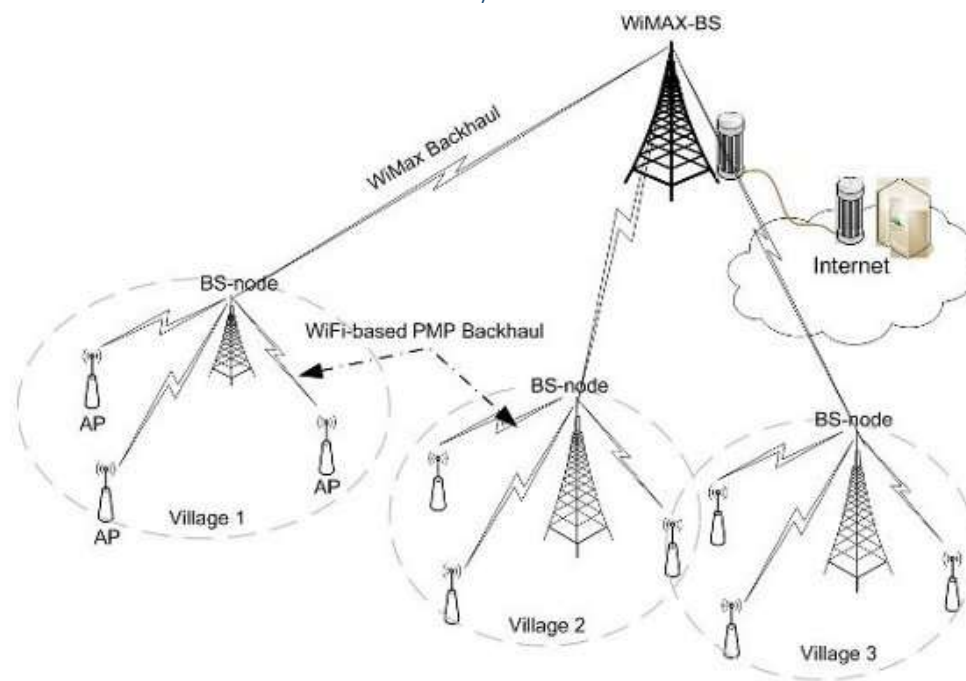
Mobile Networks

- A **cellular network** or **mobile network** is a communication **network** where the last link is wireless.
- The **network** is distributed over land areas called cells, each served by at least one fixed-location transceiver, known as a **cell** site or base station.

Wireless Networks Connection Method/Process



Mobile Networks Connection Method/Process



Chapter 11 - Emerging Multimedia Technologies

Multimedia Technologies

- ▶ **Multimedia technology** refers to interactive, computer-based applications that allow people to communicate ideas and information with digital and print elements.
- ▶ Professionals in the field use computer software to develop and manage online graphics and content.

New and Emerging Multimedia technologies

- ▶ HDTV
- ▶ 4K/UHDTV
- ▶ Vocaloid
- ▶ 3D Generators
- ▶ 3D Animation Motion Capture
- ▶ Webcam 2D animation motion capture
- ▶ Holographic Displays

HDTV

- ▶ High-definition television (HDTV) provides a resolution that is substantially higher than that of standard-definition television.

4K/UHDTV

- ▶ Ultra-high-definition television (also known as 2160p, UHD-1, Super Hi-Vision, Ultra HD television, UltraHD, UHDTV, or UHD) includes 4K UHD (2160p) and 8K UHD (4320p), which are two digital video formats proposed by NHK Science & Technology Research Laboratories and defined and approved by the International Telecommunication Union (ITU).

Vocaloid

- ▶ Vocaloid is a singing voice synthesizer.
- ▶ The software enables users to synthesize singing by typing in lyrics and melody.
- ▶ It uses synthesizing technology with specially recorded vocals of voice actors or singers.
- ▶ To create a song, the user must input the melody and lyrics.
- ▶ A piano roll type interface is used to input the melody and the lyrics can be entered on each note.
- ▶ The software can change the stress of the pronunciations, add effects such as vibrato, or change the dynamics and tone of the voice.

3D Generators

- ▶ Autodesk 123D is a suite of hobbyist CAD and 3D modelling tools created by Autodesk. It is similar in scope to Trimble SketchUp and is based on Autodesk's Autodesk Inventor.

- ▶ As well as the more basic drawing and modelling capabilities it also has assembly and constraint support and STL export.
- ▶ Available for the software is also a library of ready-made blocks and objects.

Webcam 2D Motion Capture

- ▶ Adobe Character Animator is a new type of desktop application software that combines live motion capture with a multi-track recording system to control layered 2D puppets drawn in Photoshop or Illustrator.
- ▶ It is automatically installed with Adobe After Effects since CC 2015.

Animation Motion Capture

- ▶ Motion capture (Mo-cap for short) is the process of recording the movement of objects or people.
- ▶ It is used in military, entertainment, sports, medical applications, and for validation of computer vision and robotics.
- ▶ In filmmaking and video game development, it refers to recording actions of human actors, and using that information to animate digital character models in 2D or 3D computer animation.

Question Bank with Chapter Reference

Internal 2015

Long Questions (5X12=60)

1. Define multimedia.(C1) Discuss the main properties of multimedia system and global structure of multimedia system.(C3)
2. Define multimedia communication.(C2) Explain different components for multimedia communication networks.(C2) List different challenges for multimedia system design. (C3)
3. What do you mean by computer-based animation?(C1) What are the steps involved in MPEG compression technique. (C5)
4. Why video compression is required?(C5) Describe the steps involved in MPEG compression technique.(C5)
5. Why Huffman encoding technique is essential in multimedia?(C5) A source generate the symbols S1, S2, S3, S4, and S5 randomly with probability of P1=0.16, P2=0.51, P3=0.09, P4=0.13 and P5=0.11 respectively. Generate the code word for each symbol using Huffman's coding and also calculate the compression ratio and relative redundancy of the system.(C5)
6. Why quality of service (QOS) is measured in multimedia?(C7) Why it is so important?(C7) Describe the importance of RTP and RSVP in multimedia.(C6)
7. What do you mean by multimedia retrieval?(C8) Describe about RAID level 0, RAID level 1, and RAID level 2 in detail.(C8)

Short Questions (4X5=20)

8. Describe the traditional data stream characteristics of multimedia. (C1)
9. What is sound?(C3) Explain how sound is represented digitally by computer.(C3)
10. Define medium.(C2) Explain how media is classified?(C2)
11. Define resolution.(C3) How an image is represented in computer.(C3)
12. Discuss about hypertext, hypermedia and multimedia.(C9)
13. Write short notes on:
 - a. HDTV(C11)
 - b. Luminance and Chrominance components(C3)
 - c. Hybrid Encoding (C5)

External 2013**Long Questions (5X12=60)**

1. What is multimedia?(C1) Discuss the properties, issues and the challenges for multimedia systems.(C3) Explain the mode of media transmission.(C2) Brief about the classification of medium.(C2)
2. What do you mean by data compression?(C5) Describe in details about the fundamentals of multimedia data compression coding technique.(C5)
3. Why is Huffman coding technique essential in multimedia?(C5) Explain with some suitable example.(C5)
4. Describe optical media storage?(C8) Explain the level of RAID technology.(C8)
5. How is Quality of Service (QoS) measured in multimedia?(C7) Why is it so important?(C7) Describe the importance of RTP/RCTP over multimedia.(C6)
6. Explain the process of wireless and mobile network technology.(C10)
7. Define Hypertext and Hypermedia.(C9) Describe the classification of hypertext and hypermedia with suitable examples.(C9)

Short Questions (4X5=20)

8. Define Pulse Amplitude Modulation using sampling process.(C3)
9. Differentiate between Lossless Mode and Lossy DCT-based mode.(C5)
10. What is Multicasting in multimedia system?(C6)
11. Discuss different methods used for controlling animation. (C1)
12. Describe the application of multimedia in documentation imaging. (C3)
13. How visual effects of motion is possible?(C1) Explain different types of communication channel based on the direction in which they can carry the information. (C3)
14. Explain the following terms:
 - a. Sampling rate (C3)
 - b. Quantization (C3)
 - c. Seek latency (C3)

External 2011**Long Questions (5X12=20) = 60**

1. What is Multimedia?(C1) Explain the role of media transmission.(C2) Also brief about the classification of medium.(C2)
2. What do you mean by data compression?(C5) What are its types?(C5) Describe JPEG data compression.(C5)
3. Explore your view about multimedia communication system.(C3) Explain in detail about conferencing process over multimedia with required diagram if necessary.(C6)
4. Describe magnetic media storage?(C8) Explain the level of RAID technology.(C8)
5. How Quality of Service (QoS) is measured in multimedia?(C7) Why is it so important?(C7)
6. What do you mean by computer animation?(C1) Describe the steps involved in the computer animation.(C1)
7. Explain the process of multimedia over ATM network.(C10)

Short Questions (4X5=20) = 60

8. How sound can be represented in multimedia system?(C3)
9. What do you mean by sampling and quantization in multimedia?(C3)
10. What do you understand by Multimedia in multimedia system?(C1)
11. Define Hypertext and Hypermedia.(C9) Describe about the classification of hypertext with suitable examples.(C9)
12. Write short notes on:
 - a. Error resilience(C7)
 - b. Disk spanning(C8)

External 2010

Long Questions (5X12=60)

1. What is multimedia?(C1) Discuss the main properties of multimedia system and global structure of multimedia system.(C3)
2. What is digital image?(C3) How they are acquired?(C3) Discuss about the digital image representation.(C3)
3. What is MPEG?(C5) Describe different types involved in MPEG compression.(C5)
4. A data system has only five symbols MNOPQ with the following probabilities: $p(M)=0.16$, $p(N)=0.51$, $p(O)=0.09$, $p(P)=0.13$, $p(Q)=0.11$. Construct a Huffman code tree from the above data and find out the resultant code word for each symbol. (C5)
5. Discuss how RTP (Real-time Transport Protocol) and RTCP (Real-Time Control Protocol) works in multimedia communication and the Internet. (C6)
6. What is RAID?(C8) Describe RAID Level-0 and RAID Level-1 representation.(C8)
7. Write short notes on any THREE:
 - a. Hypertext and Hypermedia(C9)
 - b. Disk Spanning(C8)
 - c. In-between process in animation(C1)
 - d. Challenges for multimedia system(C3)

Short Questions (4X5=20)

8. Discuss about the hardware and software used for digital representation of sound.(C3)
9. What is image resolution?(C3) Find out the size of 640x480 4-bit color image.(C3)
10. What is multimedia document?(C3) Briefly describe the document architecture and document structure.(C3)
11. What is communication channel?(C2) Describe the basic data communication model.(C2)
12. Why data and file format standardization is crucial?(C4) What are the key information carried in RTF files?(C3) Explain.
13. Briefly describe some application areas of multimedia system.(C3)

External 2009**Long Questions**

1. What is digital image?(C3) How an image is represented digitally? Explain.(C3)
2. A data stream has only five symbols ABCDE with the following probabilities: $p(A)=0.10$, $p(B)=0.36$, $p(C)=0.15$, $p(D)=0.20$, and find out the resultant code word for each symbol.(C5)
3. What is RAID?(C8) Explain RAID Level-0 and RAID Level-1 in detail.(C8)
4. What is JPEG?(C5) Describe JPEG compression process.(C5)
5. Discuss Resource Reservation Protocol (RSVP) and Real Time Streaming Protocol (RTSP) used in multimedia communication system.(C6)
6. Explain the advantage and disadvantages of personal selling.(C9)
7. Write short notes:
 - a. Hypertext and Hypermedia (C9)
 - b. Emerging multimedia technologies (C11)
 - c. Multimedia over Internet (C9)
 - d. In-between process in animation (C1)

Short Answers

8. What is RTF (Rich Text Format)?(C3) what are the key information carried in RTF files? Explain.(C3)
9. Write the process of representing the image in digital form?(C3)
10. Explain about the processes of digital representation of audio signal.(C3)
11. Write short notes on:
 - a. Packetization(C6)
 - b. Multimedia conference(C6)