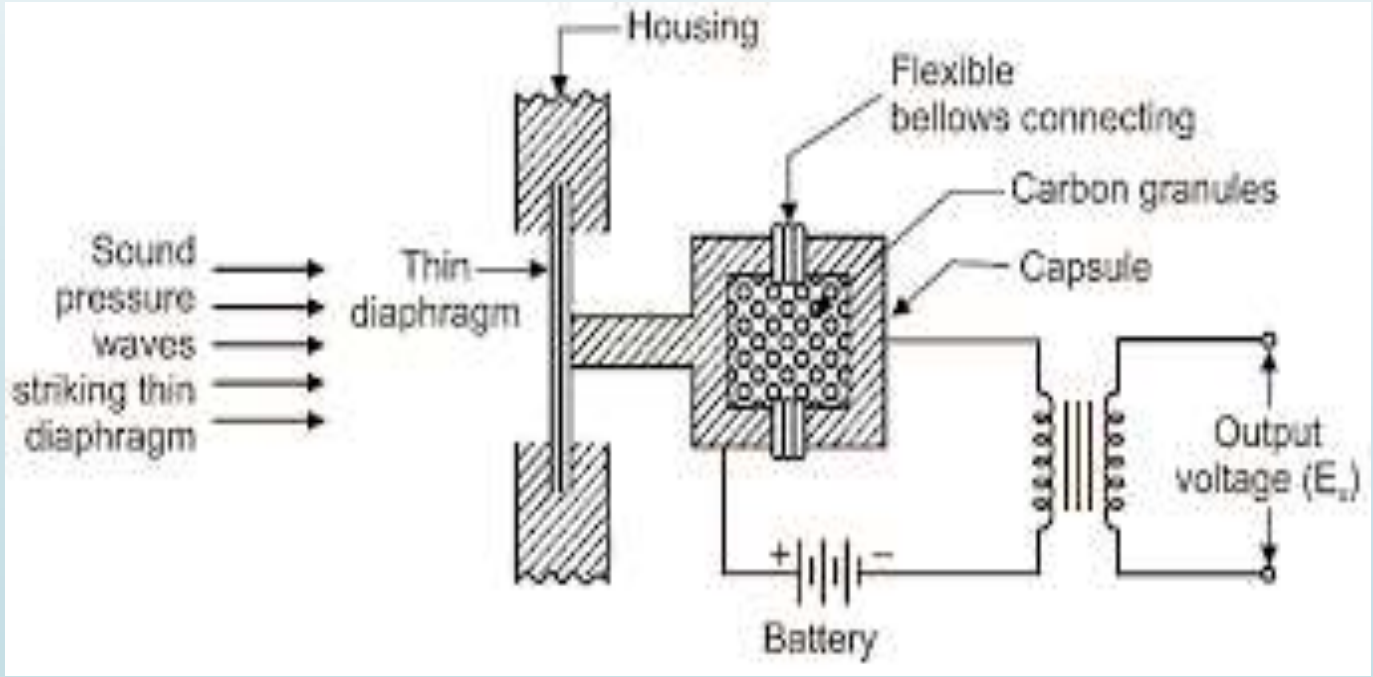
Microphone

- Microphone in short sometimes called mic or mike.
- A microphone is a **transducer** that converts sound waves into equivalent electrical signals of the same frequency and phase. The amplitudes of the output electrical signal are the same as the sound waves. The electrical signals in the audible range are called audio signals. A microphone is the first link in sound recording and transmission systems.
- **Characteristics of Microphones**
- A good microphone has some characteristics on these basics many microphones are good or bad. These characteristics should be high for the good one. These characteristics are-

- Sensitivity
- Signal to noise ratio
- Frequency Response
- Non-Linear Distortion
- Output Impedance
- Directivity

Carbon Microphone

- Construction: Carbon microphone consists of thin moving diaphragm used as primary transducer which senses sound pressure waves and convert them into displacement of diaphragm. Moving diaphragm is connected to a capsule having flexible bellows to allow compression or expansion.
- A Capsule containing granules of carbon acts as secondary transducer
- This device is externally powered by a constant voltage source.
- Hence Carbon micrphone is not a self generating type Instrument



Working

- When sound wave strikes on thin diaphragm , the diaphragm gets displaced by some distance.
- It compresses the capsule and hence carbon granules located in flexible capsule.
- When fine carbon granules enclosed in a case subjected to variations of pressure, the resistance of the granules changes.
- When such a device of carbon granules is connected in series with a load through a DC supply, the current through the load will vary in accordance with pressure variations on the carbon granules.
- Change in resistance will lead to change in output voltage. The output voltage obtained is calibrated in terms of sound pressure.

Advantages of Carbon Microphone

1. Low cost.
2. It withstands rough handling.
3. Simple and rigid construction.
4. It does not deteriorate due to
5. hotness and coldness.
6. It gives relatively high-power output as compared to other microphones.

Disadvantages of Carbon Microphone

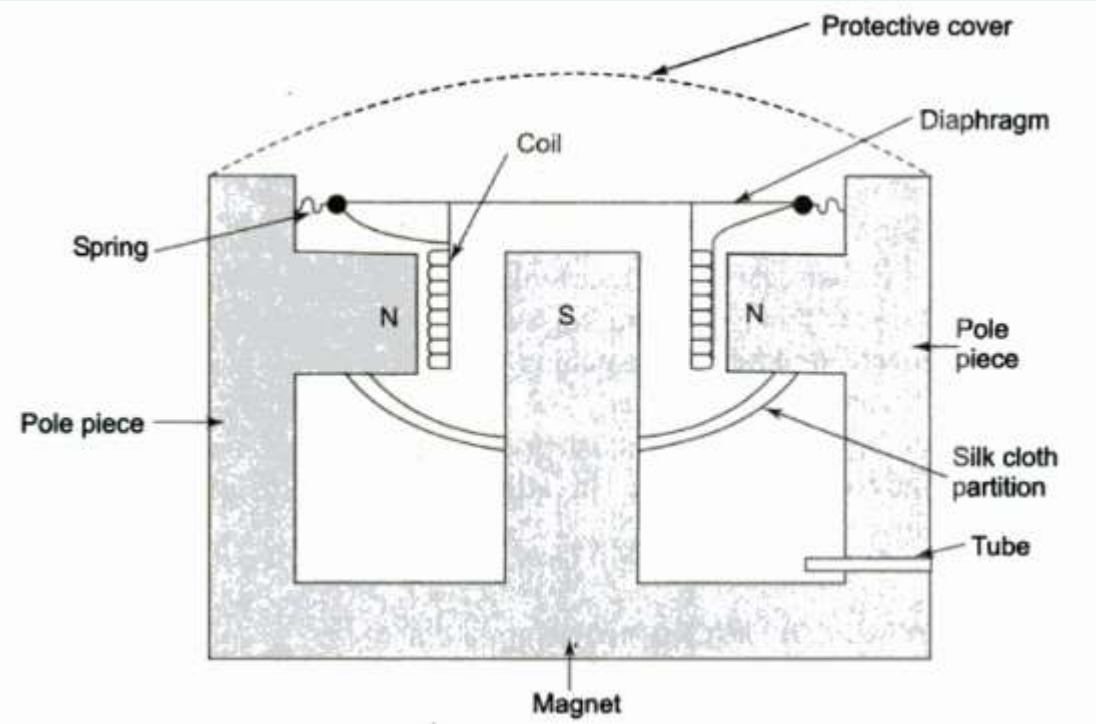
1. It requires an external power source to operate/work.
2. Distortion of sound is more as compared to other microphones.
3. It has a limited frequency response, not more than 5 kHz.
4. Less accurate.
5. Poor linearity.

Applications of Carbon Microphone

1. In Telephone transmission circuits.
2. In Telephone receivers.
3. In Radio broadcasting.
4. In Recording devices

Moving coil Microphone

- The moving-coil microphone (also called dynamic microphone) uses the principle of electromagnetic induction.
- When sound pressure variations move a coil placed in a magnetic field, there is a change of magnetic flux passing through the coil.
- An emf is, therefore, induced in the coil and this emf forms output of the microphone, (Due to similarity in construction, a moving coil loudspeaker can also work as a moving-coil microphone.
- The same unit is often used both as microphone and loudspeaker in office intercom systems.



Construction:

- The main components of a moving-coil microphone are a magnet, diaphragm and coil.
- The magnet is a permanent magnet of pot type with a central pole piece (south pole) and the peripheral pole piece (north pole).
- This type of magnet gives a uniform magnetic field in the gap between the pole pieces.
- The diaphragm is a thin circular sheet of non-magnetic material and is of' light weight.
- It is slightly domed for extra rigidity. It is fixed to the body of the magnet with the help of springs
- The springs provide compliance (equivalent to electrical capacitance) to the motion of a diaphragm.
- The mass of the diaphragm and coil assembly provide inductive effect.
- A protective cover (a metal grill) is used to save the delicate diaphragm and coil assembly from being mishandled.
- A silk cloth partition is used to separate the upper chamber from the lower chamber.
- A small tube is used in the lower chamber to g

Working

- When sound waves strike the diaphragm, it moves and hence, the coil moves in and out in the magnetic field.
- This motion changes the flux through the coil, which results in an emf being induced in the coil due to electromagnetic induction.
- The value of this emf depends on the rate of change of flux and hence on the motion of the coil.
- The displacement of the coil depends on the pressure of sound waves on the diaphragm.
- Thus, it is a pressure microphone, If B is the flux, density in tesla (or Weber/m2) 1, the length of the coil in metres, v, the velocity of diaphragm(hence coil) then The induced voltage, e, across the coil of the microphone is given by

$$E=B*l*v$$

Advantages of Moving coil Microphone

1. They are self-generating type (i.e. no external power source is needed for their operation).
2. They have high sensitivity and dynamic range.
3. They do not require battery.
4. Compact and light weight.
5. Low cost.

Disadvantages of Electro-Dynamic Microphone

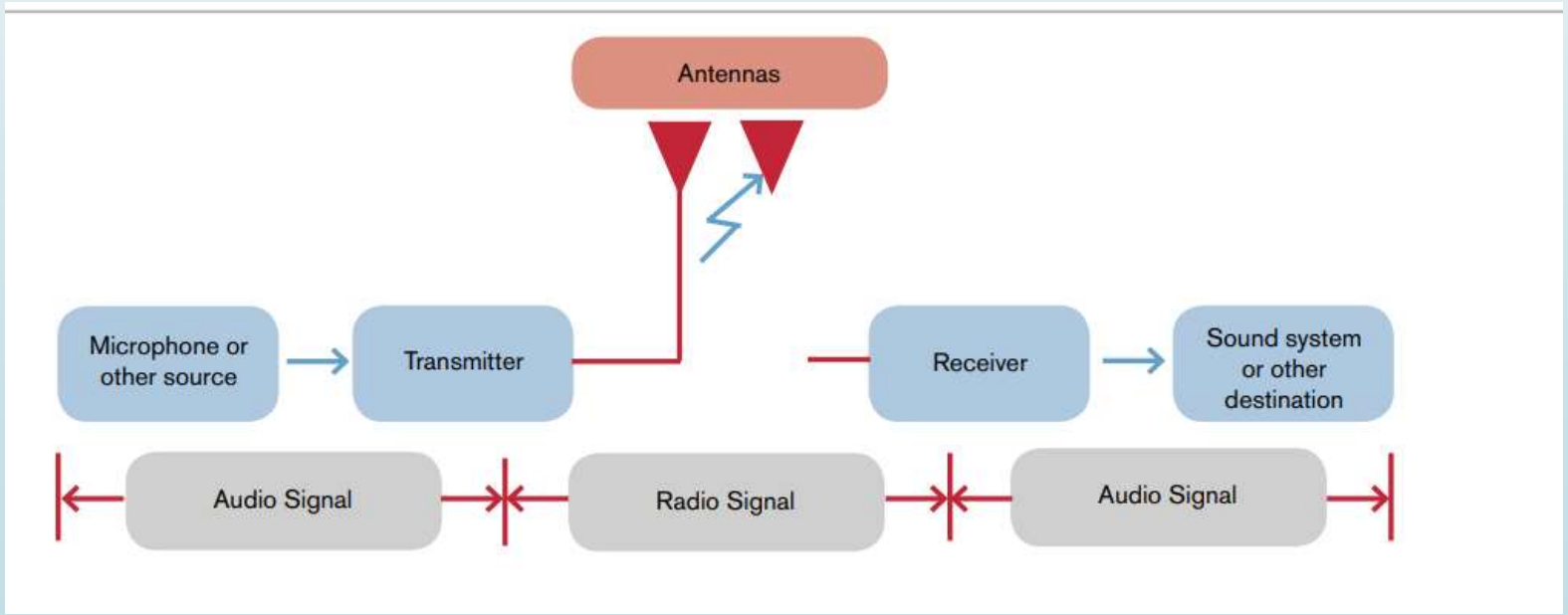
1. Poor linearity.
2. Poor frequency response due to high inertia of moving coil.
3. Low output.
4. Bulky in size.

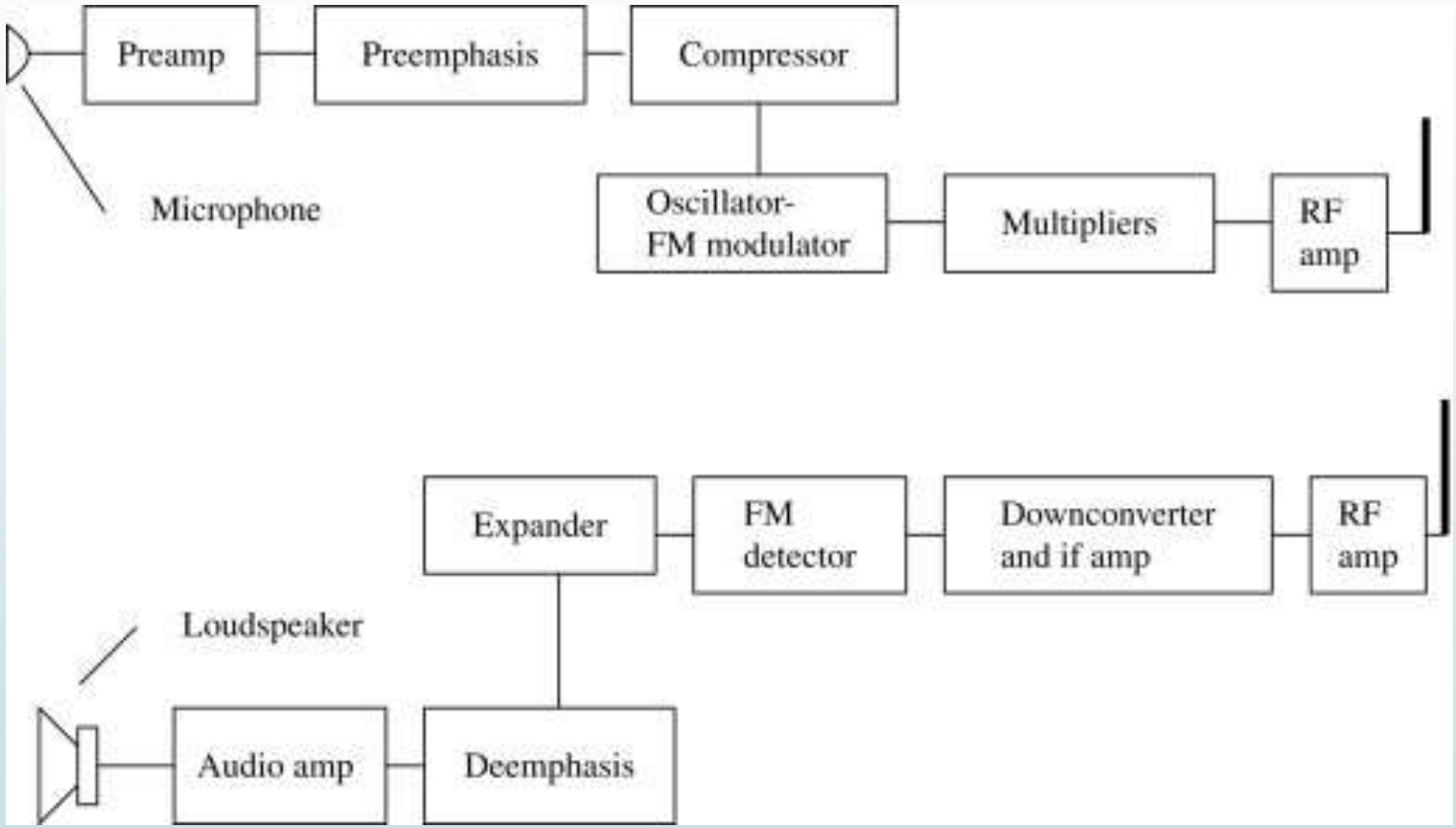
Applications of Moving coil Microphone

1. Voice communication in telephone lines.
2. Precision sound measurements.

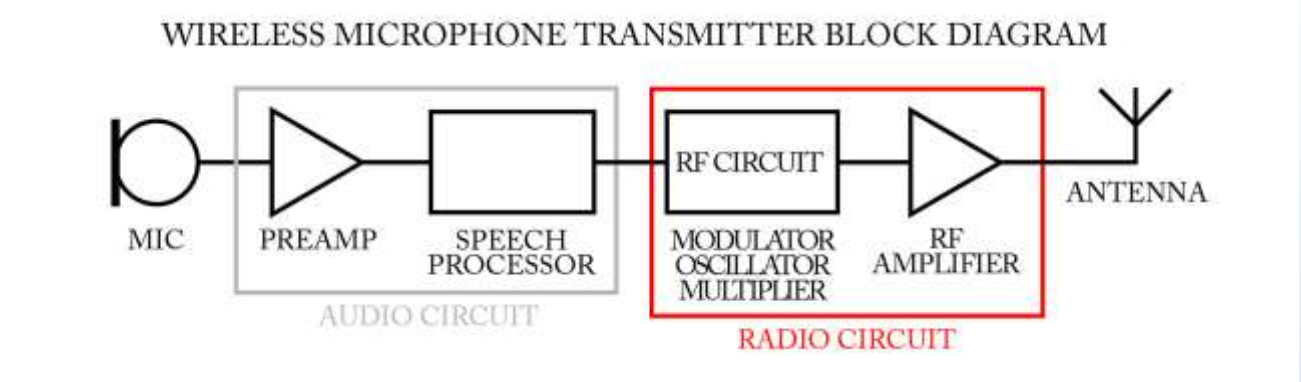
Cordless Microphone

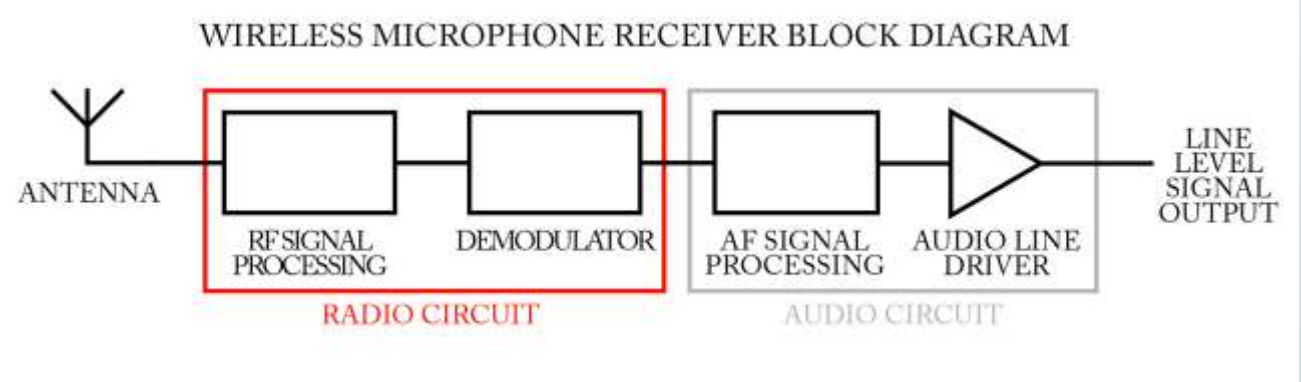
- A wireless microphone is pretty slick: no wires to trip on, no cords to untangle.
- It’s just you and your mic out there, taking on the world. But that handy little mic wouldn’t do a thing for you without the other components of a wireless system.
- The basic principle behind a wireless system is converting the audio signal being input at the microphone into a radio signal that can be transmitted over the air to the receiver
- And then turning it back into an audio signal that can be output to the rest of the sound system.
- A wireless microphone system consists of a transmitter and a receiver. The transmitter receives an audio signal and then processes it through air with ultra-high frequency modulation. The receiver then listens for this modulated signal and demodulates it




Preamp
Preemphasis
Compressor
Microphone
Oscillator-
FM modulator
Multipliers
RF
amp
Expander
FM
detector
Downconverter
and if amp
RF
amp
Loudspeaker
Audio amp
Deemphasis

- In a wireless system, the carrier signal is the radio frequency at which you transmit your information (in this case, the audio that goes into your wireless microphone).
- The audio signal modulates, or alters, the carrier frequency in a way that can be decoded in the receiver to recover the audio.
- There are many types of RF modulation, but two of the most common are amplitude modulation (AM) and frequency modulation (FM).
- Those initials should look familiar if you ever listened to the radio before XM, satellite radio, Pandora,


WIRELESS MICROPHONE TRANSMITTER BLOCK DIAGRAM
MIC
PREAMP
SPEECH PROCESSOR
AUDIO CIRCUIT
RF CIRCUIT
MODULATOR OSCILLATOR MULTIPLIER
RF AMPLIFIER
RADIO CIRCUIT
ANTENNA

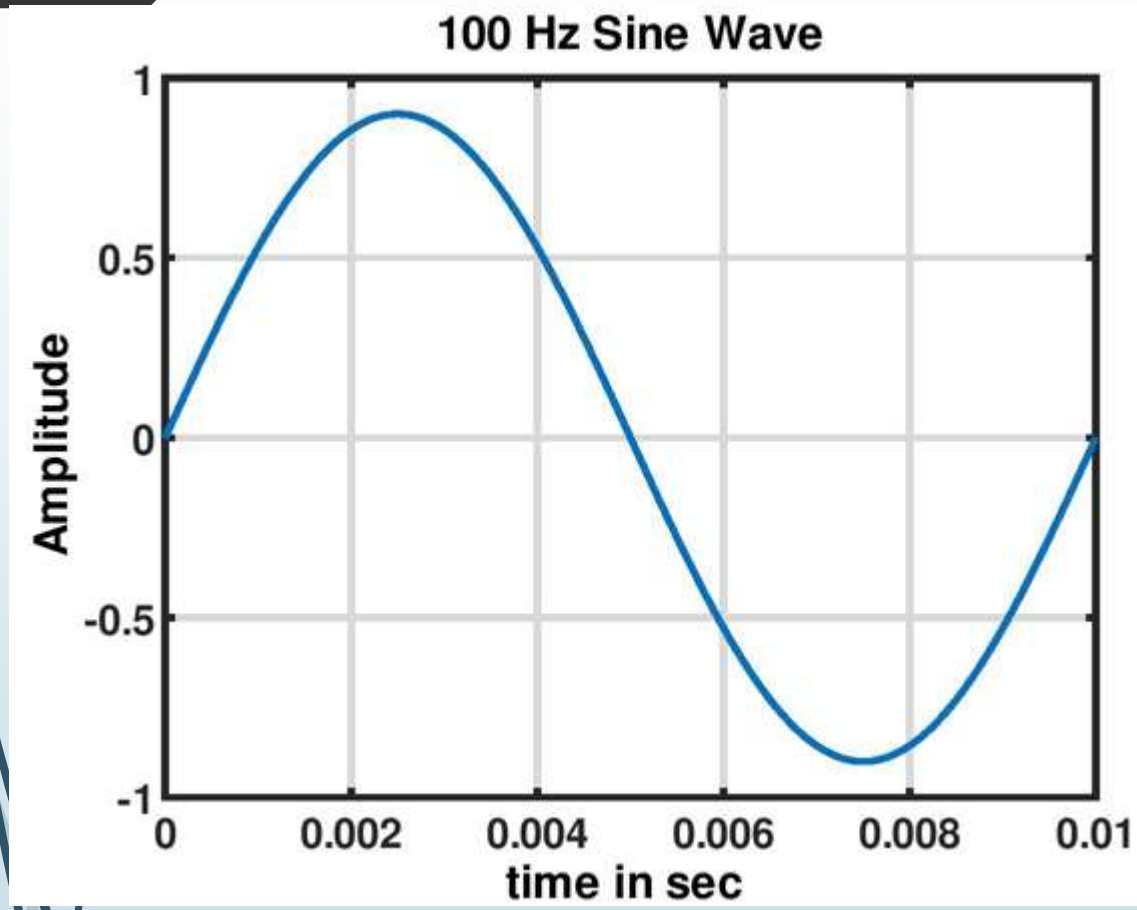

WIRELESS MICROPHONE RECEIVER BLOCK DIAGRAM
ANTENNA
RF SIGNAL PROCESSING
DEMODULATOR
RADIO CIRCUIT
AF SIGNAL PROCESSING
AUDIO LINE DRIVER
AUDIO CIRCUIT
LINE LEVEL SIGNAL OUTPUT

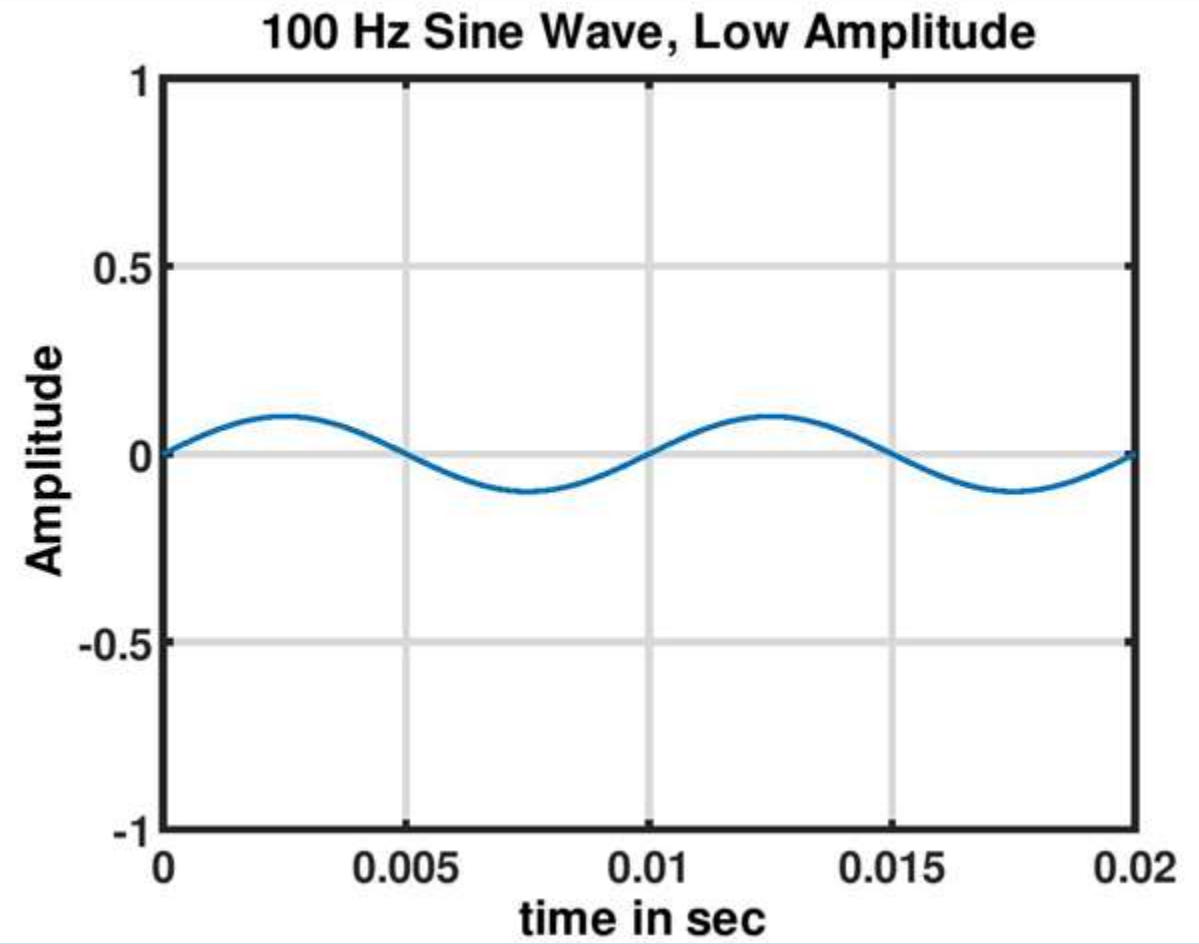
UNIT-2

Digital Audio Fundamentals

- On average, 2500 songs are uploaded every hour on Spotify, Apple Music, YouTube, and other streaming platforms which makes 60,000 songs a day and a million music tracks every week.
- Each day, almost 3-4 hours are spent by average American users listening to their favorite songs.
- But, have you ever wondered about the technology behind these songs and been amazed by hearing different instruments simultaneously?

- **Amplitude:** In audio, amplitude refers to the intensity of the contraction & expansion experienced by the medium (mostly air) the sound is traveling through. It is measured in decibels (dB) and perceived by us as the loudness of the pitch. Higher the amplitude, the louder the sound.
- **Frequency:** Frequency is referred to as the number of times vibration is experienced by the medium in one second. It is measured in hertz (Hz) and is also referred to as the pitch. Low-frequency sound travels farther than high-frequency sound. For example, the frequency of drum beat is lower than the frequency of flute.
-


100 Hz Sine Wave
Amplitude
time in sec
1
0.5
0
-0.5
-1
0
0.002
0.004
0.006
0.008
0.01


100 Hz Sine Wave, Low Amplitude
Amplitude
time in sec
1
0.5
0
-0.5
-1
0
0.005
0.01
0.015
0.02

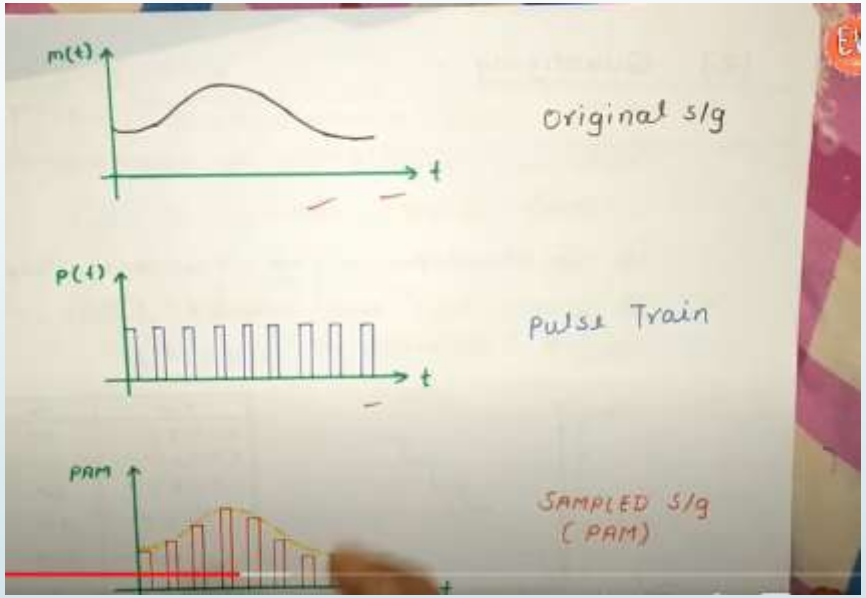
What is “Digital Audio”?

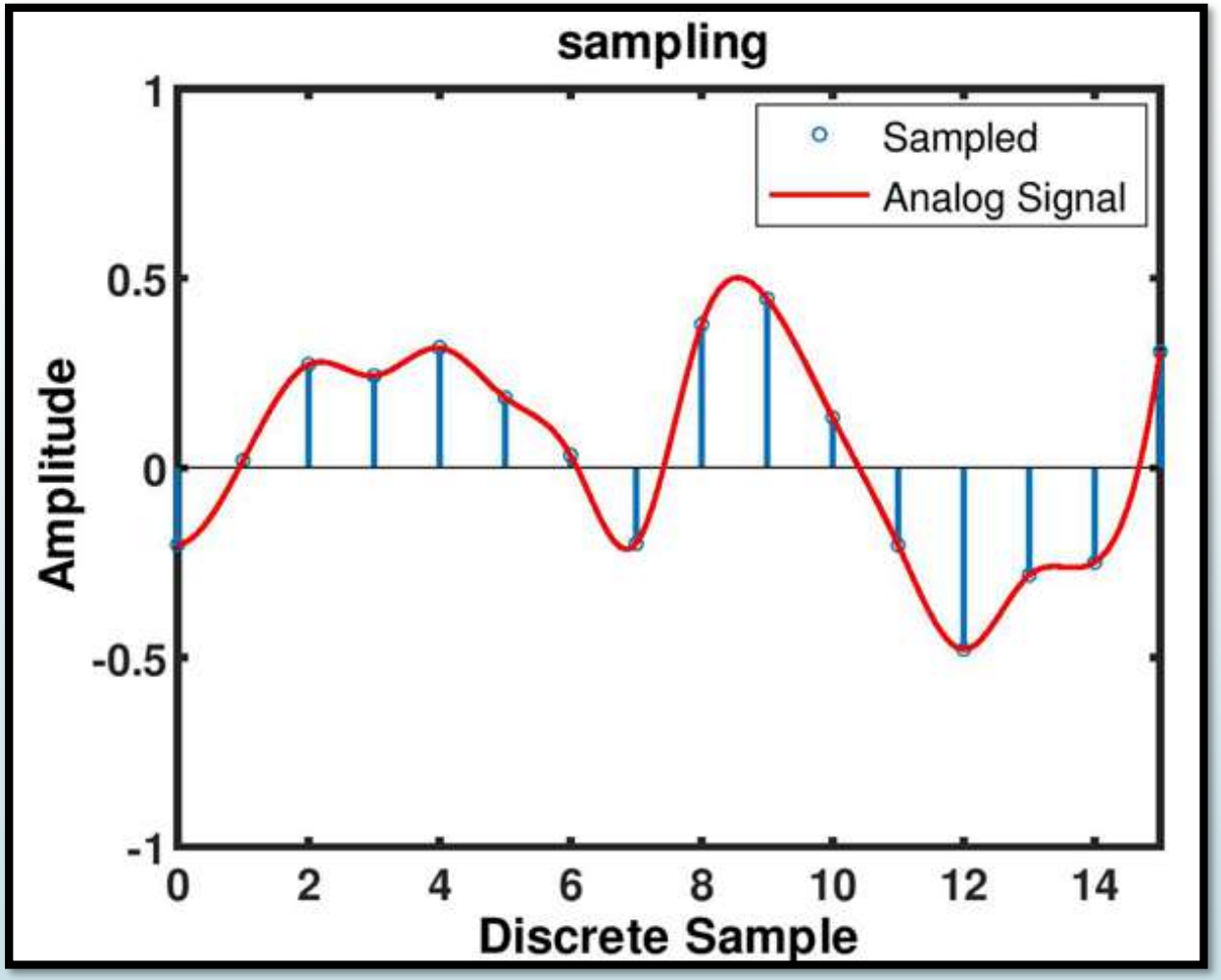
- Digital audio is the phenomenon of record, process, store and transmits audio signals through a computer system over the internet. Computers can only understand the signals that have been encoded to binary numbers. But any audio content is inherently analog which our processors can’t interpret.
- To represent the audio signals in a way that computers understand and process the data, the data needs to be converted in digital (binary) form.
- The process requires various steps. Usually, analog audio signals are found in the form of continuous sinusoidal waves whereas digital audio represents the discrete points that show the amplitude of the waveform.
- Continuous signals must be converted to discrete signals as they provide finite and countable values after a certain time interval for computer use.

- To Record a sound in digital format, Sound is firstly converted in to didgital format first.
- It is called digitization of sound.
- Sampling
- Quantization
- Aliasing
- Encoding
- Edison made first audio recording on foil covered cylinder in 1877, after that field of audio recording grown.

Sampling & Quantization OR Digitization of Audio signals

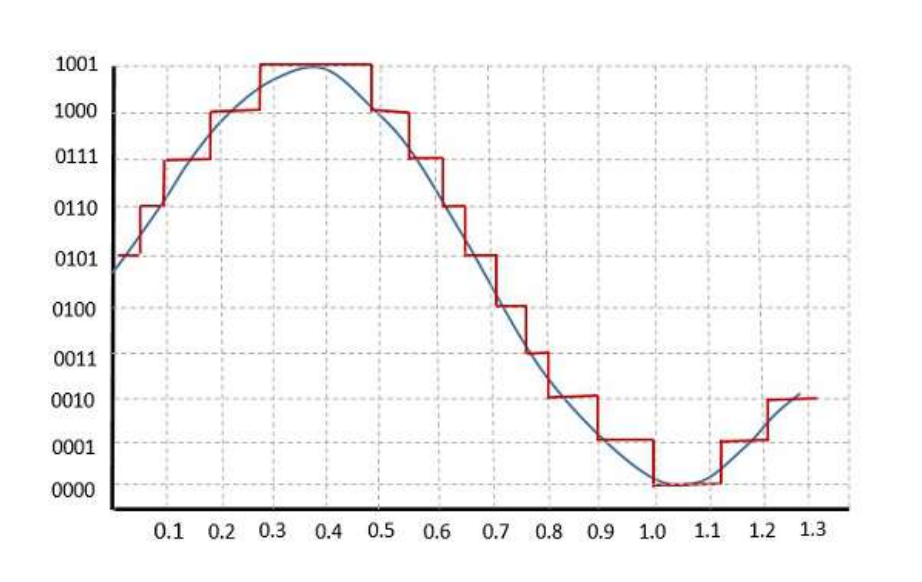
- The conversion process starts with analog to digital conversion (ADC) .
- The process of ADC must accomplish two tasks
- **Sampling and Quantization.**
- Sampling stands for the number of samples (amplitude values) captured at regular time intervals. The sampling rate is number of samples taken per second which is measured in Hertz (Hz). If we record 48000 samples per second, the sampling rate would be 48000 Hz or 48 kHz.
- Sampling rate (Fs)= 48 kHz
- Sampling period (Ts)= 1/Fs
- The smaller sampling interval allows a higher sampling rate which results in a higher audio frequency and larger file size and eventually better-quality sound. So, clearly, the sampling rate should be high enough for lossless digitization.
- Frequencies that are more than half of sampling rates can't be represented in digital samples. As per the **Nyquist theorem**, a continuous-time signal can be perfectly reconstructed from its digital samples when the sampling rate is more than double the highest audio frequency.
- **Nyquist frequency**: Sampling rate should be at least more than double of Fmax
- $Fs > 2Fmax$


m(t)
t
Original s/g
p(t)
t
Pulse Train
PAM
SAMPLED S/g
(PAM)


sampling
Sampled
Analog Signal
Amplitude
Discrete Sample
1
0.5
0
-0.5
-1
0
2
4
6
8
10
12
14

Quantization:

- The quantizing of an analog signal is done by discretizing the signal with a number of quantization levels. **Quantization** is representing the sampled values of the amplitude by a finite set of levels, which means converting a continuous-amplitude sample into a discrete-time signal



- Both sampling and quantization result in the loss of information. The quality of a Quantizer output depends upon the number of quantization levels used. The discrete amplitudes of the quantized output are called as **representation levels** or **reconstruction levels**. The spacing between the two adjacent representation levels is called a **quantum** or **step-size**.

Quantization of Audio Signals

- It is the process of mapping analog audio signals with infinite values from a large dataset to digital audio signals with finite and countable values in smaller data set during analog-to-digital conversion (ADC).
- Bit-depth plays an important role in determining the accuracy and quality of the quantized value. If an audio signal uses 16-bit then the maximum number of amplitude values represented are 2^16= 65,536 values.
- It shows that the amplitude of the signal is divided into 65,536 samples and the amplitude of all samples will be assigned a discrete value from a range of possible values.
- During this process, a small perceivable loss in audio quality may occur, but that is not usually understood by human ears. This loss is due to the difference between the input value and quantized value and is described as **quantization error**.

Encoding: It is used to convert quantized signal in to binary form.

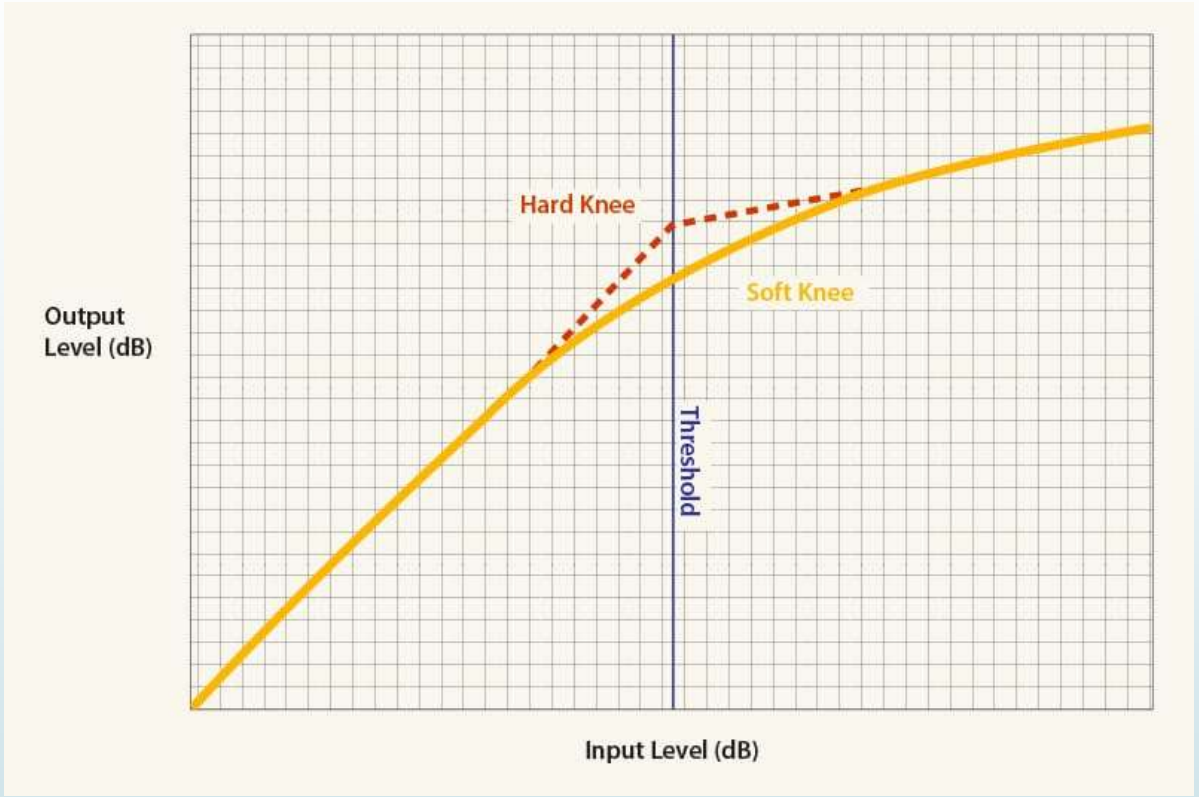
- **Aliasing:** Aliasing is a type of artifact or distortion that occurs when a signal is sampled at less than twice the highest audio frequency present in the signal. Aliasing often results in the difference between the signals reconstructed from samples and the original continuous signal. It depends on the frequency and sampling rate of the signal. For instance, if a signal is sampled with a 38 kHz sampling rate, any frequency components above 19kHz create aliasing.
- **Anti-aliasing Filters:** The process of aliasing can be avoided by using low-pass filters or anti-aliasing filters. These filters are applied to the input signals before sampling to restrict the bandwidth of the signal. Anti-aliasing filters remove the components above Nyquist frequency and allow to reconstruct the signals from digital samples without any additional distortion.
- **Bit-depth:** In a nutshell, bit-depth is the number of bits available for each sample. Computers only understand and store the info in binary digits i.e., 1 or 0. These binary digits are called bits. The higher no. of bits determines more information has been stored. Hence, the higher the bit-depth, the more data will be captured to get a more precise result.
- **Dynamic range:** Bit-depth also determines the dynamic range of the signal. When the sampled signals are quantized to the nearest value within a given range, these values within this range are determined by bit-depth. These dynamic ranges are represented in decibels (dB). In digital audio, 24-bit audio has the maximum dynamic range of 144dB, whereas 16-bit audio has a maximum of 96dB of dynamic range.
- The bit-depth of 16-bit digital audio with a sampling rate of 44.1 kHz is widely used for consumer audio, whereas 24-bit audio with a sampling rate of 48 kHz is used for professional audio for content recording, mixing, storing and editing.

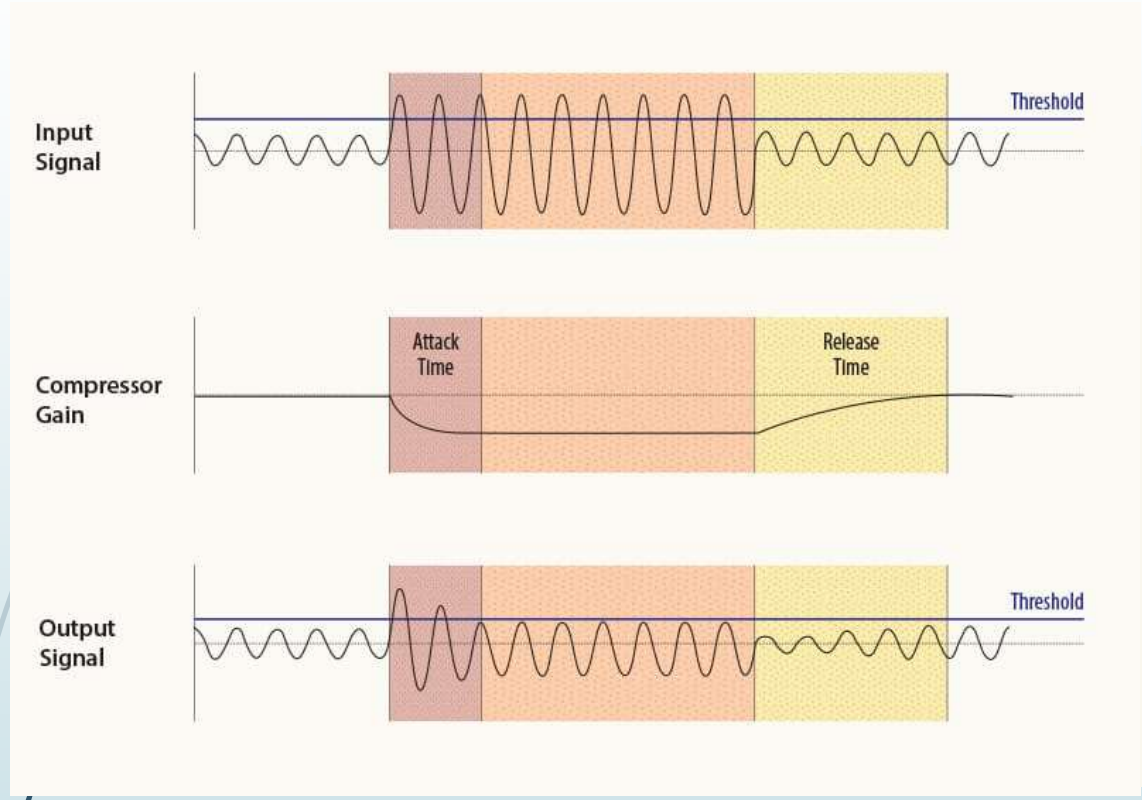
- Modern computers can store increasingly large numbers of files, but file size still matters. The smaller our files are, the more files we can store. We use compression algorithms to reduce the amount of space needed to represent a file.
- Compressors are one of the most important effects to understand when trying to get recordings that sound professional and radio-ready. When used properly, they can make your tracks sound punchy, balanced, and loud, while also injecting coloration and tone.

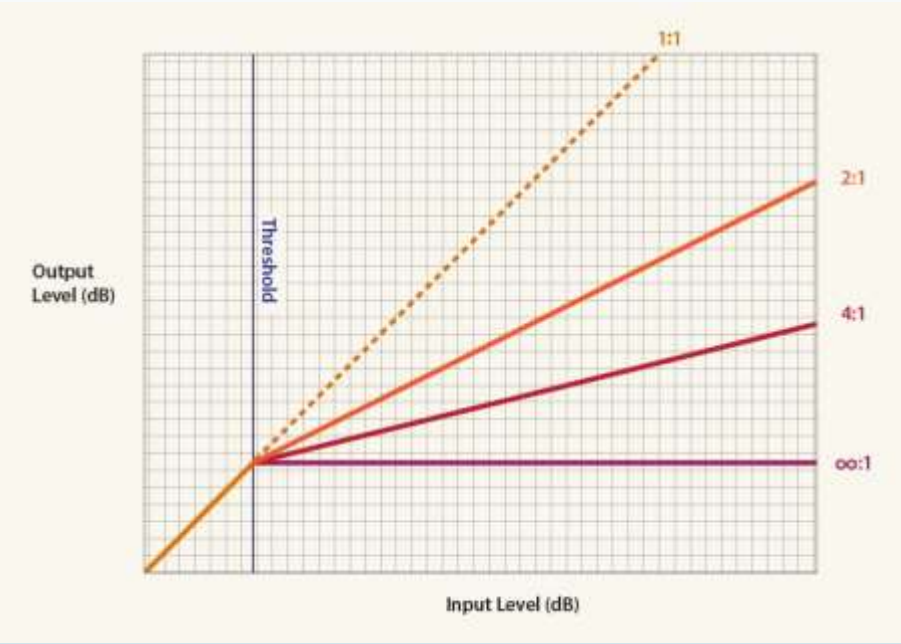
  But over-compressing can squeeze the life out of your recordings. So having a good grasp of the basics will ensure that you are getting the most out of this essential tool.

- Compression reduces the overall dynamic range of a piece of audio by detecting when it exceeds a specified level, and then attenuating it by a specified amount. Put simply, it narrows the difference between the loudest and softest parts of a track so that it's more consistent in level
- Lossless compression usually results in smaller file size reductions than lossy compression, but preserves the original quali
- Modern computers can store increasingly large numbers of files, but file size still matters. The smaller our files are, the more files we can store. We use compression algorithms to reduce the amount of space needed to represent a file.

- Threshold
- The threshold is the level at which the compression effect is engaged. For example, if the threshold level is set at - 10 dB, only signal peaks that extend above that level will be compressed
- Knee
- The knee refers to how the compressor transitions between non-compressed and compressed states. Most compressors allow you to choose either a “soft” or a “hard” knee. While some compressors allow you to select positions between the two types of knees.
- Attack Time
- This refers to the time it takes for the signal to become fully compressed after exceeding the threshold. Faster attack times are usually between 20 and 800 microseconds, while slower times generally range from 10 to 100 milliseconds. Some compressors express this as slopes in dB per second, rather than time.
- Release Time
- You can think of release as the opposite of attack. It’s the time it takes for the signal to go from the compressed state back to the original non-compressed state.


Output
Level (dB)
Hard Knee
Soft Knee
Threshold
Input Level (dB)


Input Signal
Threshold
Attack Time
Release Time
Compressor Gain
Output Signal
Threshold


1:1
2:1
4:1
∞:1
Threshold
Output Level (dB)
Input Level (dB)

Time Compression/Expansion:

- Time compression is a phenomenon where a longer real-time event gets compressed into a shorter perceived experience and this is even more pronounced in Virtual Reality because time goes by faster than we think when playing games in VR compared to other conventional methods.
- A process where a sound file of a given length is electronically speed up or slowed down so it will play in a shorter or longer period of time. When speaking of time compression or expansion it is generally assumed that the pitch of the material is not changed, so this isn’t as simple as just speeding up or slowing down the playback device. This type of process requires that the material’s playback speed be adjusted and then some type of pitch correction applied to return its pitch to normal.

UNIT-3

TELEVISION

Gross Structure: Geometric form and Aspect ration of the picture.

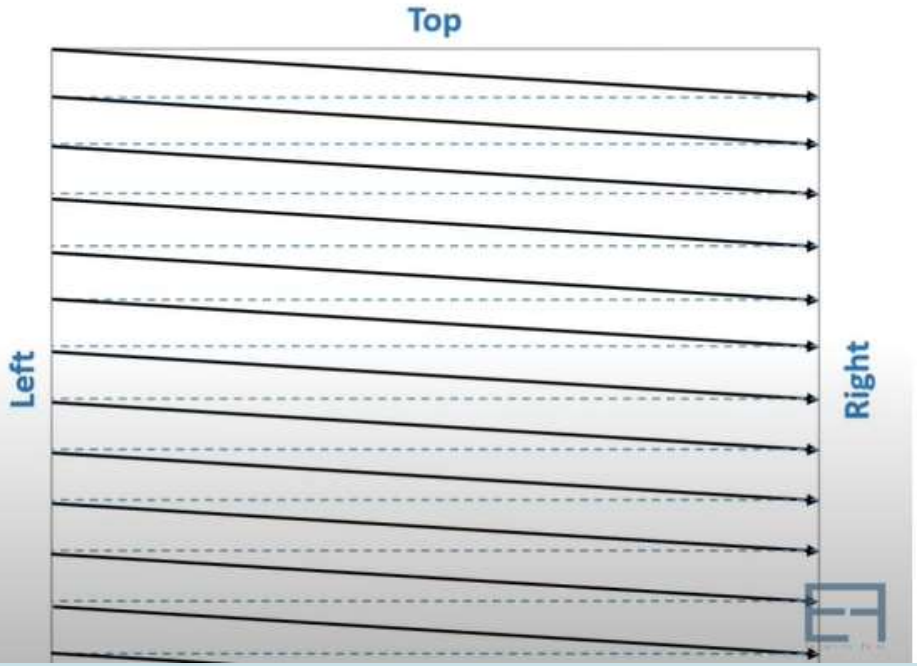
- Frame adopted in all television systems is rectangular with width /height ratio I e aspect ratio=4/3 because
- Most of the motion occurs in horizontal plane so large width is desirable.
- The eyes can view with more ease and comfort when the width of picture is more than its height
- This enables direct television transmission of film programmes without wastage of any file area.

- Aspect ratio of picture televised and picture produced on the receiver screen should be same.
- This is done by following methods
- A) Setting the magnitude of the current in the deflection coils to the correct values, both at TV camera and receiving picture tube.
- Same coordinates should be scanned at any instant both at camera beam tube and picture tube beam in the receiver.
- Synchronizing pulses are transmitted along with the picture information to achieve exact congruence between transmitter and receiver scanning system.

Image Continuity:

Basics of Continuity of TV

- TV picture element of the frame produced by a scan process so that illusion of continuity is created.
- Human eye's can see video with continuity, if 16 frames per second is scanned.
- Human eye's can not separate two frames, if frames are scanned with (1/16)th second per frame.



Parameters of Image Continuity in TV

- In commercial motion picture, frame rate is 25 frame per seconds in most TV.
- Picture scanning is divided into two parts
  - ❑ Horizontal scanning
  - ❑ Vertical scanning

Scanning:

- Scanning is the process by which an electron beam spot is made to move across a rectangular area, so as to cover it completely
- In order to produce video signal for all the elements in the picture it is scanned by the electron beam one element at a time or in sequential order
- The scanning is done in the same way as a written page is read to cover all the words in one line & all lines on the page

- The scene is scanned rapidly both is horizontal and vertical directions simultaneously to provide sufficient number of complete pictures or frames per second to give the illusion of continuous motion.
- Frame repetition rate is 25 per second
- The lines that are scanned on the tube screen are produced by a narrow electron beam that is focused into a small 'spot' which is repeatedly moved across the screen, then progressively down it until the entire area has been covered. This is referred to as a 'Raster'.

Horizontal Scanning:

- The movement of electron beam spot from left to right and back so as to start a new line in the same direction is termed as horizontal scanning. Horizontal scanning frequency is defined as the number of lines scanned per second.
- Obviously in 625-line, 50 Hz system where 25 frames are transmitted per second, the horizontal scanning rate is 15625 lines per second.
- This is also termed as 15625 Hz because the signal that enables the spot scan horizontally at the rate of 15625Hz, as one cycle makes the spot scan from left extreme to right extreme.
- The linear rise of current in horizontal deflections coils deflects the beam across the screen with a continuous ,uniform motion for trace from left to right.
- At the peak of the rise , the sawtooth wave reverses direction and decreases rapidly to its initial value.
- This fast reversal produces the retrace or flyback.
- Total 625 lines are there horizontally. Out of there 313 are there with trace and 312 are there with retrace.

In one second 50 frame are recorded

f (Horizontal) = 313*50=15625hz , T(Horizontal)= 1/15625=64µsec

f (vertical) =50Hz,T(Vertical)=1/50=20msec

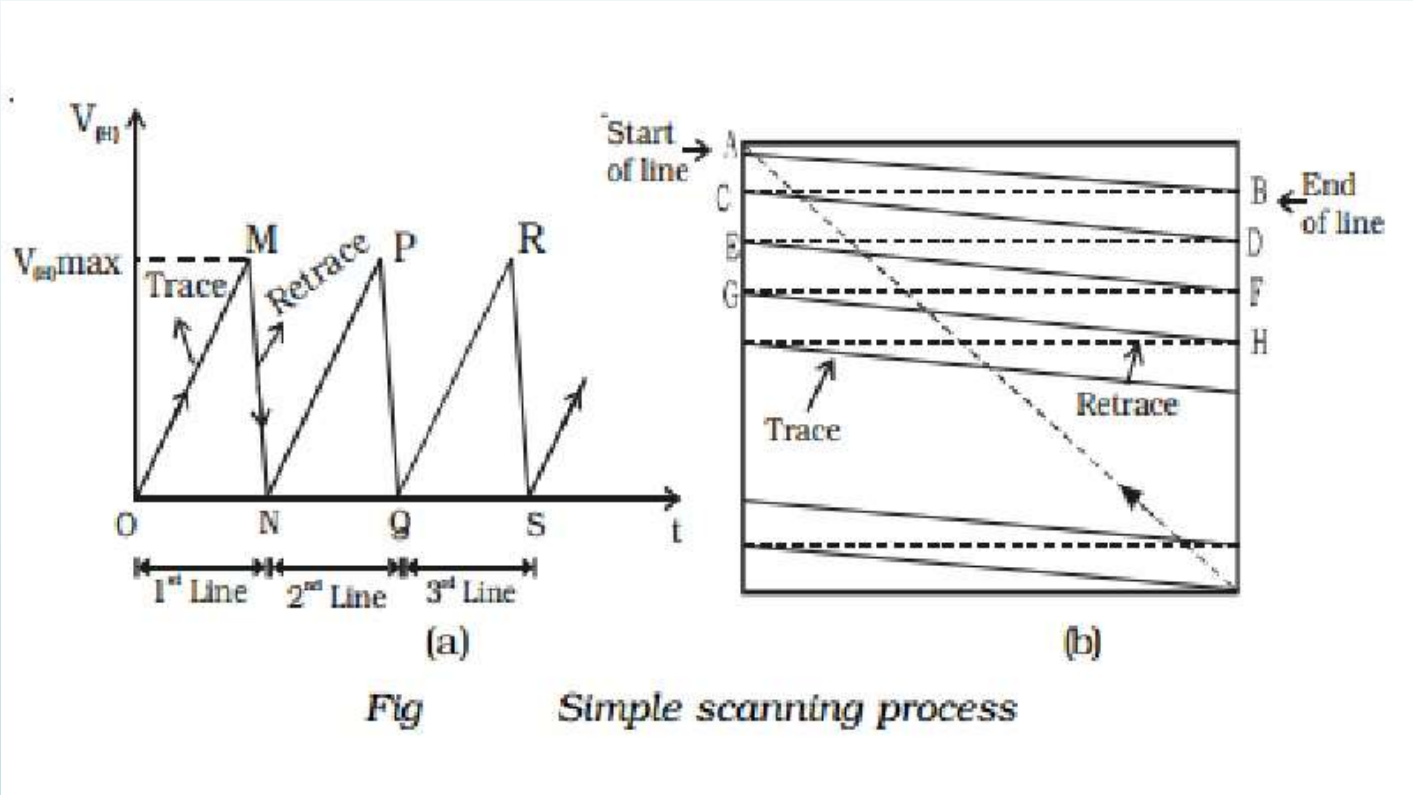
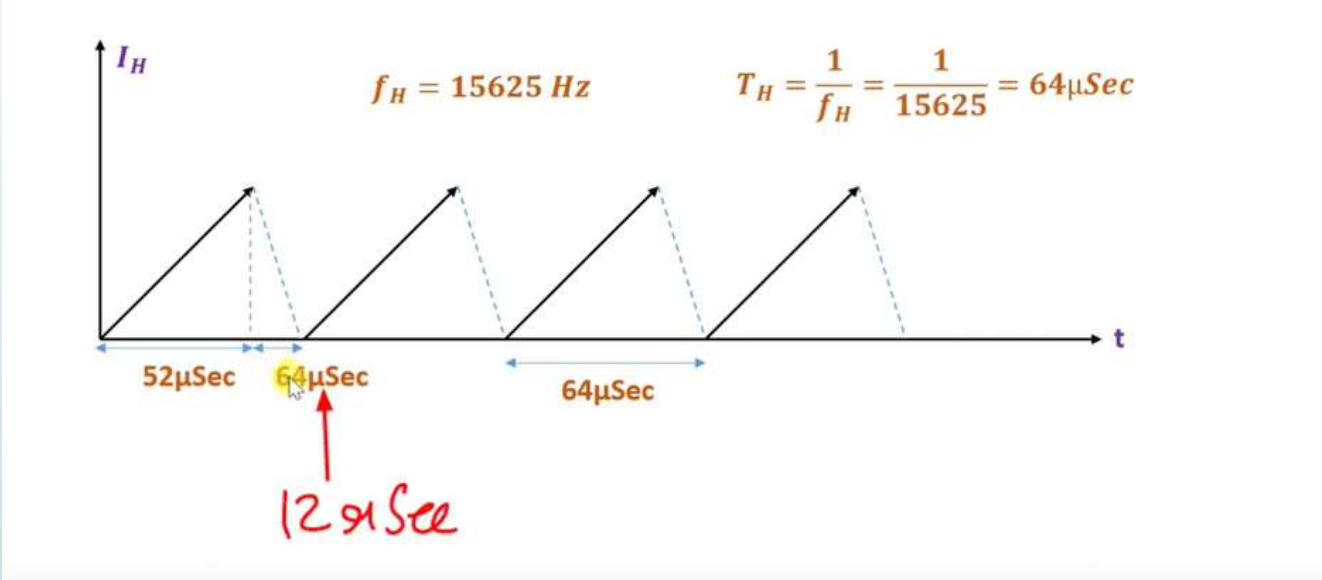


Fig Simple scanning process

- Dfdg

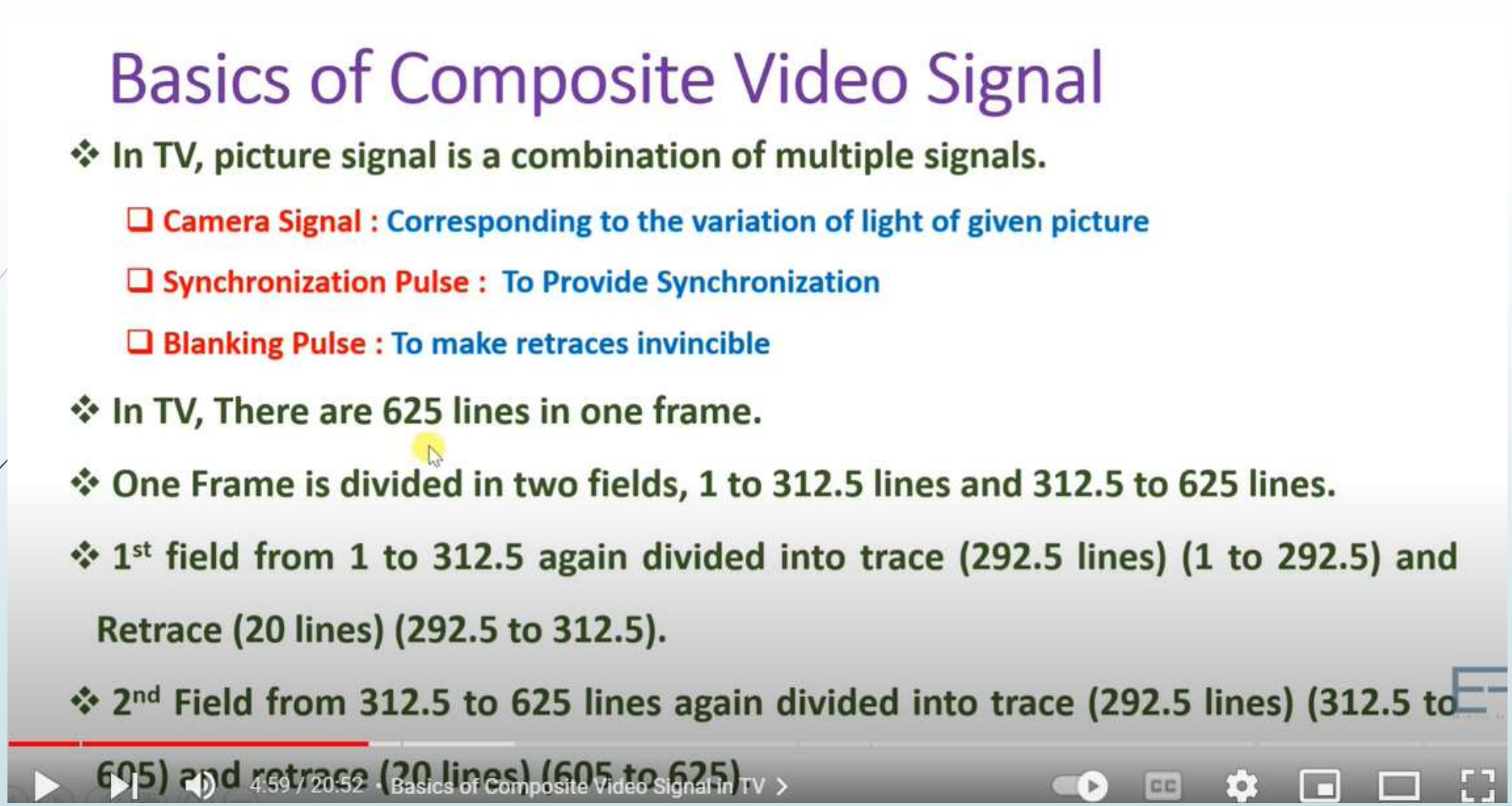

I_H
$f_H = 15625\ Hz$
$T_H = \frac{1}{f_H} = \frac{1}{15625} = 64\mu Sec$
t
52µSec
64µSec
64µSec
12 µSec

Composite Video Signal:-

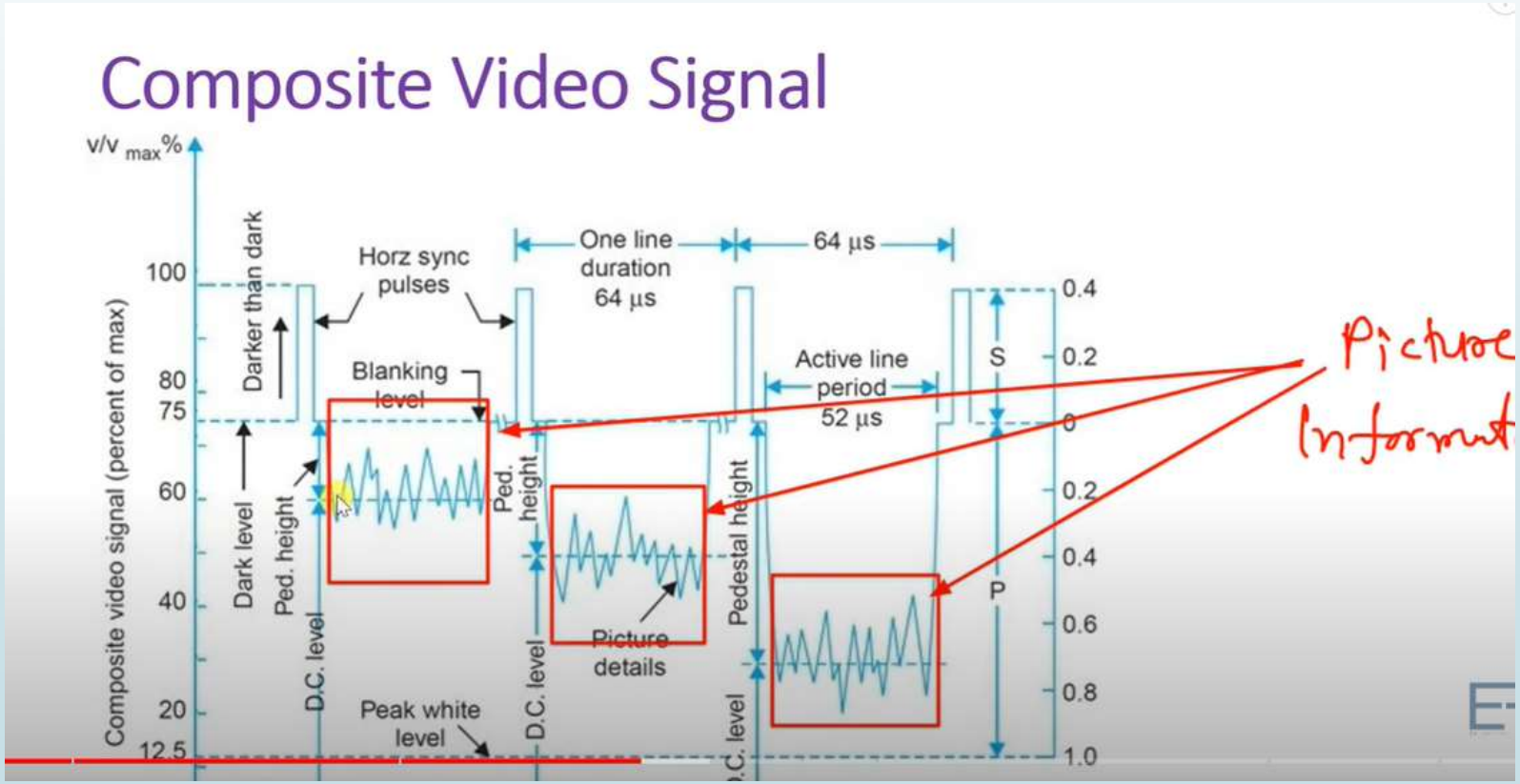
- The composite video signal is the video signal into which blanking and synchronizing pulses are inserted at proper timings.
- Composite video signal consists of
- A camera signal corresponds to desired picture information
- blanking pulses to make the retraces invisible
- Synchronizing pulses to synchronize the transmitter and receiver scanning.

Basics of Composite Video Signal

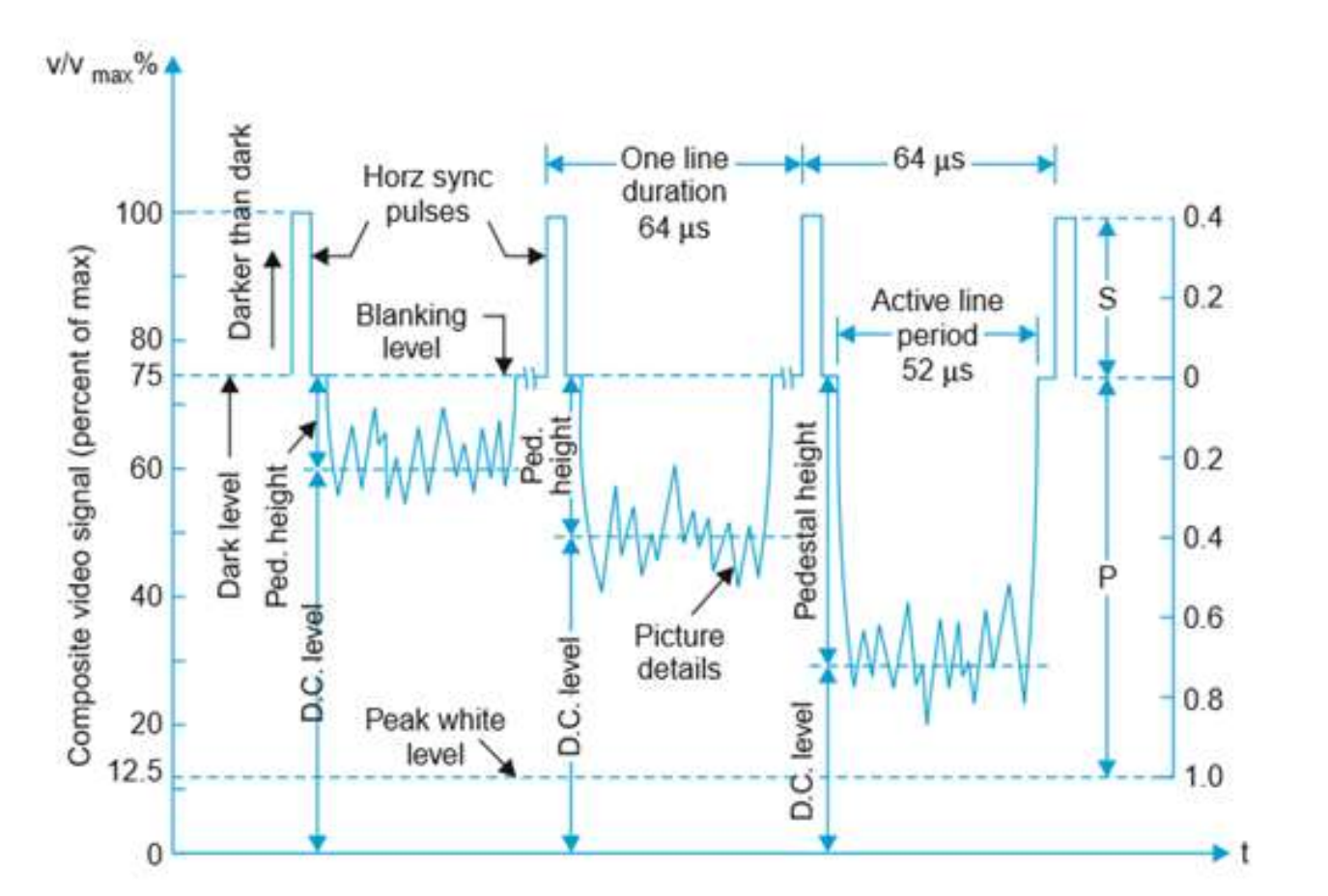
- In TV, picture signal is a combination of multiple signals.
  - Camera Signal : Corresponding to the variation of light of given picture
  - Synchronization Pulse : To Provide Synchronization
  - Blanking Pulse : To make retraces invincible
- In TV, There are 625 lines in one frame.
- One Frame is divided in two fields, 1 to 312.5 lines and 312.5 to 625 lines.
- 1st field from 1 to 312.5 again divided into trace (292.5 lines) (1 to 292.5) and Retrace (20 lines) (292.5 to 312.5).
- 2nd Field from 312.5 to 625 lines again divided into trace (292.5 lines) (312.5 to 605) and retrace (20 lines) (605 to 625).



- Video signal is from 12.5 %to 75%. Low level is Peak white level. Higher level is peak dark level.
- Synchronization is from 75% to 100%



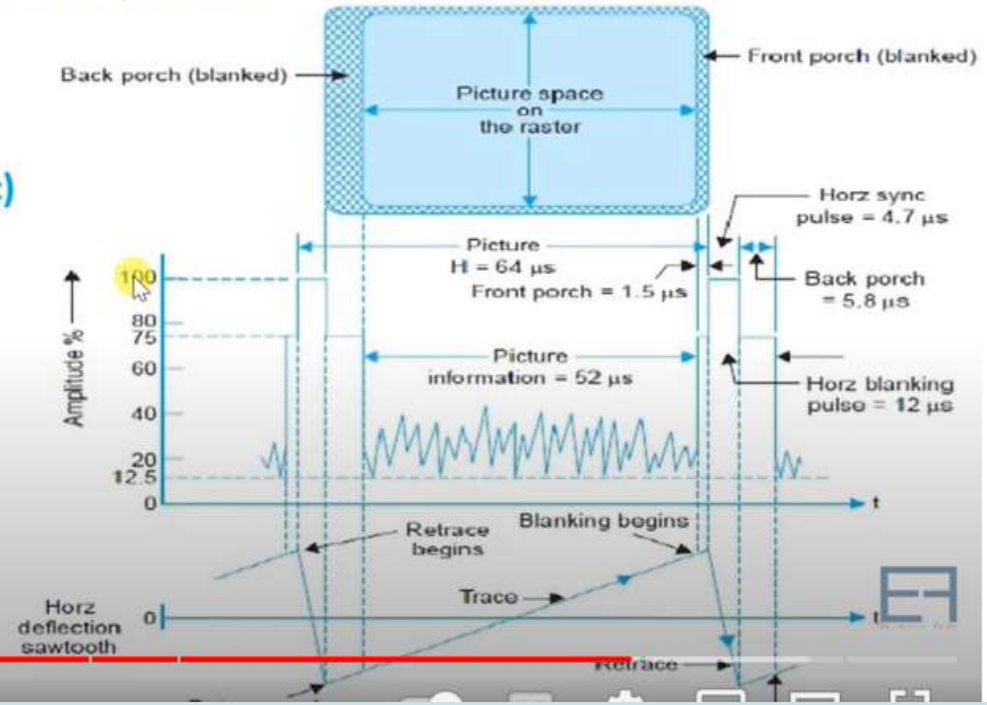
P/S should be maintained =10/4



Horizontal Blanking Pulse

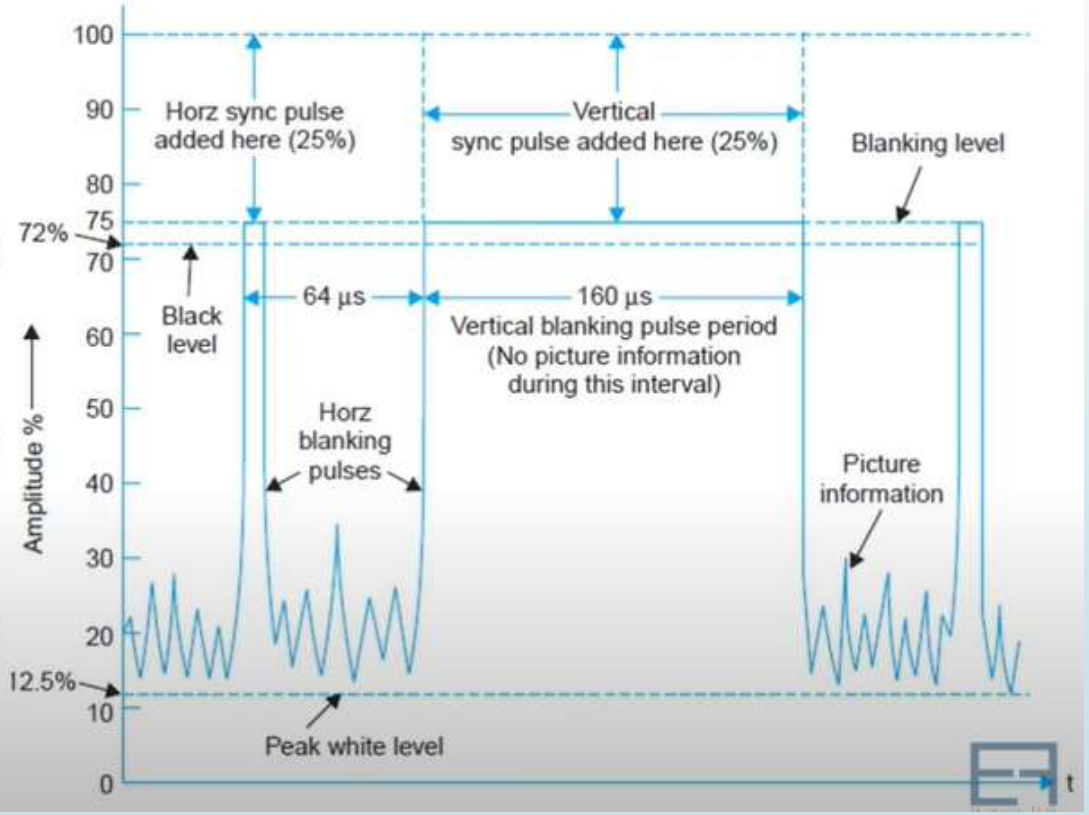
- **Horizontal Blanking Pulse (12 µSec) has three portion**

1. **Front Porch (1.5 µSec)**
   - Fly back initiated with black level
2. **Horizontal Synchronization pulse (4.7 µSec)**
   - Synchronization is done to Tx and Rx by pulse
3. **Back Porch (5.8 µSec)**
   - Fly back completed with black level



Vertical Sync Pulse

- It is of 2.5 line duration.
- So its time period is 2.5*64 = 160 µsec.
- At the end of first field vertical sync pulse is added at (312.5 to 315) (2.5 lines).
- At the end of second field vertical sync pulse is added at (1 to 2.5) (2.5 lines).
- One vertical sync pulse ends at half line period and one ends at full line period.



Vertical Blanking Period

- It is period during which picture information is completely suppressed and flyback retrace of field is initiated and completed.
- It is of 20 lines duration. So time will be 20*64µsec = 1.28 msec.

- The composite video signal contains blanking pulses to make the retrace lines invisible by raising the signal amplitude slightly above the black level (75 per cent) during the time the scanning circuits produce retraces.
- Vertical Blanking: This is the period of time between the end of one field and the beginning of the next. During this time, the electron beam is turned off and repositioned to start the next field.
- Synchronization Signals: These signals are used to ensure that the TV display is synchronized with the video signal.
- The synchronizing pulses are transmitted or stored along with the analog video signal for each line. These synchronizing pulses are then used to trigger the receiver's circuitry to make sure that the scene is sequenced properly on the screen.

- In TV blanking means ‘going black’ as part of the video signal, the blanking voltage is at the black level.
- Video voltage at the black level cuts off the beam currents in the picture tube to black out the light from screen.
- The purpose of providing the blanking pulses is to make invisible the retraces of the scanning process.
- The horizontal blanking pulse at the frequency of 15625Hz. Blanks out the retrace from right to left for each line.
- The vertical blanking pulses at 50 Hz blank out the retrace from bottom to top for each field.

No:	Particles	Frequency in Hz
1	Horizontal Scanning Pulses	15625
2	Horizontal Sync Pulses	15625
3	Horizontal blanking Pulses	15625
4	Vertical Scanning Pulses	50
5	Vertical Sync Pulses	50
6	Vertical blanking Pulses	50
7	Equalizing Pulses	31250

UNIT-3 Part B

COLOUR TELEVISION

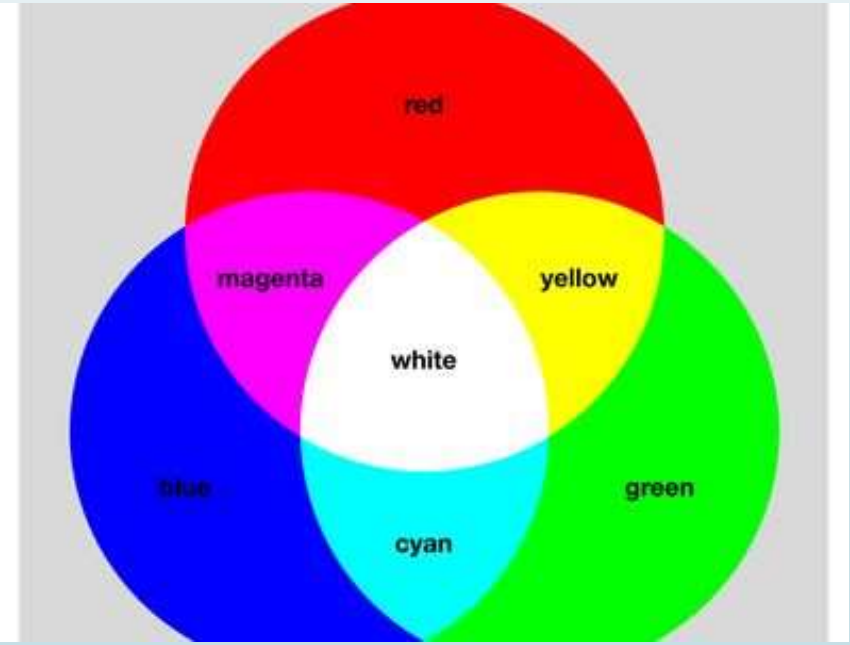
Colour TV

- Colour are of two types
- Primary volour
- Secondary colour

- Colours which can not be produced by mixing other colous are called Primary Colour. Red, Green,Blue are called Primary colour.
- Secondary colour can be produced by misxing other colours(Primary colour)
- They are made with help of Primary colour.

Three colour Theory:

- The RGB colour model is considered an additive system, because it adds wavelengths of the primary colours red, green, and blue together to create a broad range of colours.
- RGB color model is an additive color model in which red, green, and blue colors are mixed in various proportions to form a different array of colors. The name was given with the first letters of three primary colors red, green, and blue. In this model, colors are prepared by adding components, with white having all colors in it and black without the presence of any color. It is used in various digital displays like TV and video displays, Computer displays, digital cameras, and other light-based display devices.

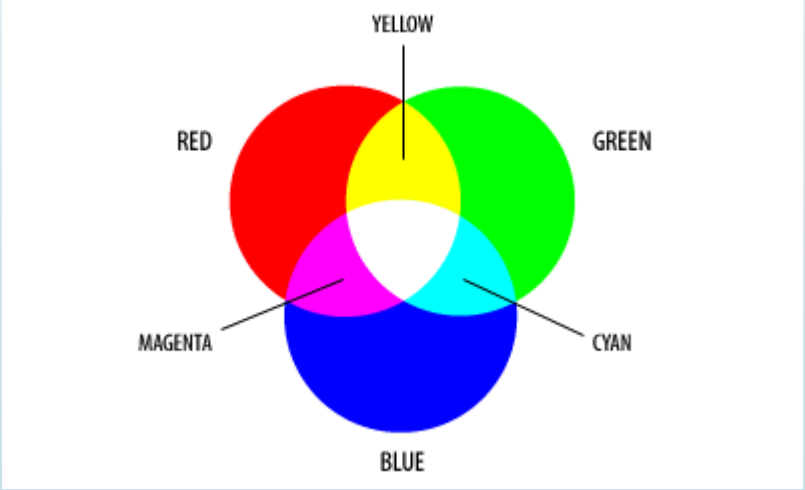


Understanding RGB Color Model

- A color model is a process for creating more colors using a few primary colors. There are two types of color models:
- The Additive color model
- The subtractive color model.
- In the additive color, model light is used to display colors. While in the subtractive color model, printing inks are used to produce color. The most common additive color model used is an RGB color model, and a CMYK color model is used for printing.
- RGB color model is the additive color model using Red, green, and blue colors. The main use of the RGB color model is for displaying images on electronic devices. In the RGB color model, overlaying the three colors with the least intensity produces the color black, while adding them with full light intensity creates the color white. To make a different array of colors, these primary colors should be superimposed in different intensities. According to some studies, the intensity of each primary colour can vary from 0 to 255, creating almost 16,777,216 colors.

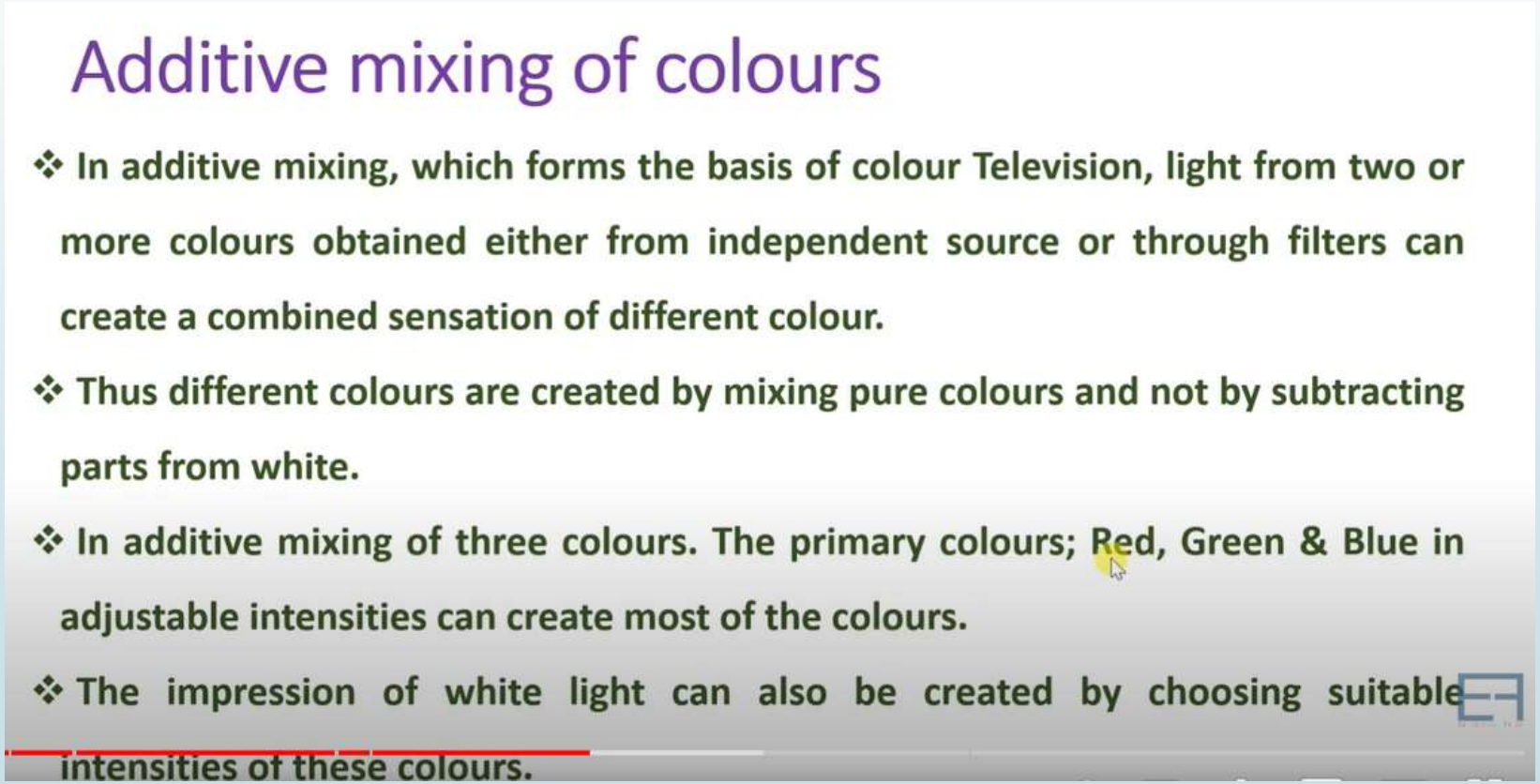
- For each primary color, it is possible to take 256 different shades of that color. So by adding 256 shades of 3 primary colors, we can produce over 16 million different colors. Cone cells or photoreceptors are part of the human eye responsible for color perception. In the RGB color model, combining primary colors creates different colors that we perceive by simultaneously stimulating the different cone cells.

- https://www.educba.com/rgb-color-model/



Additive Mixing:

- When actual coloue is perceived , It is called Additive mixing
- It is used in colour TV system
- In additive missing ,light from two or more colours obtained either from independent source or through filters can create a combined sensation of a different colours



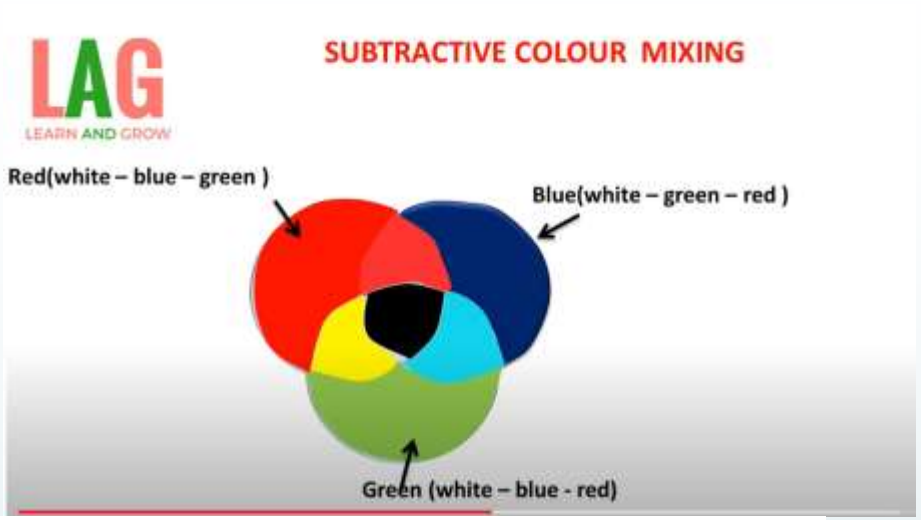
Grassmann’s laws

- Grassmann’s laws describe empirical results about how the perception of mixtures of colored lights (i.e., lights that co-stimulate the same area on the retina) composed of different spectral power distributions can be algebraically related to one another in a color matching context. Discovered by Hermann Grassmann these “laws” are actually principles used to predict color match responses to a good approximation under photopic and mesopic vision. A number of studies have examined how and why they provide poor predictions under specific conditions.

$$Y=.3R+.59G+.11B$$

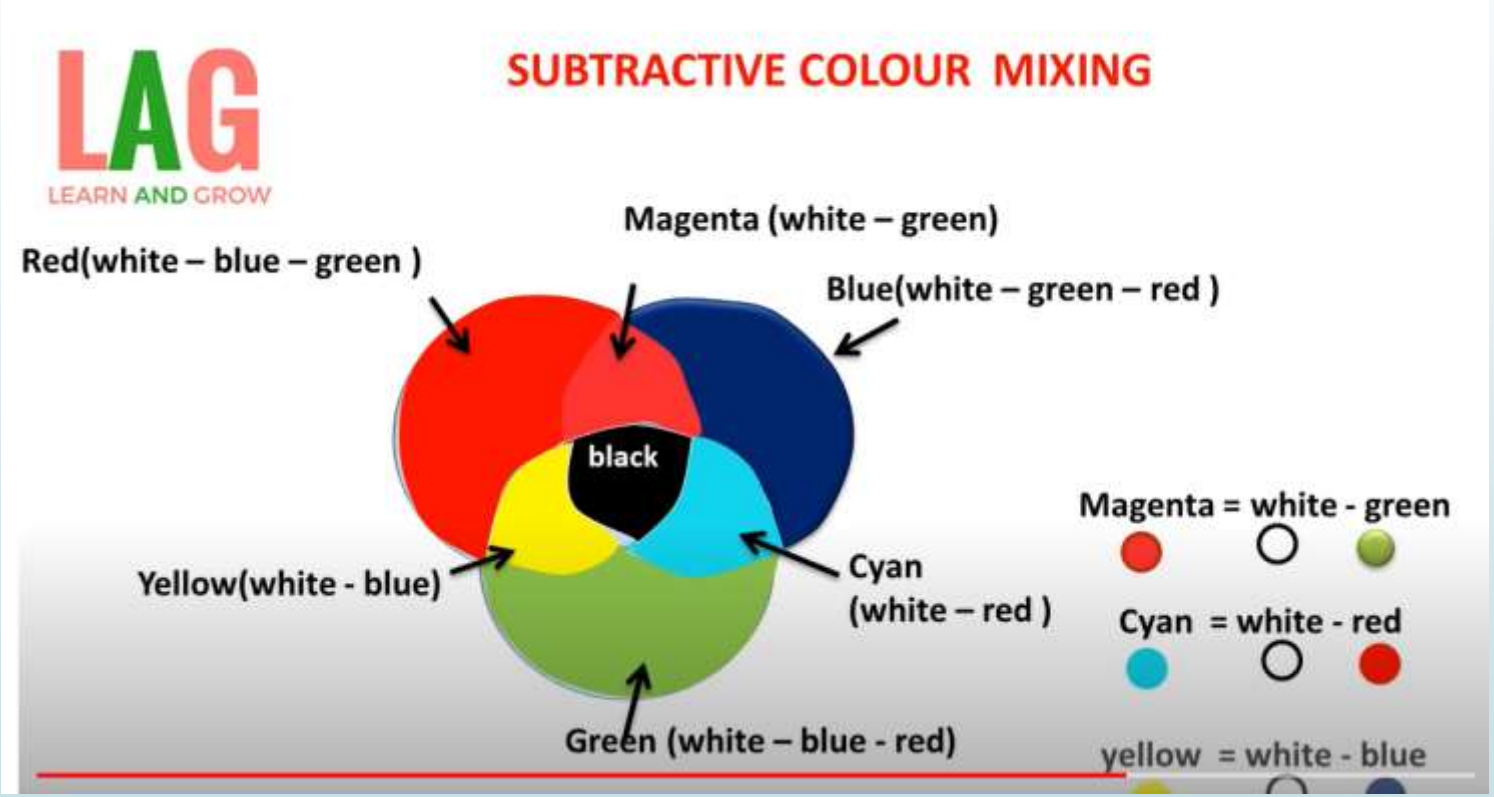
Subtractive Mixing:

- Reflecting Properties



Subtractive mixing of colours

- In subtractive mixing, reflecting properties of pigments are used, which absorbs all wavelengths for their colour characteristics.
- When pigments of two or more colours are mixed, they reflect wavelengths which are common to both.
- Since the pigments are not quite saturated (pure colour), they reflects fairly wide wavelengths.
- This type of mixing takes place in painting and colour printing.


LAG
LEARN AND GROW
SUBTRACTIVE COLOUR MIXING
Magenta (white – green)
Red(white – blue – green)
Blue(white – green – red)
black
Yellow(white - blue)
Cyan
(white – red)
Green (white – blue - red)
Magenta = white - green
Cyan = white - red
yellow = white - blue

- There are two main types of color mixing: additive color mixing and subtractive color mixing.
- Additive color mixing is creating a new color by a process that adds one set of wavelengths to another set of wavelengths. Additive color mixing is what happens when lights of different wavelengths are mixed. When we add all of the different wavelengths of sunlight, we see white light rather than many individual colors. It is called additive because all of the wavelengths still reach our eyes. It is the combination of different wavelengths that creates the diversity of colors.
- Subtractive color mixing is creating a new color by the removal of wavelengths from a light with a broad spectrum of wavelengths. Subtractive color mixing occurs when we mix paints, dyes, or pigments. When we mix paints, both paints still absorb all of the wavelengths they did previously, so what we are left with is only the wavelengths that both paints reflect. It is called subtractive mixing because when the paints mix, wavelengths are deleted from what we see because each paint will absorb some wavelengths that the other paint reflects, thus leaving us with a lesser number of wavelengths remaining afterward. So the easy way to remember the difference between additive and subtractive color mixing is that additive color mixing is what happens when we mix lights of different colors whereas subtractive color mixing occurs when we mix paints or other colored material.

COLOR TELEVISION CAMERA

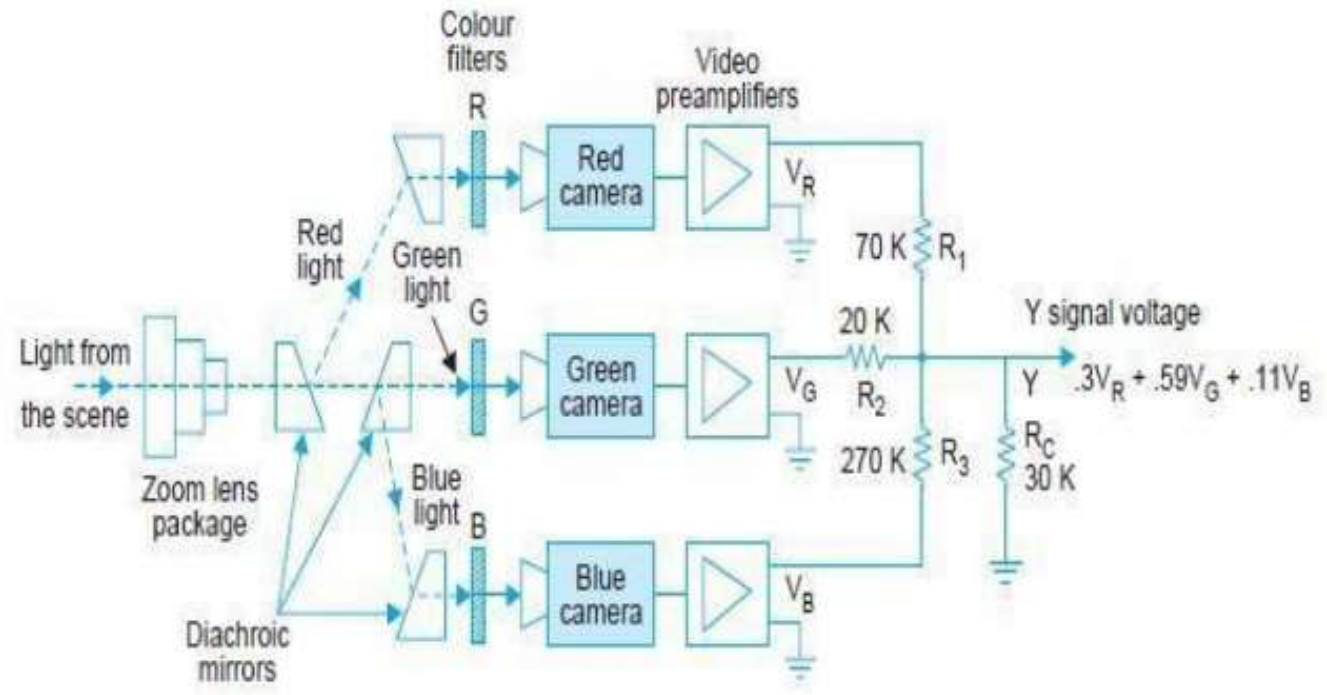


Figure. Plan of a color television camera showing generation of color signals and Y matrix for obtaining the luminance (brightness) signal

- It essentially consists of three camera tubes in which each tube receives selectively filtered primary colors.
- Each camera tube develops a signal voltage proportional to the respective color intensity received by it.
- Light from the scene is processed by the objective lens system. The image formed by the lens is split into three images by means of glass prisms.
- These prisms are designed as diachroic mirrors.
- A diachroic mirror passes one wavelength and rejects other wavelengths (colors of light).Thus red, green, and blue color images are formed.
- The rays from each of the light splitters also pass through color filters called trimming filters.
-

- These filters provide highly precise primary color images which are converted into video signals by image-orthicon or vidicon camera tubes.
- Thus the three color signals are generated. These are called Red (R), Green (G) and Blue (B) signals.
- Simultaneous scanning of the three camera tubes is accomplished by a master deflection oscillator and sync generator which drives all the three tubes.
- The three video signals produced by the camera represent three primaries of the color diagram. By selective use of these signals, all colors in the visible spectrum can be reproduced on the screen of a special (color) picture tube.
- At any instant during the scanning process the transmitted signal must indicate the proportions, of red, green and blue lights which are present in the element being scanned. Besides this, to fulfil the requirements of compatibility, the luminance signal which represents the brightness of the elements being scanned must also be generated and transmitted along with the color signals.
-

UNIT-3 Part B

COLOUR TELEVISION

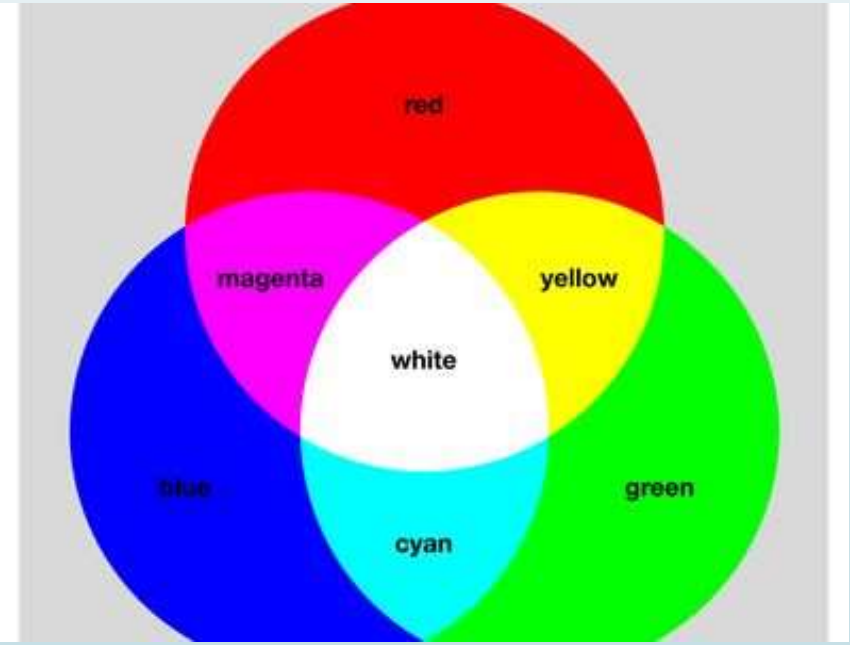
Colour TV

- Colour are of two types
- Primary volour
- Secondary colour

- Colours which can not be produced by mixing other colous are called Primary Colour. Red, Green,Blue are called Primary colour.
- Secondary colour can be produced by misxing other colours(Primary colour)
- They are made with help of Primary colour.

Three colour Theory:

- The RGB colour model is considered an additive system, because it adds wavelengths of the primary colours red, green, and blue together to create a broad range of colours.
- RGB color model is an additive color model in which red, green, and blue colors are mixed in various proportions to form a different array of colors. The name was given with the first letters of three primary colors red, green, and blue. In this model, colors are prepared by adding components, with white having all colors in it and black without the presence of any color. It is used in various digital displays like TV and video displays, Computer displays, digital cameras, and other light-based display devices.

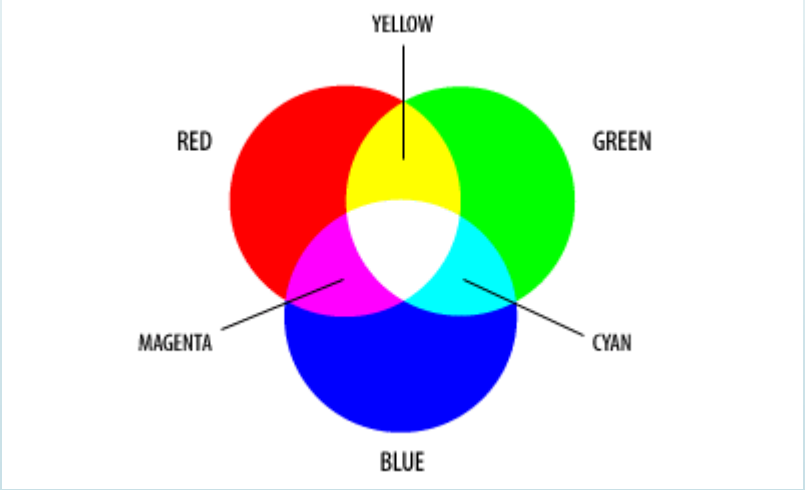


Understanding RGB Color Model

- A color model is a process for creating more colors using a few primary colors. There are two types of color models:
- The Additive color model
- The subtractive color model.
- In the additive color, model light is used to display colors. While in the subtractive color model, printing inks are used to produce color. The most common additive color model used is an RGB color model, and a CMYK color model is used for printing.
- RGB color model is the additive color model using Red, green, and blue colors. The main use of the RGB color model is for displaying images on electronic devices. In the RGB color model, overlaying the three colors with the least intensity produces the color black, while adding them with full light intensity creates the color white. To make a different array of colors, these primary colors should be superimposed in different intensities. According to some studies, the intensity of each primary colour can vary from 0 to 255, creating almost 16,777,216 colors.

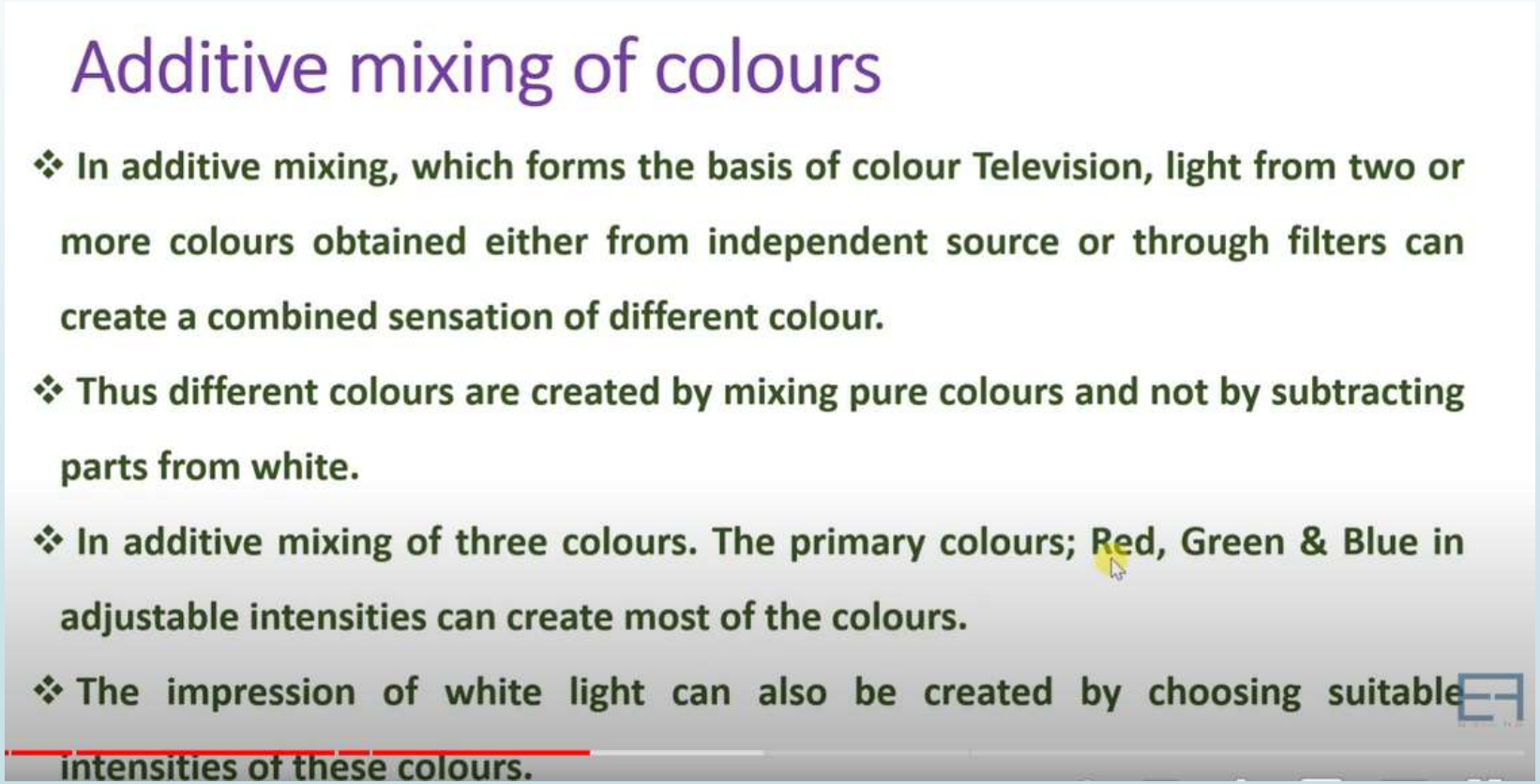
- For each primary color, it is possible to take 256 different shades of that color. So by adding 256 shades of 3 primary colors, we can produce over 16 million different colors. Cone cells or photoreceptors are part of the human eye responsible for color perception. In the RGB color model, combining primary colors creates different colors that we perceive by simultaneously stimulating the different cone cells.

- https://www.educba.com/rgb-color-model/



Additive Mixing:

- When actual coloue is perceived , It is called Additive mixing
- It is used in colour TV system
- In additive missing ,light from two or more colours obtained either from independent source or through filters can create a combined sensation of a different colours



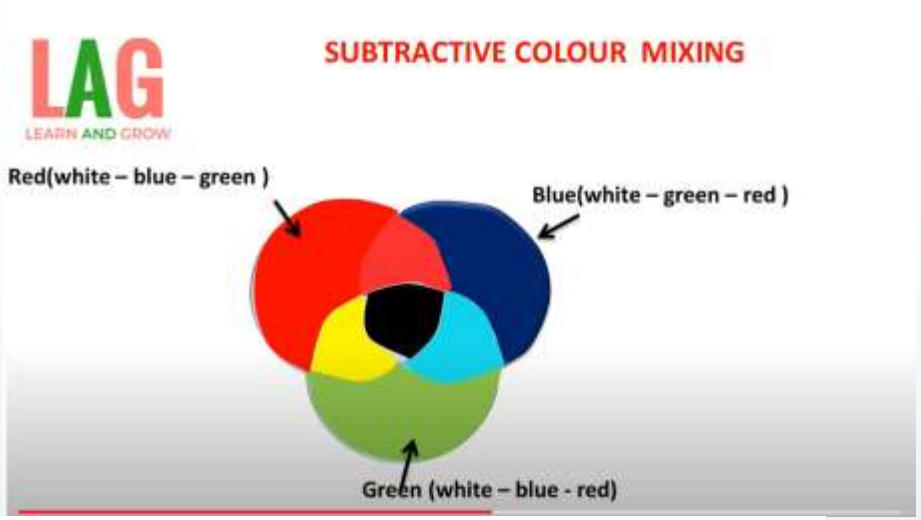
Grassmann’s laws

- Grassmann’s laws describe empirical results about how the perception of mixtures of colored lights (i.e., lights that co-stimulate the same area on the retina) composed of different spectral power distributions can be algebraically related to one another in a color matching context. Discovered by Hermann Grassmann these “laws” are actually principles used to predict color match responses to a good approximation under photopic and mesopic vision. A number of studies have examined how and why they provide poor predictions under specific conditions.

$$Y=.3R+.59G+.11B$$

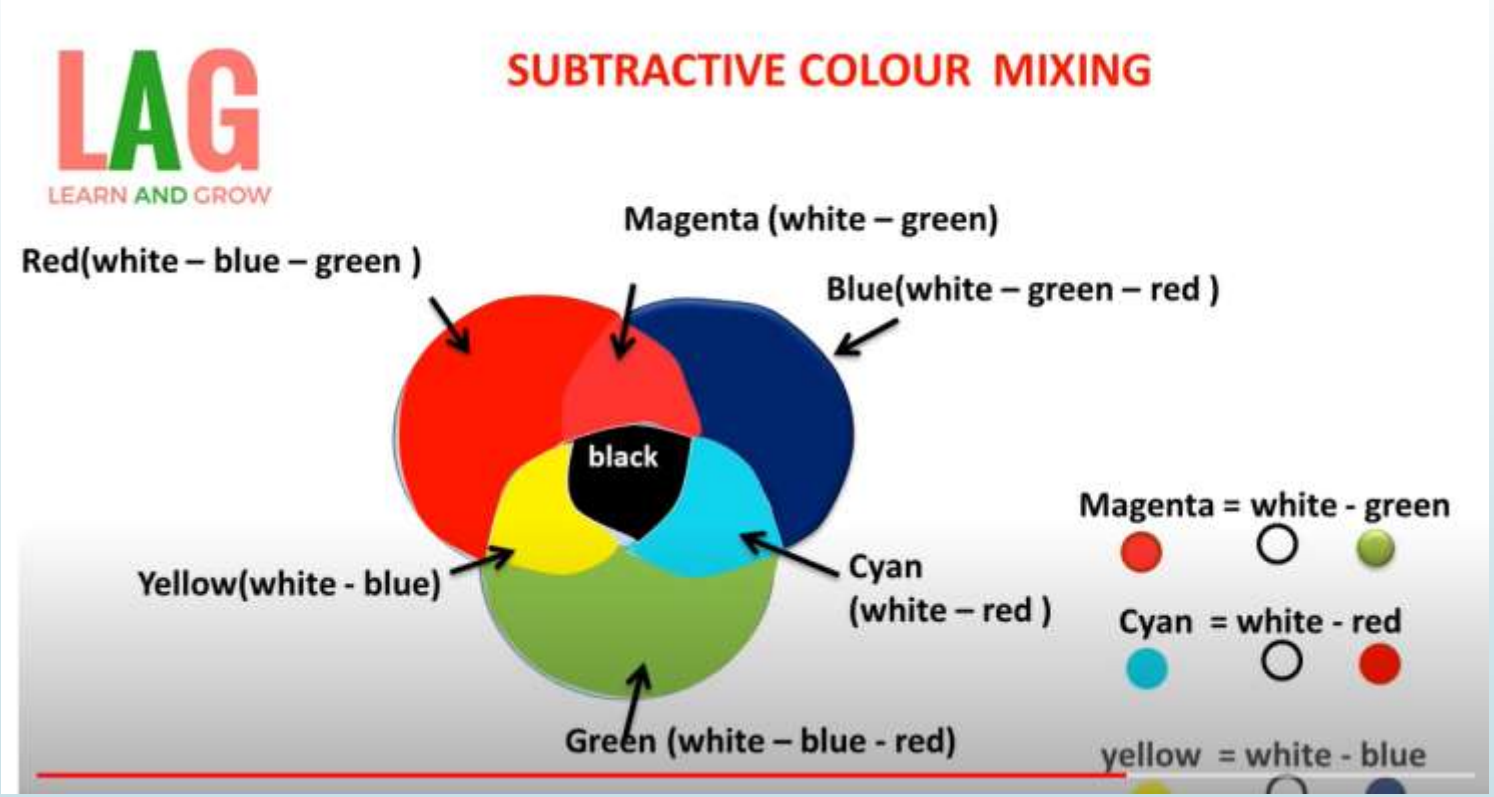
Subtractive Mixing:

- Reflecting Properties



Subtractive mixing of colours

- In subtractive mixing, reflecting properties of pigments are used, which absorbs all wavelengths for their colour characteristics.
- When pigments of two or more colours are mixed, they reflect wavelengths which are common to both.
- Since the pigments are not quite saturated (pure colour), they reflects fairly wide wavelengths.
- This type of mixing takes place in painting and colour printing.


LAG
LEARN AND GROW
SUBTRACTIVE COLOUR MIXING
Magenta (white – green)
Red(white – blue – green)
Blue(white – green – red)
black
Yellow(white - blue)
Cyan
(white – red)
Green (white – blue - red)
Magenta = white - green
Cyan = white - red
yellow = white - blue

- There are two main types of color mixing: additive color mixing and subtractive color mixing.
- Additive color mixing is creating a new color by a process that adds one set of wavelengths to another set of wavelengths. Additive color mixing is what happens when lights of different wavelengths are mixed. When we add all of the different wavelengths of sunlight, we see white light rather than many individual colors. It is called additive because all of the wavelengths still reach our eyes. It is the combination of different wavelengths that creates the diversity of colors.
- Subtractive color mixing is creating a new color by the removal of wavelengths from a light with a broad spectrum of wavelengths. Subtractive color mixing occurs when we mix paints, dyes, or pigments. When we mix paints, both paints still absorb all of the wavelengths they did previously, so what we are left with is only the wavelengths that both paints reflect. It is called subtractive mixing because when the paints mix, wavelengths are deleted from what we see because each paint will absorb some wavelengths that the other paint reflects, thus leaving us with a lesser number of wavelengths remaining afterward. So the easy way to remember the difference between additive and subtractive color mixing is that additive color mixing is what happens when we mix lights of different colors whereas subtractive color mixing occurs when we mix paints or other colored material.

COLOR TELEVISION CAMERA

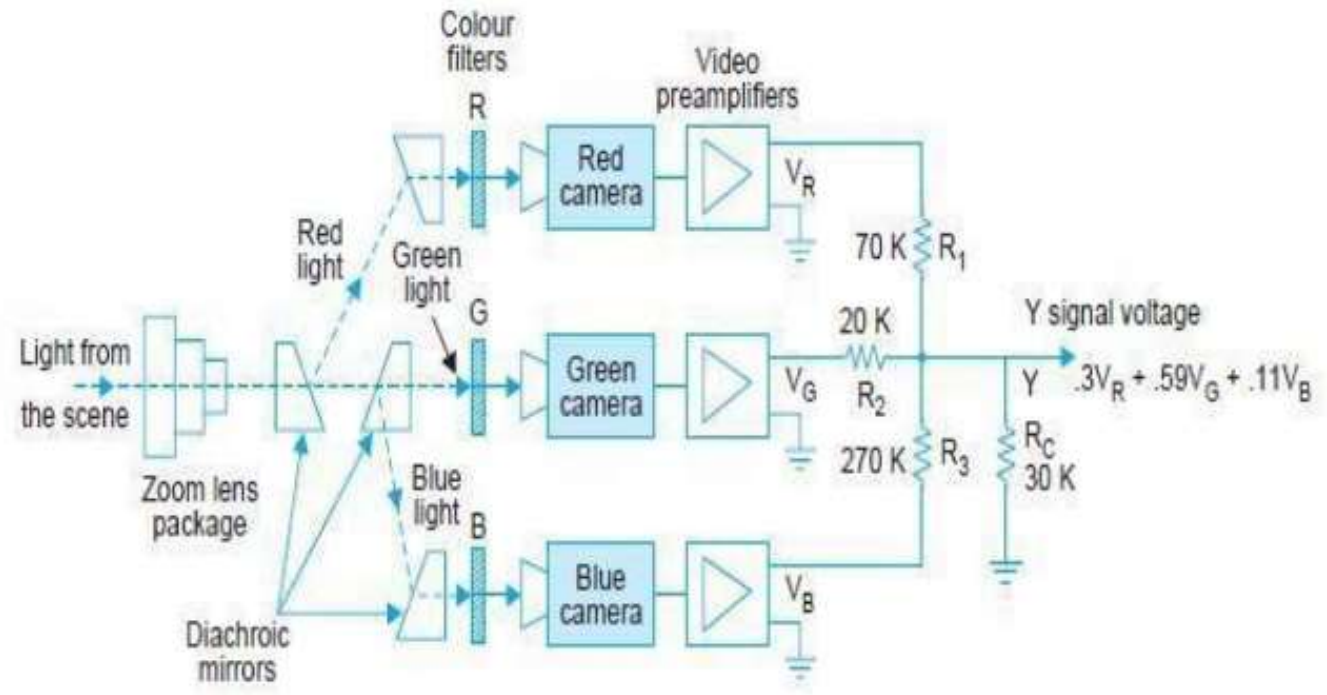


Figure. Plan of a color television camera showing generation of color signals and Y matrix for obtaining the luminance (brightness) signal

- It essentially consists of three camera tubes in which each tube receives selectively filtered primary colors.
- Each camera tube develops a signal voltage proportional to the respective color intensity received by it.
- Light from the scene is processed by the objective lens system. The image formed by the lens is split into three images by means of glass prisms.
- These prisms are designed as diachroic mirrors.
- A diachroic mirror passes one wavelength and rejects other wavelengths (colors of light).Thus red, green, and blue color images are formed.
- The rays from each of the light splitters also pass through color filters called trimming filters.
-

- These filters provide highly precise primary color images which are converted into video signals by image-orthicon or vidicon camera tubes.
- Thus the three color signals are generated. These are called Red (R), Green (G) and Blue (B) signals.
- Simultaneous scanning of the three camera tubes is accomplished by a master deflection oscillator and sync generator which drives all the three tubes.
- The three video signals produced by the camera represent three primaries of the color diagram. By selective use of these signals, all colors in the visible spectrum can be reproduced on the screen of a special (color) picture tube.
- At any instant during the scanning process the transmitted signal must indicate the proportions, of red, green and blue lights which are present in the element being scanned. Besides this, to fulfil the requirements of compatibility, the luminance signal which represents the brightness of the elements being scanned must also be generated and transmitted along with the color signals.
-

UNIT-3 Part B

COLOUR TELEVISION

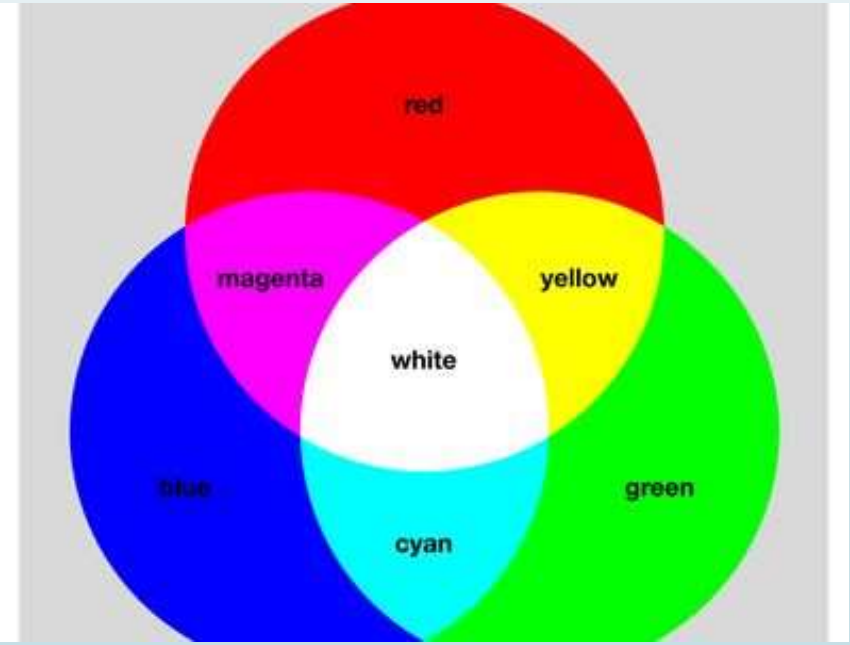
Colour TV

- Colour are of two types
- Primary volour
- Secondary colour

- Colours which can not be produced by mixing other colous are called Primary Colour. Red, Green,Blue are called Primary colour.
- Secondary colour can be produced by misxing other colours(Primary colour)
- They are made with help of Primary colour.

Three colour Theory:

- The RGB colour model is considered an additive system, because it adds wavelengths of the primary colours red, green, and blue together to create a broad range of colours.
- RGB color model is an additive color model in which red, green, and blue colors are mixed in various proportions to form a different array of colors. The name was given with the first letters of three primary colors red, green, and blue. In this model, colors are prepared by adding components, with white having all colors in it and black without the presence of any color. It is used in various digital displays like TV and video displays, Computer displays, digital cameras, and other light-based display devices.

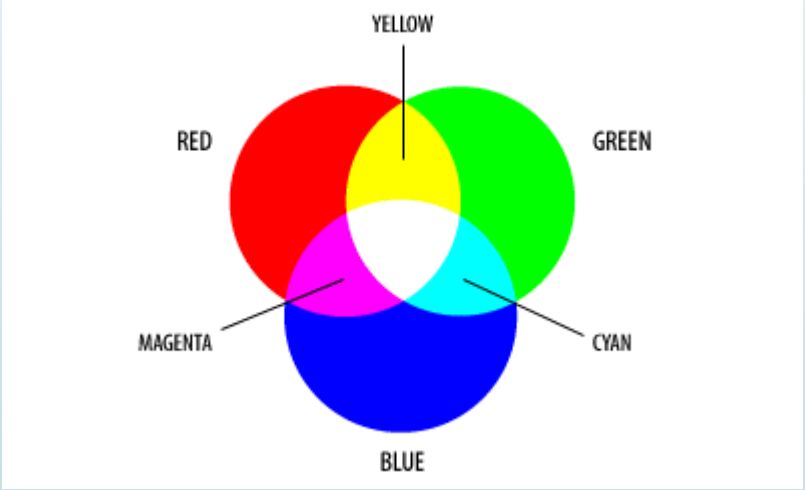


Understanding RGB Color Model

- A color model is a process for creating more colors using a few primary colors. There are two types of color models:
- The Additive color model
- The subtractive color model.
- In the additive color, model light is used to display colors. While in the subtractive color model, printing inks are used to produce color. The most common additive color model used is an RGB color model, and a CMYK color model is used for printing.
- RGB color model is the additive color model using Red, green, and blue colors. The main use of the RGB color model is for displaying images on electronic devices. In the RGB color model, overlaying the three colors with the least intensity produces the color black, while adding them with full light intensity creates the color white. To make a different array of colors, these primary colors should be superimposed in different intensities. According to some studies, the intensity of each primary colour can vary from 0 to 255, creating almost 16,777,216 colors.

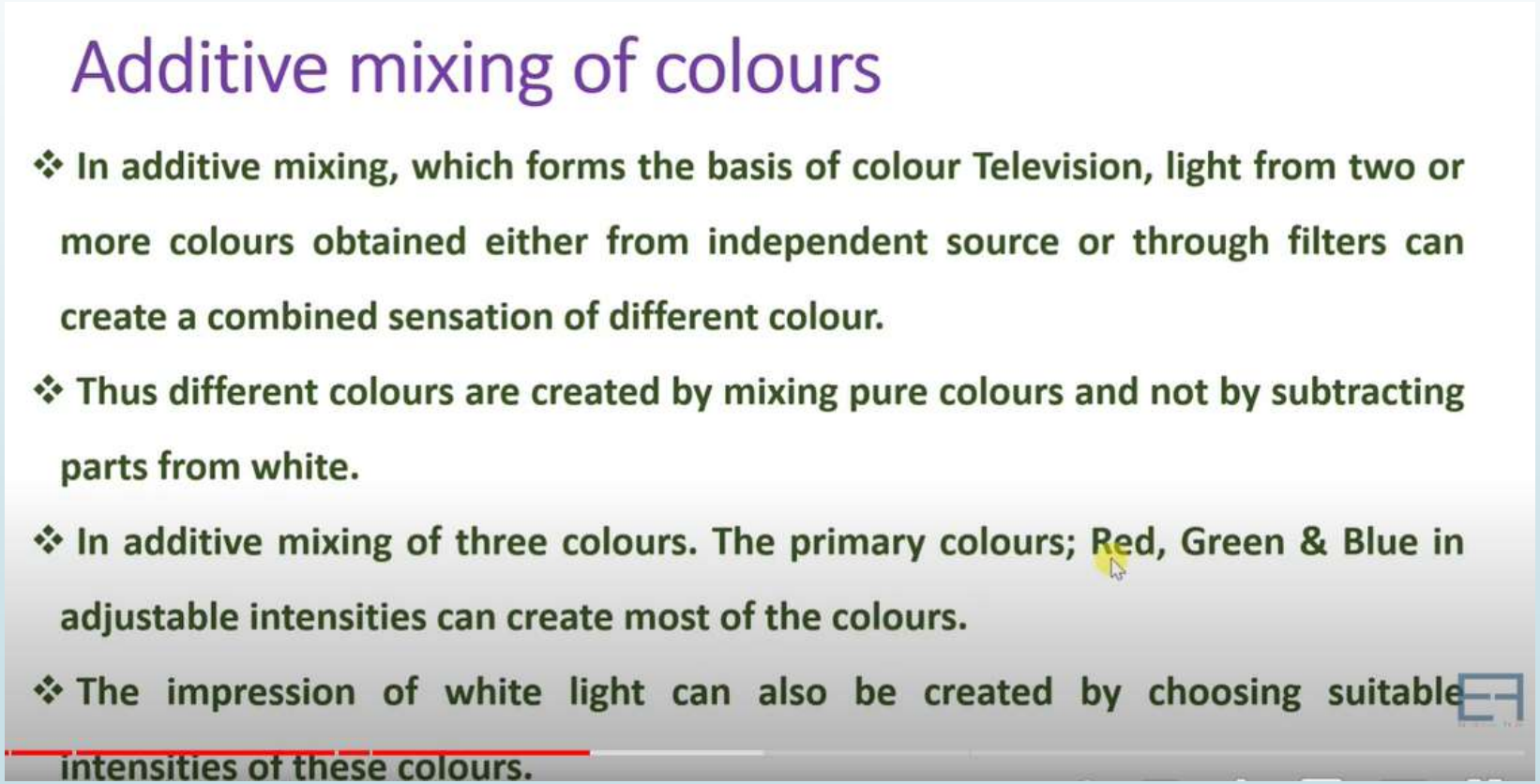
- For each primary color, it is possible to take 256 different shades of that color. So by adding 256 shades of 3 primary colors, we can produce over 16 million different colors. Cone cells or photoreceptors are part of the human eye responsible for color perception. In the RGB color model, combining primary colors creates different colors that we perceive by simultaneously stimulating the different cone cells.

- https://www.educba.com/rgb-color-model/



Additive Mixing:

- When actual coloue is perceived , It is called Additive mixing
- It is used in colour TV system
- In additive missing ,light from two or more colours obtained either from independent source or through filters can create a combined sensation of a different colours



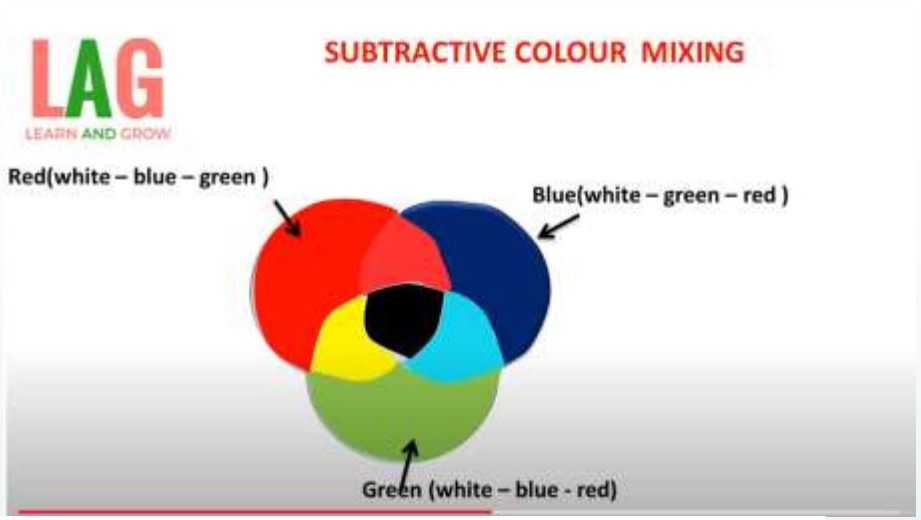
Grassmann’s laws

- Grassmann’s laws describe empirical results about how the perception of mixtures of colored lights (i.e., lights that co-stimulate the same area on the retina) composed of different spectral power distributions can be algebraically related to one another in a color matching context. Discovered by Hermann Grassmann these “laws” are actually principles used to predict color match responses to a good approximation under photopic and mesopic vision. A number of studies have examined how and why they provide poor predictions under specific conditions.

$$Y=.3R+.59G+.11B$$

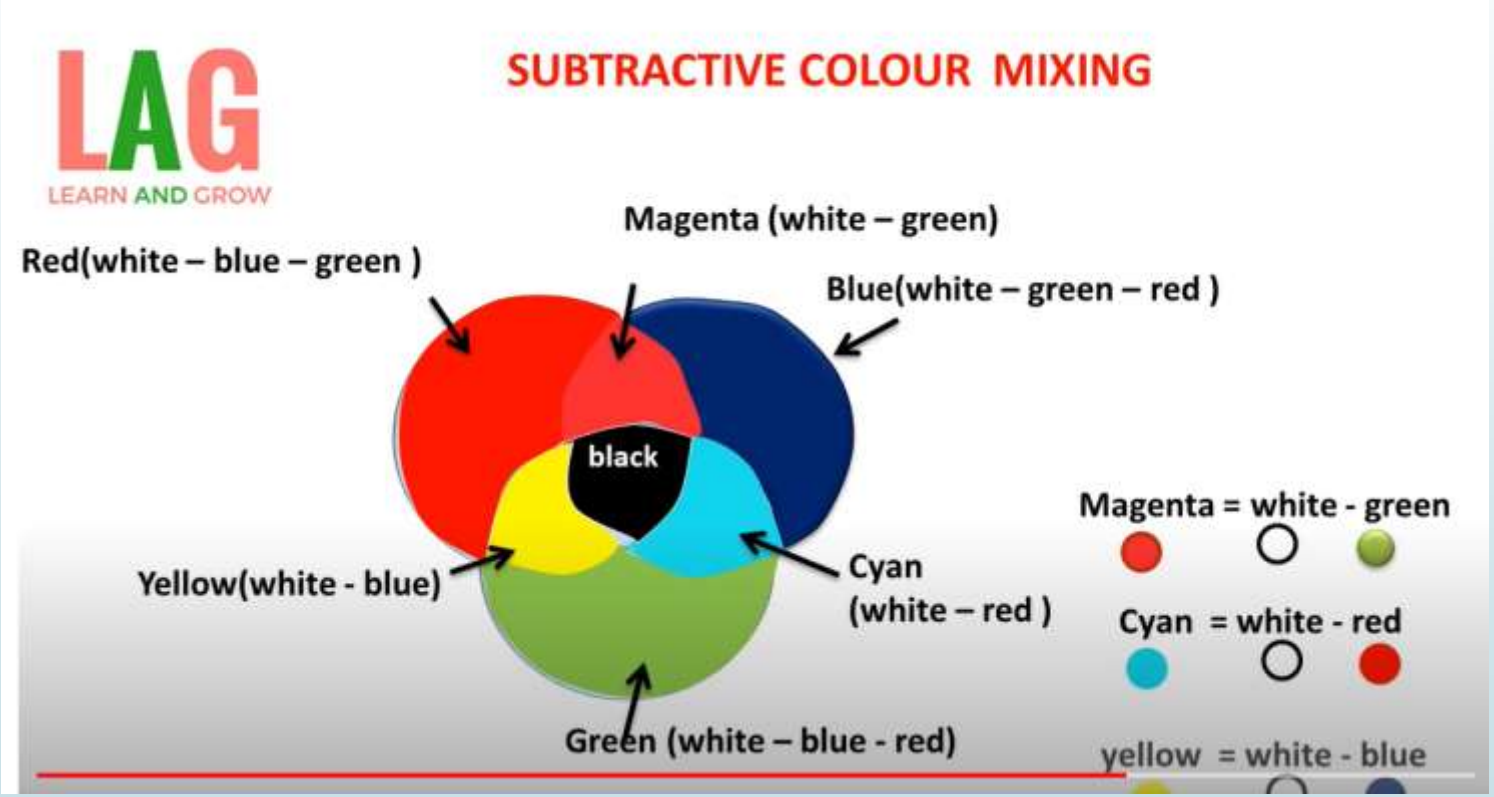
Subtractive Mixing:

- Reflecting Properties



Subtractive mixing of colours

- In subtractive mixing, reflecting properties of pigments are used, which absorbs all wavelengths for their colour characteristics.
- When pigments of two or more colours are mixed, they reflect wavelengths which are common to both.
- Since the pigments are not quite saturated (pure colour), they reflects fairly wide wavelengths.
- This type of mixing takes place in painting and colour printing.


LAG
LEARN AND GROW
SUBTRACTIVE COLOUR MIXING
Magenta (white – green)
Red(white – blue – green)
Blue(white – green – red)
black
Yellow(white - blue)
Cyan
(white – red)
Green (white – blue - red)
Magenta = white - green
Cyan = white - red
yellow = white - blue

- There are two main types of color mixing: additive color mixing and subtractive color mixing.
- Additive color mixing is creating a new color by a process that adds one set of wavelengths to another set of wavelengths. Additive color mixing is what happens when lights of different wavelengths are mixed. When we add all of the different wavelengths of sunlight, we see white light rather than many individual colors. It is called additive because all of the wavelengths still reach our eyes. It is the combination of different wavelengths that creates the diversity of colors.
- Subtractive color mixing is creating a new color by the removal of wavelengths from a light with a broad spectrum of wavelengths. Subtractive color mixing occurs when we mix paints, dyes, or pigments. When we mix paints, both paints still absorb all of the wavelengths they did previously, so what we are left with is only the wavelengths that both paints reflect. It is called subtractive mixing because when the paints mix, wavelengths are deleted from what we see because each paint will absorb some wavelengths that the other paint reflects, thus leaving us with a lesser number of wavelengths remaining afterward. So the easy way to remember the difference between additive and subtractive color mixing is that additive color mixing is what happens when we mix lights of different colors whereas subtractive color mixing occurs when we mix paints or other colored material.

COLOR TELEVISION CAMERA

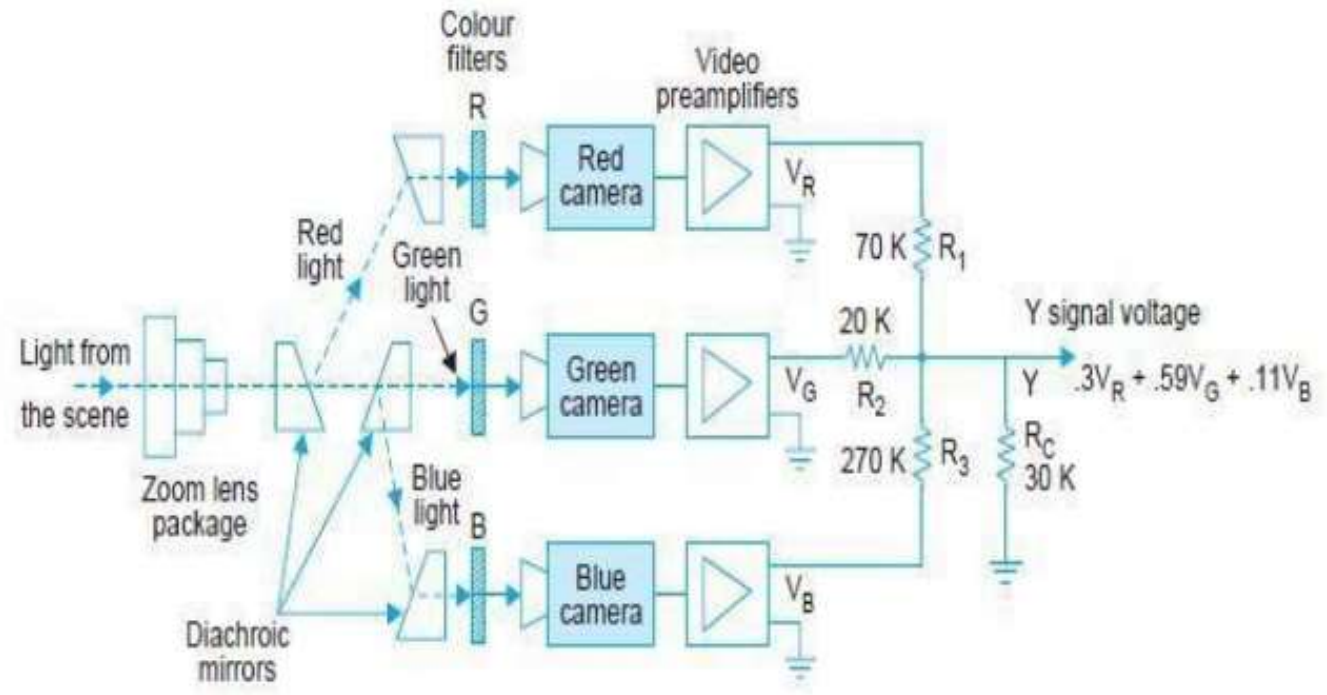


Figure. Plan of a color television camera showing generation of color signals and Y matrix for obtaining the luminance (brightness) signal

- It essentially consists of three camera tubes in which each tube receives selectively filtered primary colors.
- Each camera tube develops a signal voltage proportional to the respective color intensity received by it.
- Light from the scene is processed by the objective lens system. The image formed by the lens is split into three images by means of glass prisms.
- These prisms are designed as diachroic mirrors.
- A diachroic mirror passes one wavelength and rejects other wavelengths (colors of light).Thus red, green, and blue color images are formed.
- The rays from each of the light splitters also pass through color filters called trimming filters.
-

- These filters provide highly precise primary color images which are converted into video signals by image-orthicon or vidicon camera tubes.
- Thus the three color signals are generated. These are called Red (R), Green (G) and Blue (B) signals.
- Simultaneous scanning of the three camera tubes is accomplished by a master deflection oscillator and sync generator which drives all the three tubes.
- The three video signals produced by the camera represent three primaries of the color diagram. By selective use of these signals, all colors in the visible spectrum can be reproduced on the screen of a special (color) picture tube.
- At any instant during the scanning process the transmitted signal must indicate the proportions, of red, green and blue lights which are present in the element being scanned. Besides this, to fulfil the requirements of compatibility, the luminance signal which represents the brightness of the elements being scanned must also be generated and transmitted along with the color signals.
-

UNIT-3 Part B

Digital Video

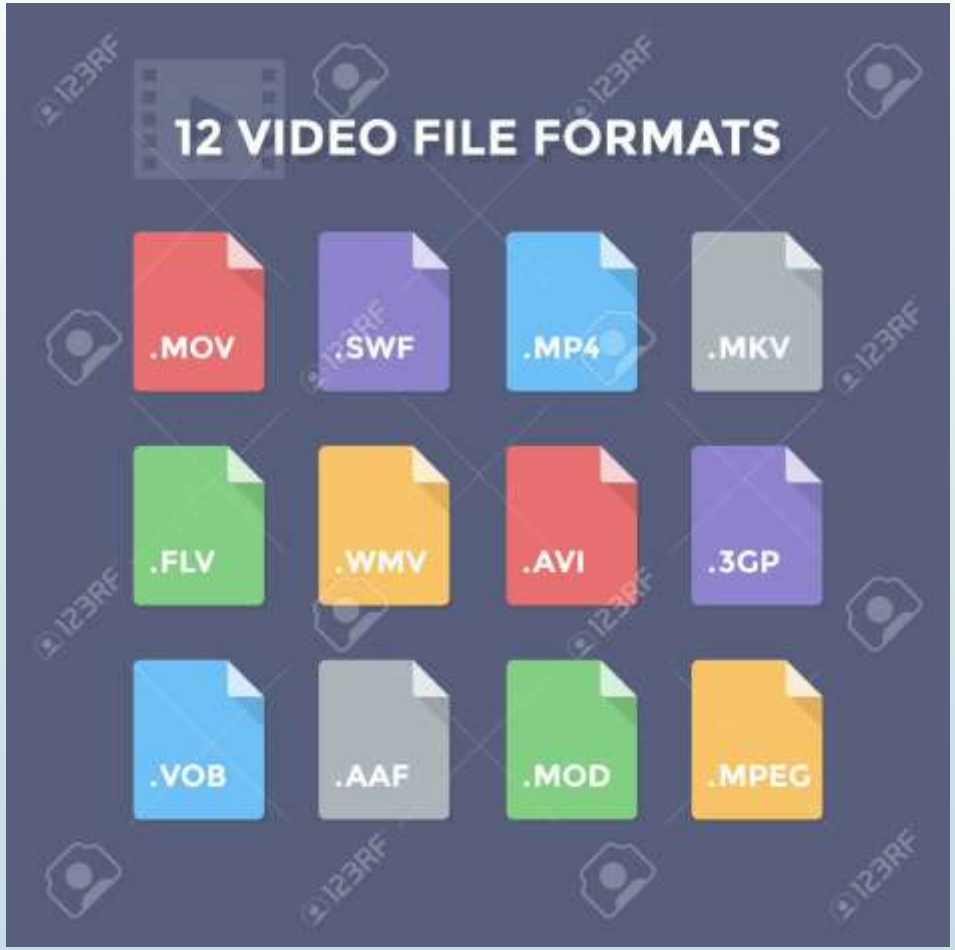
Video

- Video is an electronic Medium for recording,copying, playback,broadcasting and display of moving visual media.
- Charcteristics of Video:
- 1. Number of frames per second
- 2. Aspect Ratio
- 3. Pixel Per Inch
- 4. Video Quality

Video Types

- **Analog Video:** Analog signal is video signal transferred by an analog signal
- An analog colour signal contains luminance,brightness and chrominance of an analog television Image
- Digital Video: It is representation of moving visual images in the form of encoded digital data.
- It includes High definition multimedia Interface(HDMI),Digital Video Interface(DVI)and Display port Interface.

Video Format



- Video compression is the process of reducing the total number of bits needed to represent a given image or video sequence. Video compression is most commonly performed by a program with a specific algorithm or formula for determining the best way to shrink the size of the data. Video compression algorithms such as H
- There are two main types of video compression: lossless and lossy. Lossless compression preserves all the original data and quality, but it can only achieve a small reduction in file size.
- The main purpose of compression/encoding is reducing the volume of data that are needed to capture, store, and transmit video. This leads to reductions in storage hardware, data transmission time, and required delivery bandwidth. While many different algorithms exist to encode video

- Video compression tools work by using video encoding algorithms known as codecs. Codecs, by encoding video sequences, reduce the number of bits needed to represent a video. After encoding, the video sequences are wrapped in video containers (such as MP4 and AVI) and then output as compressed videos
- CODEX: is compression & Decompression. It is hard ware or software that compresses and decompress digital video to make file size smaller. Storage and distribution will be easier.
- Container: It is used for packaging the file. It packs audio and video data.

- Standards/ Formats Compression Factor Pros Cons
- M-JPEG 1 is to 20
- 1. Low CPU utilisation
- 2. Clearer images at lower frame rates, compared to MPEG-4
- 3. Not sensitive to motion complexity, i.e. highly random motion
- 1. Nowhere near as efficient as MPEG-4 and H.264
- 2. Quality deteriorates for frames with complex textures, lines, and curves
- MPEG-4 Part 2 1 is to 50
- 1. Good for video streaming and television broadcasting
- 2. Compatibility with a variety of digital and mobile devices
- 1. Sensitive to motion complexity (compression not as efficient)
- 2. High CPU utilisation
- H.264 1 is to 100
- 1. Most efficient
- 2. Extremely efficient for low-motion video content
- 1. Highest CPU utilisation
- 2. Sensitive to motion complexity (compression not as efficient)

- Video Compression is the term used to define a method for reducing the data used to encode digital video content. This reduction in data translates to benefits such as smaller storage requirements and lower transmission bandwidth requirements, for a clip of video content

- Video compression is a technique which reduces redundancies in spatial and temporal directions

- Spatial reduction physically reduces the size of the video data by selectively discarding up to a fourth or more of unneeded parts of the original data in a frame

- Temporal reduction, Inter-frame delta compression or motion compression, significantly reduces the amount of data needed to store a video frame by encoding only the pixels that change between consecutive frames in a sequence

- Several important standards like Moving Picture Experts Group (MPEG) standard, H.261, 263 and 264 standards are the most commonly used techniques for video compression

- 1. Also known as MPEG-4 Part 10, Advanced Video Coding (MPEG-4 AVC) is one of the best video compression formats as it is capable of offering high-quality files at lower bit rates. This is a versatile format that is compatible with a number of players and devices. ...
- 2 DivX. ...
- 3 MP4. ...
- 4 AVI. ...
- 5 WMV.
- MJPEG
- H264
- Video format 1: AVCHD

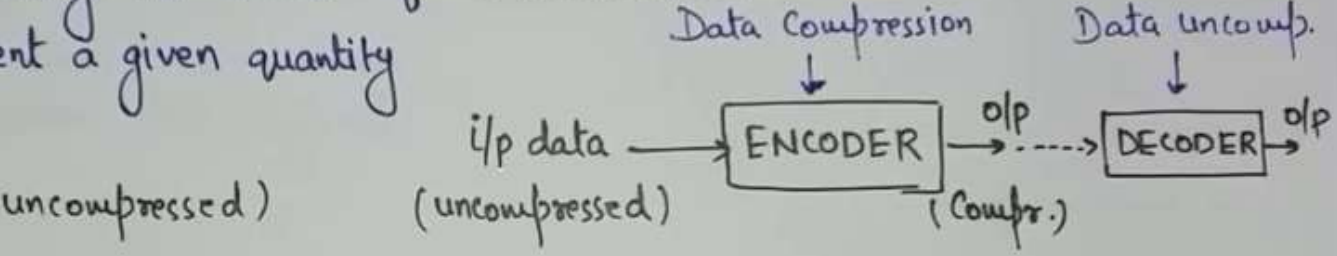
  It is the highest quality video format for those shooting high end video footage. The H. 264/MPEG-4 compression technology used by this video file format results in very small file sizes without a loss in data quality.

Data Compression Introduction:

It is the process of reducing the amount of data required to represent a given quantity of information.

↓ amount of disk space required.

↓ transmission bandwidth.



Video file → 2GB (uncompressed)
(2 hr)
→ 750MB (Compressed)
(2 hr)

Data Compression Types:

- LOSSLESS Compression :- No data is lost.
  - ↳ Exact Replica ✓
  - ↳ Text Encryption
- LOSSY Compression :- Some info^n is lost. Less imp. info^n from the media is removed.
  - ↳ IMAGE, AUDIO, VIDEO.
  - ↳ Exact Replica ✗

- Encoder compresses the data
- Decoder converts the compressed data in to original

- Parameter: Compression Ratio 750Mb/2GB compressed size/Originnal size

- Compression Factor =1/ CR
- Compression Time: Time taken by encoder to compress the data. ms
- Decompression Time: Time taken by decoder to decompress the data in to original.

Colour Model

- Colour Model is a way of specifying or describing a color numerically
- common examples include RGB, HSV ,HLS and CMYK, YIQ,
- In the 24-bit-deep RGB color model, the intensity of each of the red, green and blue components of the model (8 bits for each channel) are represented on a scale from 0 to 255.
- Red, Green and Blue (RGB) elements or Cyan, Magenta, Yellow and Black (CMYK)
- HSL (Hue, Saturation, Lightness)

RGB COLOR MODEL

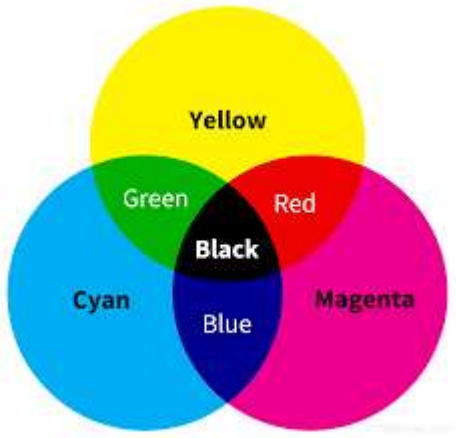
- The RGB model is used when working with digital screen based designs, such as those viewed on a computer screen or phone display.
- In the RGB color model, a value between 0 and 255 is assigned to each of the primary colors, Red, Green and Blue, where 0 is dark and 255 is bright.
- By listing the three values for the red, green and blue phosphors, you can specify the exact color that will be mixed.
- The RGB color model is an additive color system, which means colors get lighter when mixed.
- As each component of light is mixed in, the combination becomes a new color. Red, green and blue are the three additive primaries.
- Any colour is created by any color within the constraint of the device using different combinations of the additive primaries. When you mix all three together in balanced amounts, you get white.
- Television screens and computer monitors create color by turning on the red, green and blue primaries within each pixel. By changing each of the red, green, and blue primaries within a pixel to a different brightness, the monitor creates unique colors.
- Because the RGB color model is only capable of producing a certain range (or gamut) of colors, there are some colors that cannot be reproduced accurately by a computer monitor. The number of colors visible on a monitor is further reduced by the limitations of the video hardware in the computer, which may display anywhere from just black and white up to 16.7 million colors.

HSL COLOR MODEL (HUE, SATURATION, LIGHTNESS)

- The hue determines which basic color it is.
- Red, green, blue, yellow, orange, etc. are different hues.
- Saturation and luminance tell more about the variations of these basic colors.
- Saturation is the vividness (or "purity") of the color, i.e., how much of the color's complement is mixed in. Finally, lightness refers to the "whiteness" of the color. It may also be termed "brightness," "value" or "intensity."
- Other models related to the HSL model are the HSB (Hue, Saturation, Brightness) and HSI (Hue, Saturation, Intensity) models. These terms are all similar but not interchangeable.

CMYK COLOR MODEL

- The CMYK color model describes colors based on their percentage of Cyan, Magenta, Yellow and Black. Many computer printers and traditional "four-color" printing presses use the CMYK model.
- In the CMYK model, by mixing cyan, magenta, yellow and black inks or paints, you can create nearly any color desired.
- CMYK is a subtractive color model

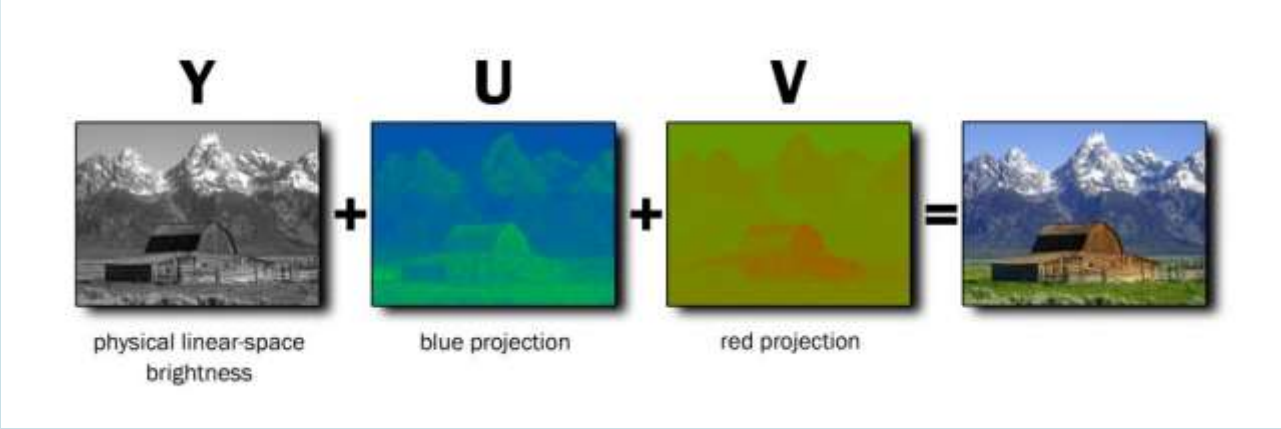


YUV

- YUV is just an abbreviated term for ‘luma’, ‘red projection’ and ‘blue projection’. Essentially, a YUV system is a mathematical encoding system like any other, but incorporates both brightness and color.

- The color encoding system used for analog television worldwide (NTSC, PAL and SECAM). The YUV color space (color model) differs from RGB, which is what the camera captures and what humans view. When color signals were developed in the 1950s, it was decided to allow black and white TVs to continue to receive and decode monochrome signals, while color sets would decode both monochrome and color signals.
- The Y in YUV stands for "luma," which is brightness, or lightness, and black and white TVs decode only the Y part of the signal. U and V provide color information and are "color difference" signals of blue minus luma (B-Y) and red minus luma (R-Y). Through a process called "color space conversion," the video camera converts the RGB data captured by its sensors into either composite analog signals (YUV) or component versions (analog YPbPr or digital YCbCr). For rendering on screen, all these color spaces must be converted back again to RGB by the TV or display system.

- YUV also saves transmission bandwidth compared to RGB, because the chroma channels (B-Y and R-Y) carry only half the resolution of the luma. YUV is not compressed RGB; rather, Y, B-Y and R-Y are the mathematical equivalent of RGB.
- YUV space uses mathematical formulas to represent colors. In this case, Y varies from 0 to 1 or 0 to 255 if you want to get technical with digital formats. U and V range from -0.5 to 0.5



- From RGB to YUV

  Y = 0.299R + 0.587G + 0.114B
- U = 0.492 (B-Y)
- V = 0.877 (R-Y)

- It can also be represented as:
- Y = 0.299R + 0.587G + 0.114B
- U = -0.147R - 0.289G + 0.436B
- V = 0.615R - 0.515G - 0.100B

- From YUV to RGB
- R = Y + 1.140V
- G = Y - 0.395U - 0.581V
- B = Y + 2.032U

- As we know, RGB stands for red, blue and green and YUV stands for (Y) luma, or brightness, (U) blue projection and (V) red projection. HSL stands for (H) hue, (S) saturation, and L (lightness) and CMYK stands for (C) cyan, (M) magenta, (Y) yellow and (K) black.

Basics of JPEG

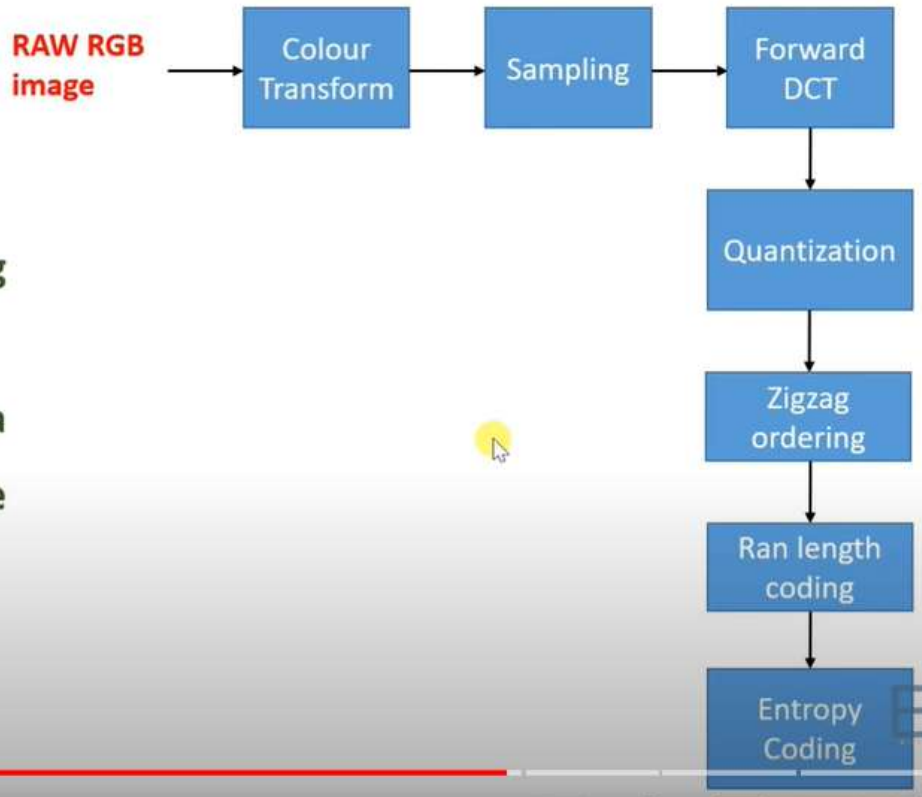
- It is "Joint Photographic Expert Group"
- It is only applicable to image format
- JPEG is lossy compression technique.
- It is 1st international standard in image compression.
- It is utilizing 2^{24} colours for image.
- It supports various level of compression, which makes use of JPEG in web graphics.

Content of JPEG

- JPEG has metadata, which has following information
  - Image dimensions
  - Colour space
  - Profile information

JPEG Algorithm

- Transform RGB to YIQ or YUV.
- Sampling into 8×8 blocks. F(I,f)
- DCT on image blocks. F(u,v) using Huffman coding
- Quantization (After quantization data will be smaller than above block). Image is compressed by scale of 7.
- Zig zag ordering
- Ran length coding.
- Entropy coding



Advantages of JPEG

- JPEG is best on photographs and painting of realistic scenes.
- The sharing of JPEG images is quick & efficient
- Require small space to store in a device.
- Its file can also contain high quality image data with lossless compression.
- It is compatible with almost every image processing application.
- It is compatible with almost every hardware devices. E.g. Printer
- JPEG format can be used to store high resolution fast moving images which would be blur in other image formats.

Disadvantages of JPEG

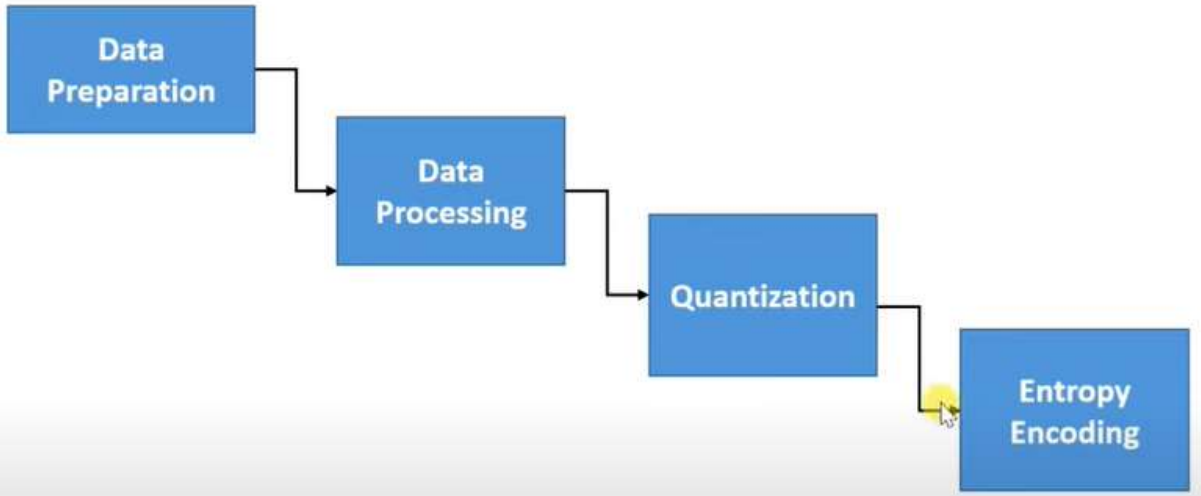
- JPEG is a lossy compression method.
- Quality of image reduced after JPEG compression.
- Only 8 bit images are supported by JPEG format.
- it does not support transparency.
- It do not support layered images.

Basics of MPEG

- It is "Motion Picture Expert Group"
- Standard for encoding videos/ movies/ motion picture
- MPEG has Video extension with mp4 and Audio extension with mp3
- Evolving set of standards
  - MPEG-1, 2, 4, 7 & 21
- It is lossy video compression technique, but that compression is very high
- Apply the similar techniques as JPEG to individual image

MPEG compression steps

- Data preparation
  - Similar to JPEG
- Data processing
  - Motion prediction
  - DCT
- Quantization
- Entropy encoding

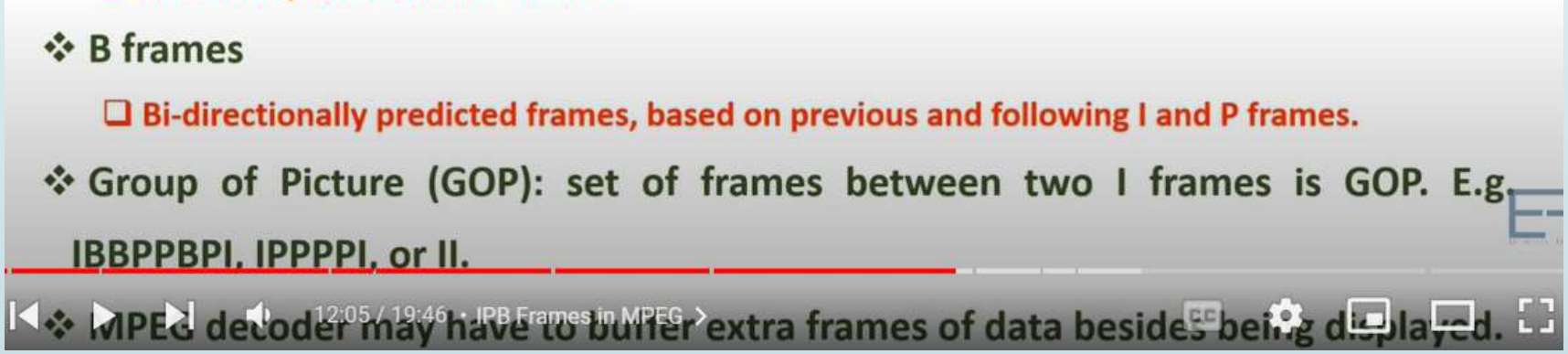


Data Processing in MPEG

- Apply motion prediction at the macroblock level
- In most cases, predictive encoding only makes sense for parts of images with motion and not for the whole image.
- Motion prediction used to figure out where this macroblock may be in the next frame.
  - Forward prediction : Prediction based on previous frame
  - Backward prediction : Prediction based on future frame
  - Bidirectional prediction : Prediction based on both previous and future frames

IPB frames in MPEG

- I frames
  - Independently coded and no temporal prediction
  - We can start decoding, once we have an I-frame
- P frames
  - Forward prediction frames
  - Based on previous I or P frames
- B frames
  - Bi-directionally predicted frames, based on previous and following I and P frames.
- Group of Picture (GOP): set of frames between two I frames is GOP. E.g. IBBPPBPI, IPPPPI, or II.
- MPEG decoder may have to buffer extra frames of data besides being displayed.



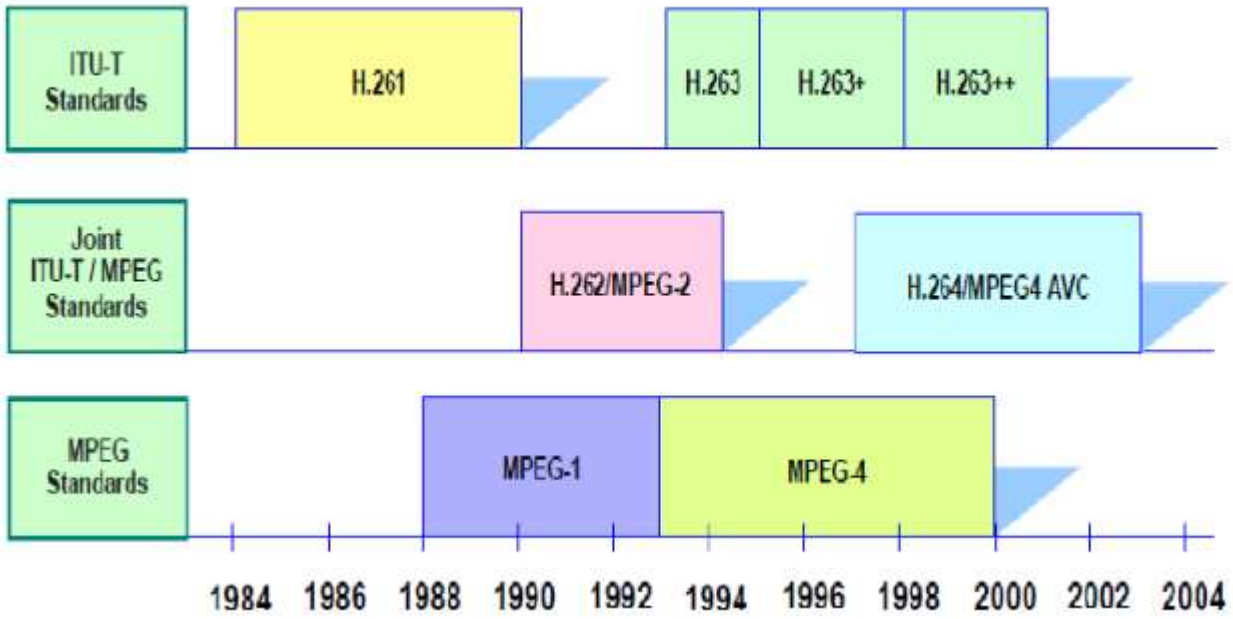
Quantization in MPEG

- Apply Quantization on the frequency domain coefficients
- Favor low frequency coefficients
- So, it requires minimum data to represent given video

Entropy encoding in MPEG

- Convert 2 dimensional symbols into 1 dimensional series
- Use Zig-zag or vertical scans
- Apply run length coding on the 1D series

Vol. 2(9), 2010, 4622-4631

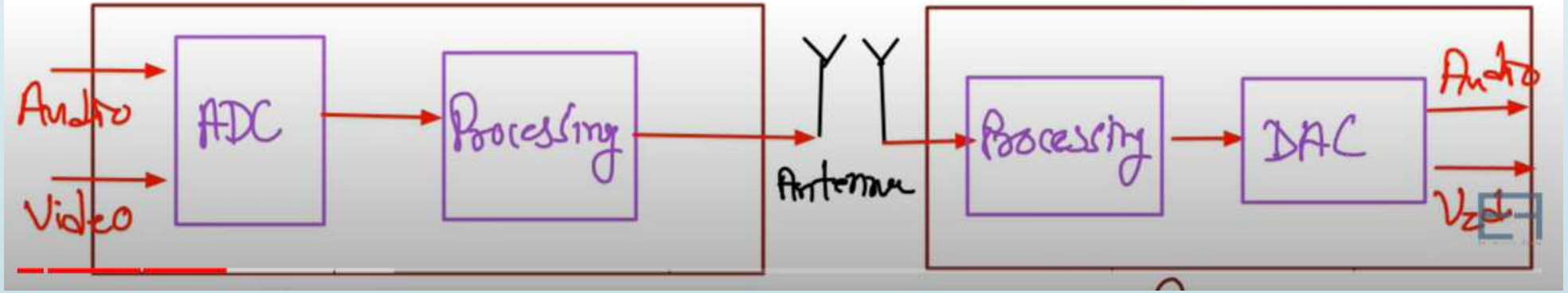


Advanced Video Coding:

- **The H.264 video compression standard , also known as MPEG-4 Part 10, Advanced Video Coding, MPEG-4 AVC or AVC video, is an industry standard for video compression that is one of the most frequently used video formats nowadays.**
- It was developed and maintained by the ITU-T Video Coding Experts Group (VCEG) with the ISO/IEC JTC1 Moving Picture Experts Group (MPEG).

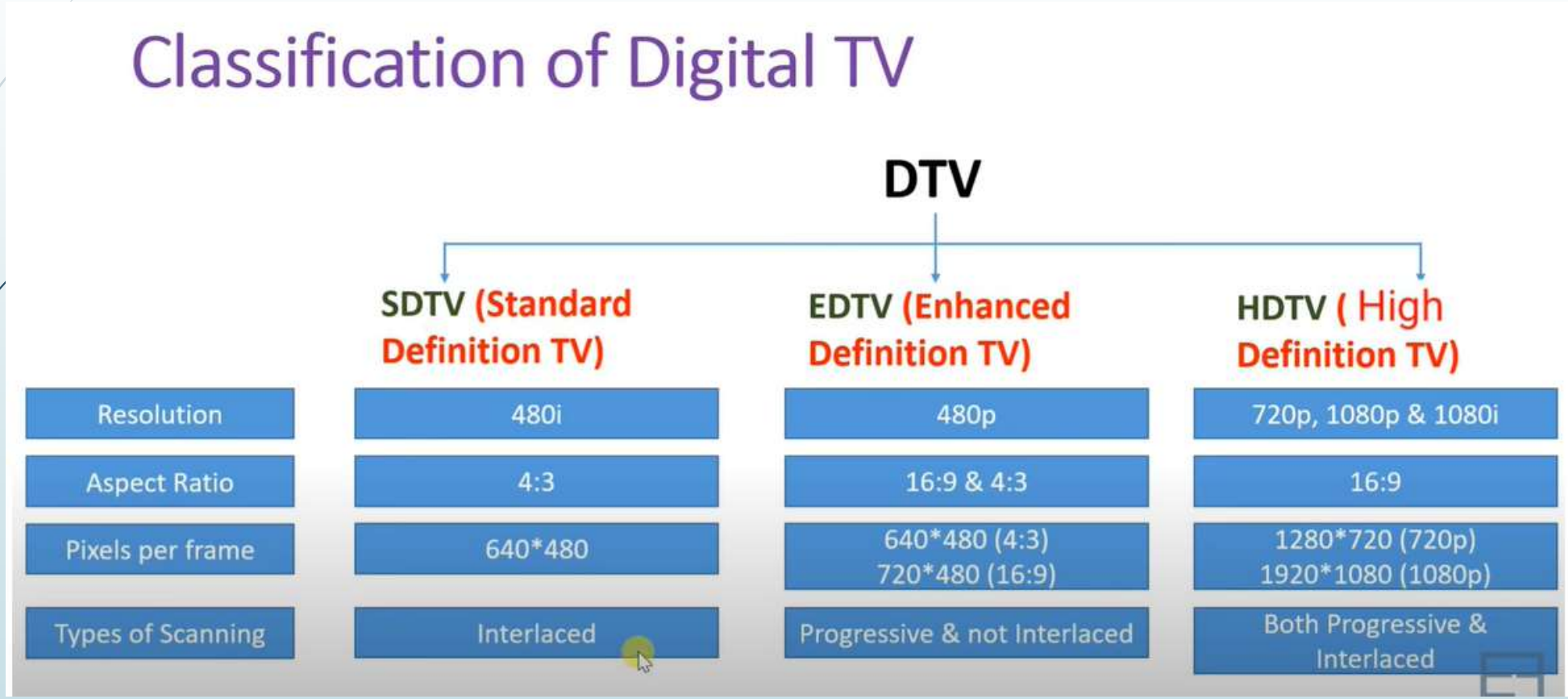
Basics of Digital TV

- In Digital TV, we transmit and receive digital Audio and Video
- Here at transmitter 1st we convert analog audio & video signals into digital audio & video, then we multiplex it into channel and than we do channel encoding for transmission. At receiver side we do reverse process.

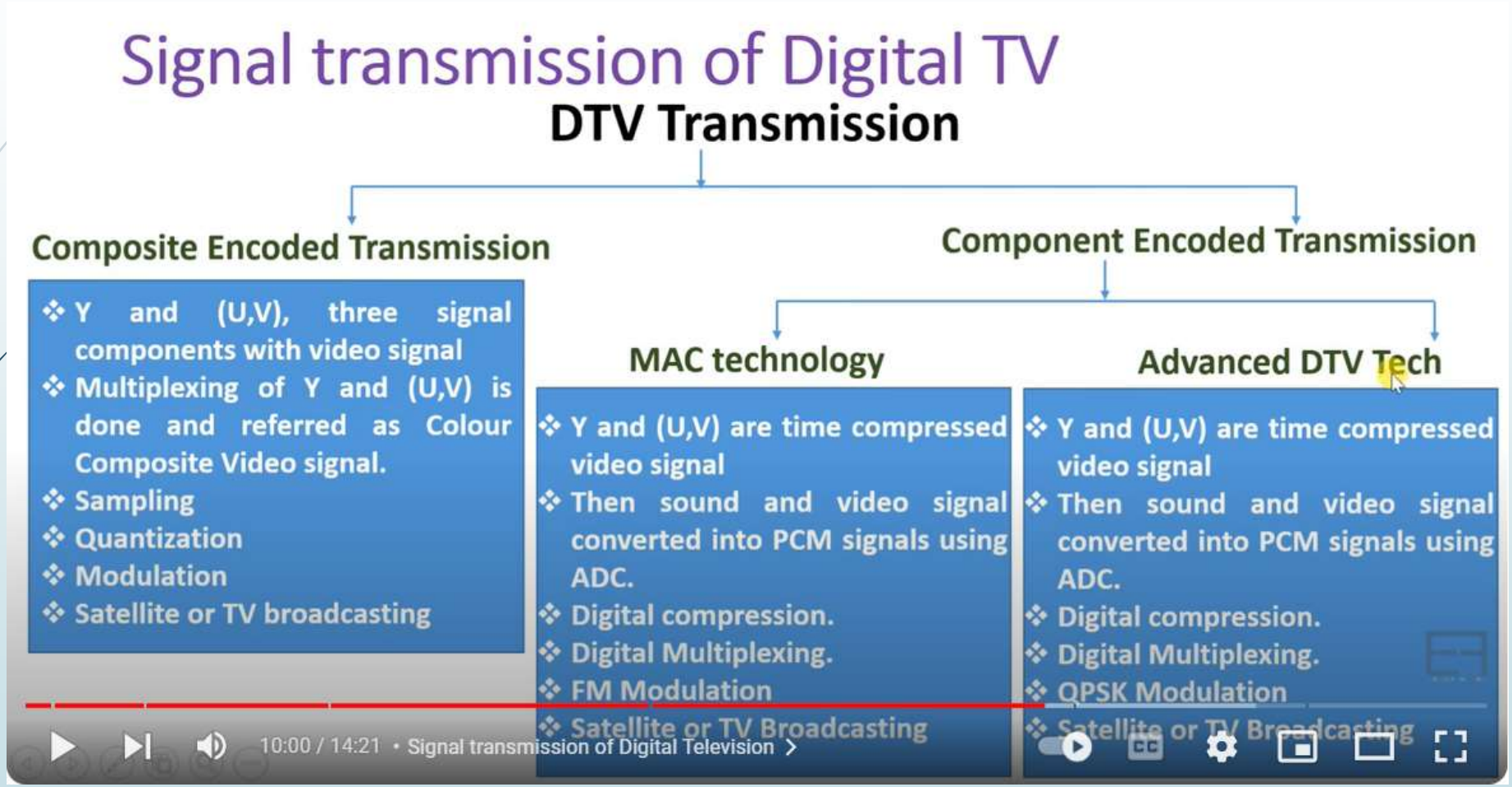


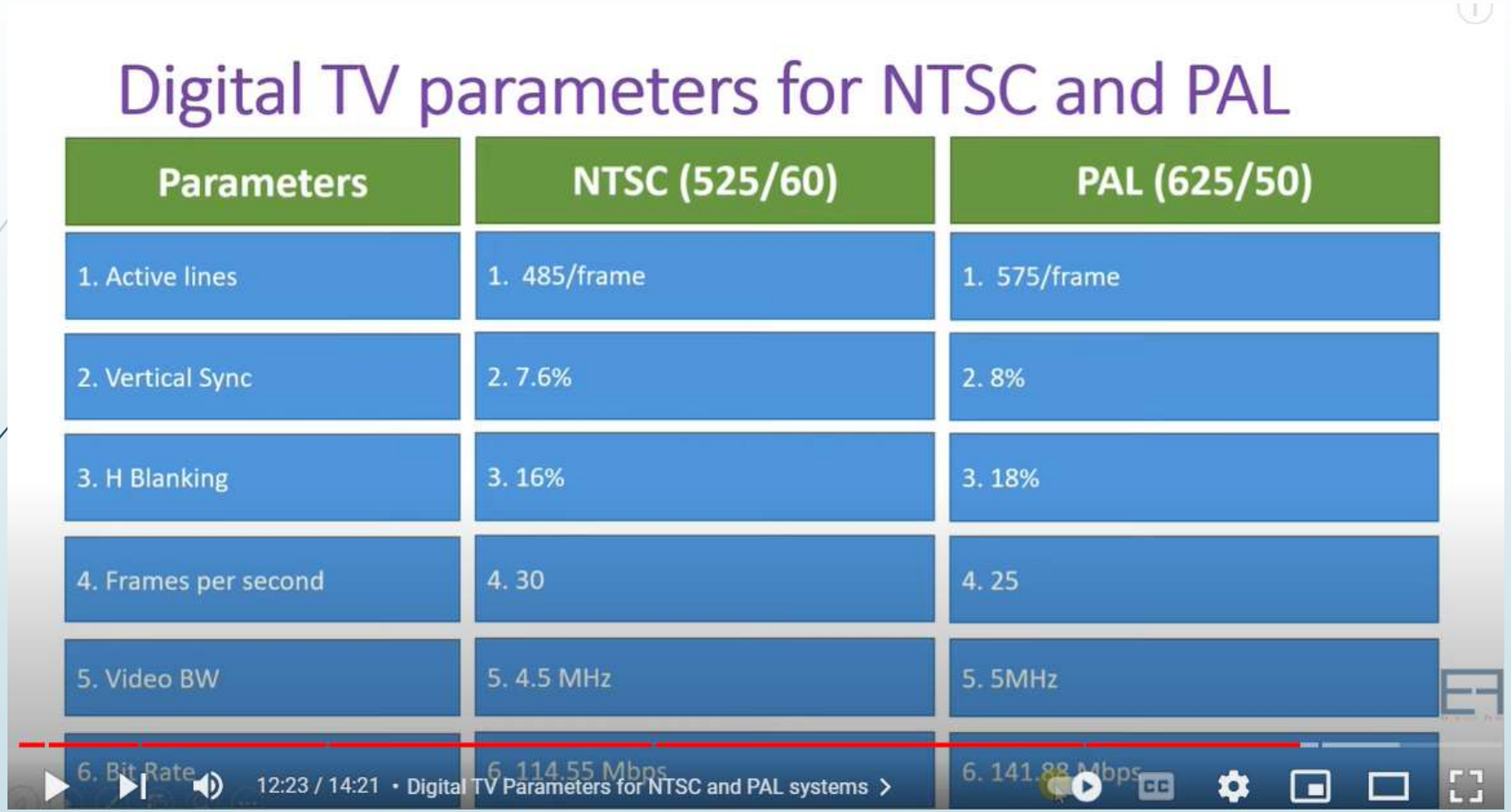
- In digital TV we can transmit more than one channel on same channel bandwidth.
- Standard for Digital TV is DVB (Digital Video Broadcasting)

Classification of Digital TV



Signal transmission of Digital TV




Digital TV parameters for NTSC and PAL
Parameters
NTSC (525/60)
PAL (625/50)
1. Active lines
1. 485/frame
1. 575/frame
2. Vertical Sync
2. 7.6%
2. 8%
3. H Blanking
3. 16%
3. 18%
4. Frames per second
4. 30
4. 25
5. Video BW
5. 4.5 MHz
5. 5MHz
6. Bit Rate
6. 114.55 Mbps
6. 141.88 Mbps
12:23 / 14:21 • Digital TV Parameters for NTSC and PAL systems

Merits of Digital TV

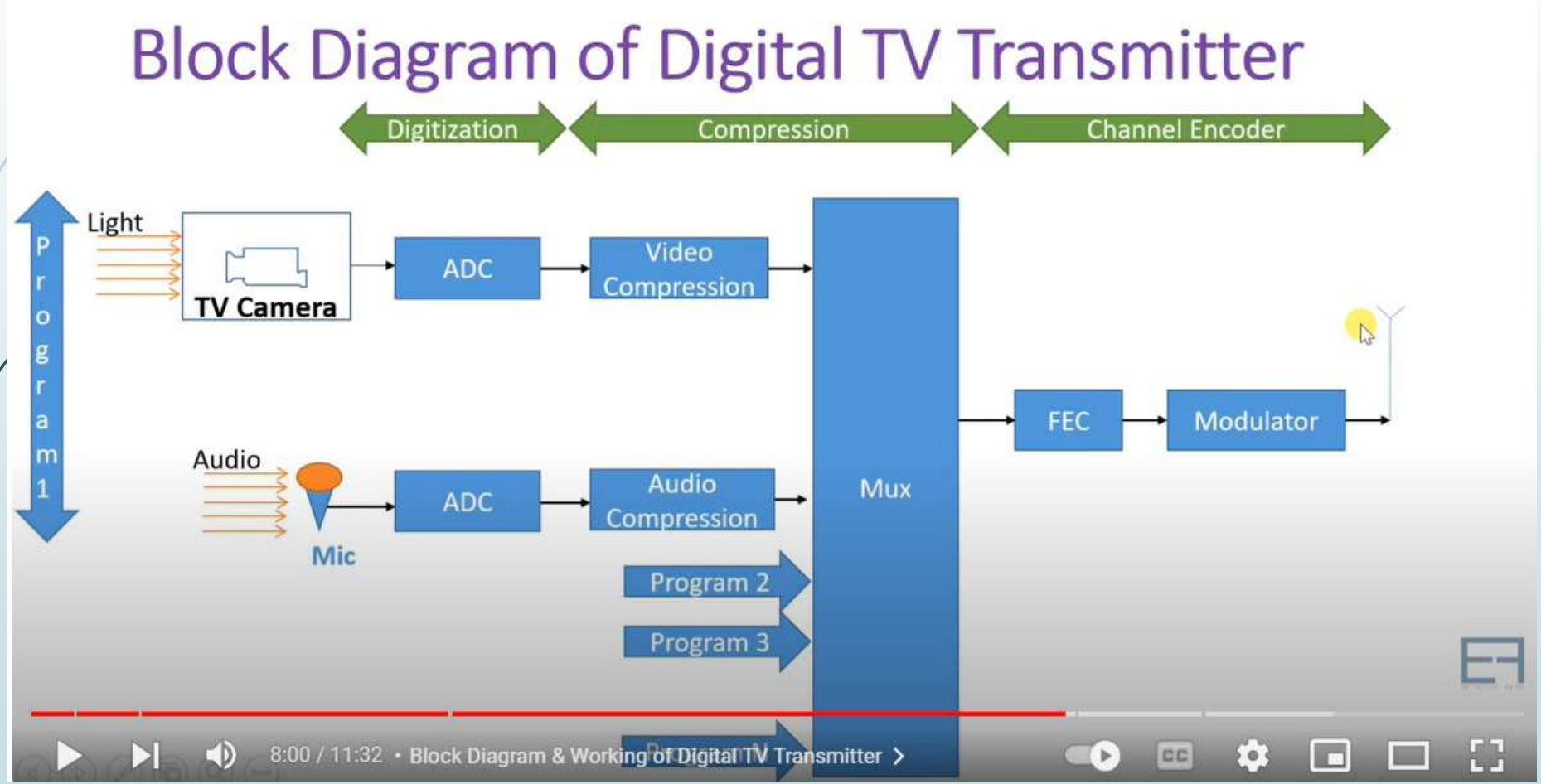
- Reduced Ghosts
- Reduced 50Hz flicker
- High resolution picture
- Pictures in Pictures
- Slow motion action
- Reduced operational instability
- Improved reception in fringe areas

Basics of Digital TV Transmitter

- Digital TV signal transmission can be sub divided into three parts

1. Digitization
   - Conversion of Analog signal into digital signal
   - ADC converter has sampling, quantization and encoding process
2. Digital compression
   - Video and Audio compression digitally
   - MPEG encoder compress digital video
   - Non Linear Quantization used to compress audio (Companding)
3. Channel Encoding
   - It has forward error correction and Modulation

FEC=Forward Error correction

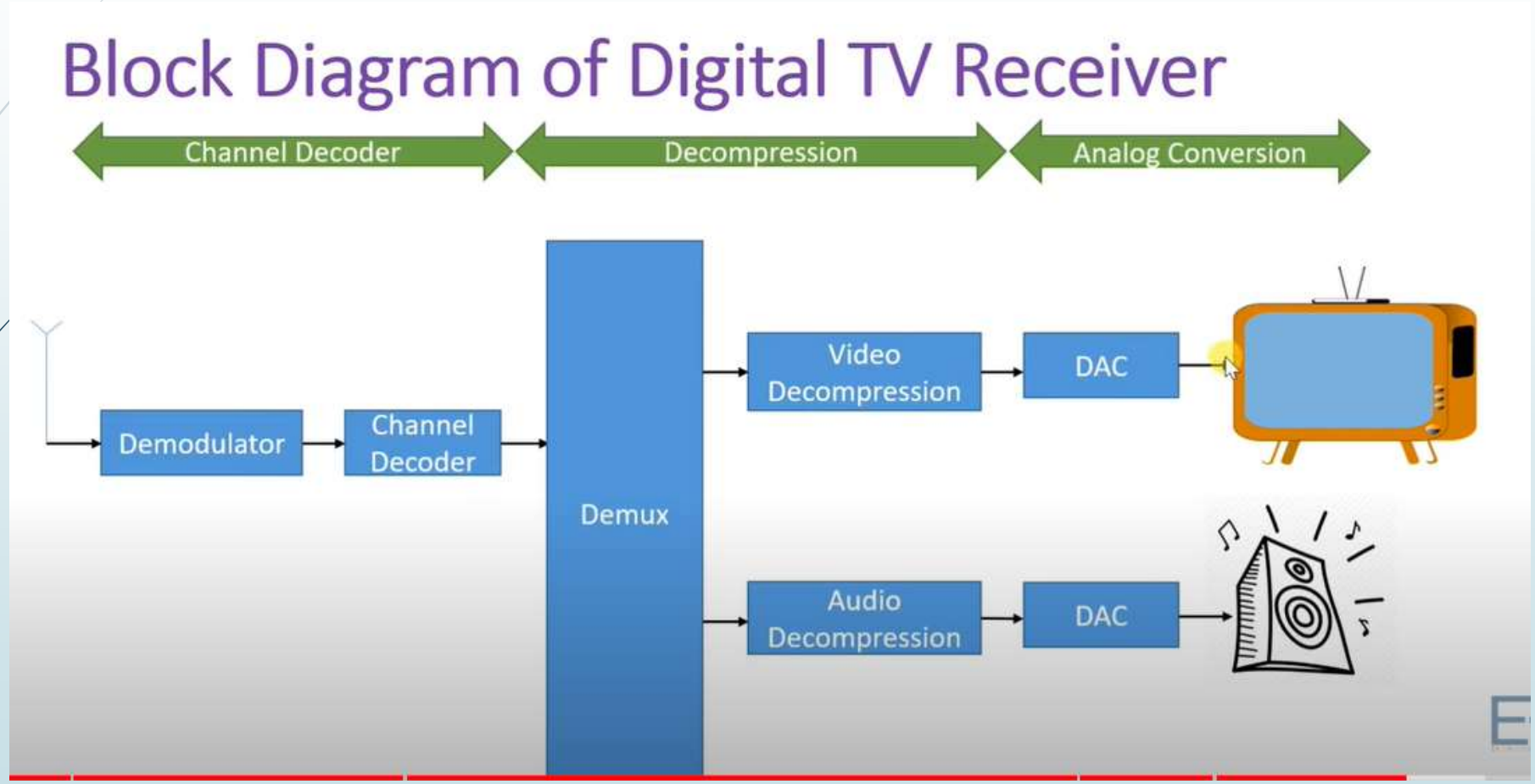


Basics of Digital TV Receiver

- Digital TV signal Receiver can be sub divided into three parts

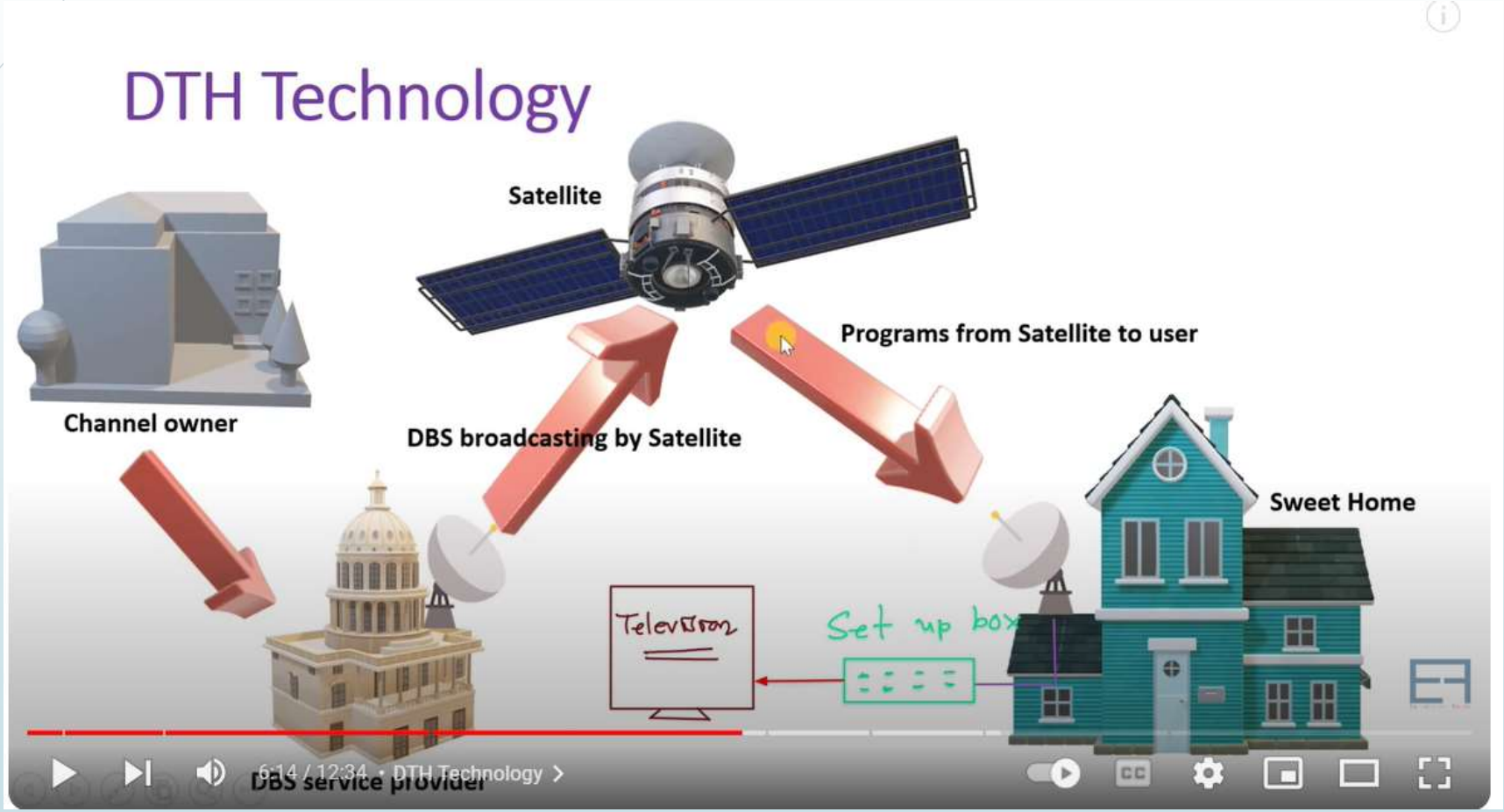
1. Channel Decoding
   - Demodulation of received signal
   - Error Detection and correction
2. Digital Decompression
   - Video and Audio Decompression
   - MPEG decoder decompress digital video
   - Expanding (Non Linear Dequantization) to decompress audio
3. Analog Conversion
   - Digital data converted into analog signal to display TV program on Television

Block Diagram of Digital TV Receiver



Basics of DTH Television

- DTH stands for Direct To Home Television.
- Here no need of cable operator, broadcaster directly in touch with the consumers.
- Users are receiving TV channels by personal dish in individual home.
- TV programs are transmitted to the users directly from the satellite.
- It employs wireless technology.
- This service does not require the usage of cables and any other wiring infrastructure.


DTH Technology
Satellite
Channel owner
DBS broadcasting by Satellite
Programs from Satellite to user
Sweet Home
Television
Set up box
DBS service provider
6:14 / 12:34 • DTH Technology

Some DTH service provider in India

- Tata sky
- Dish TV
- Airtel Digital TV
- Sun direct
- Videocon D2H

Services given by DTH Technology

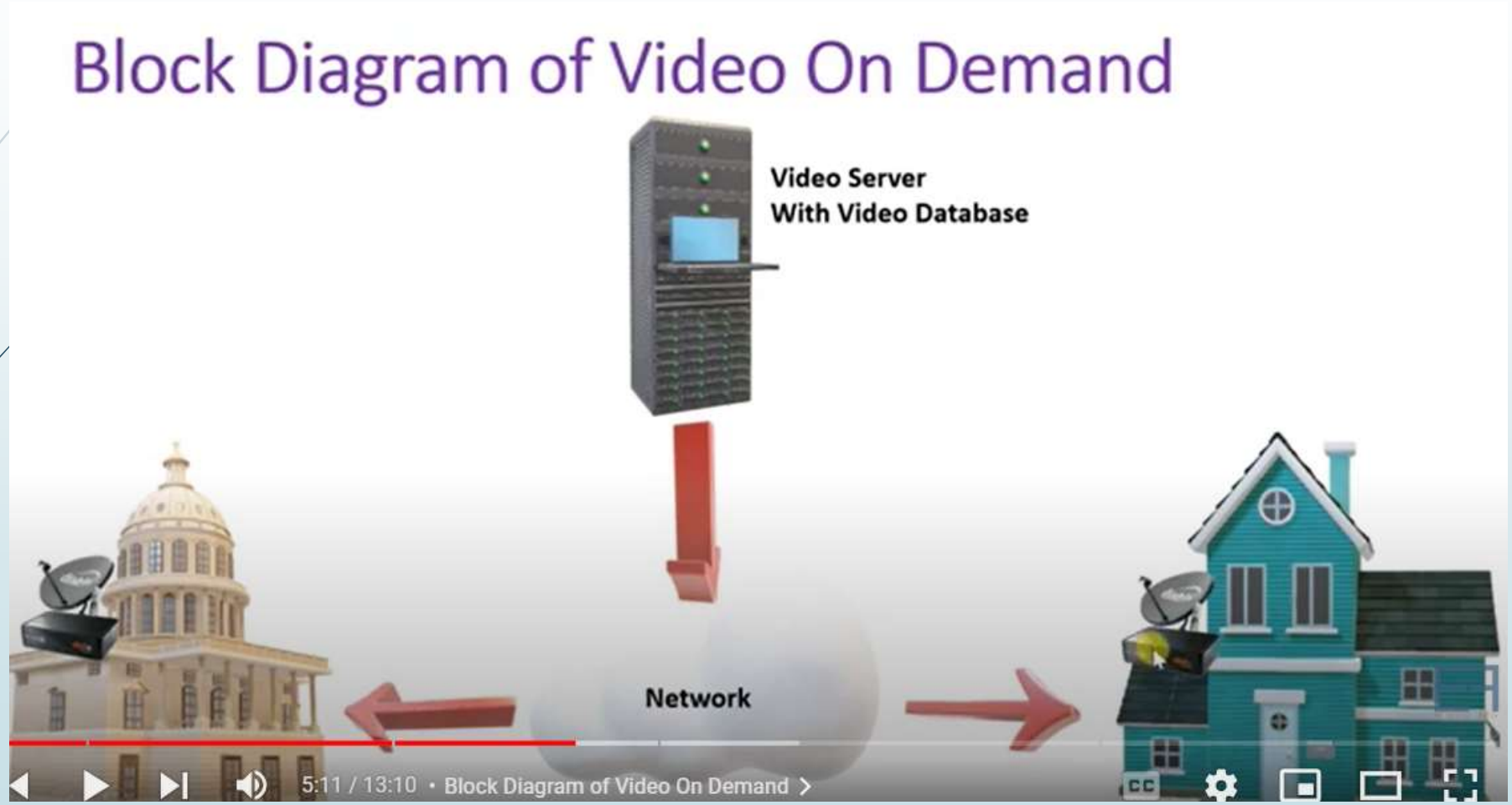
- Movie On demand
- Internet access
- Video Conferencing
- Online Gaming
- Email

Difference between DTH and Cable TV

- DTH Television does not need cabling
- Channel directly reaches user from broadcaster in DTH Television
- Operator does not required in DTH Television
- Cable TV provide service based on Television, not more than it.
- Quality of Video is way batter in DTH Television.

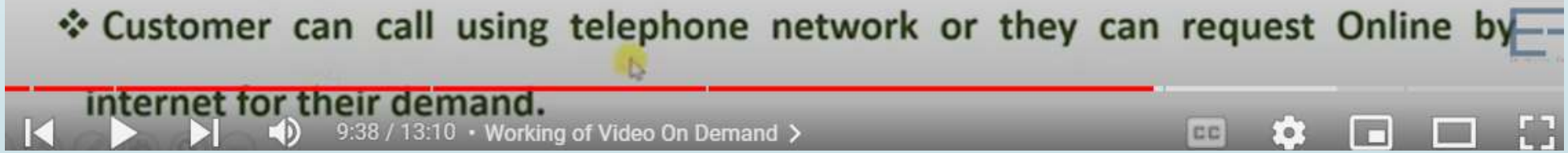
Basics of Video On Demand

- Video On Demand (VOD) is such type of system in which the user can select a program of his choice and watch and listen to video and audio.
- VOD can work by two different network
  - Wide geographic region
  - Satellite based network


Block Diagram of Video On Demand
Video Server
With Video Database
Network
5:11 / 13:10 • Block Diagram of Video On Demand

Working of Video On Demand

- VOD provides all common feature of DVD player
- VOD has standard TV receiver and Set up box
- VOD offers subscriber to view video or program later.
- Video server has video database, from where subscriber can request for their demand.
- Set up box is used to process video and provides basic functions as it is their with DVD player.
- Customer can call using telephone network or they can request Online by internet for their demand.



History of VOD

- 1st VOD service were launch in Hong Kong in early 1990's.
- In 2000, US has used it through cabling.
- In past, VOD suffered from a lack of bandwidth.
- Now a days in 2019, VOD works very well as large bandwidth is available.

Applications of VOD

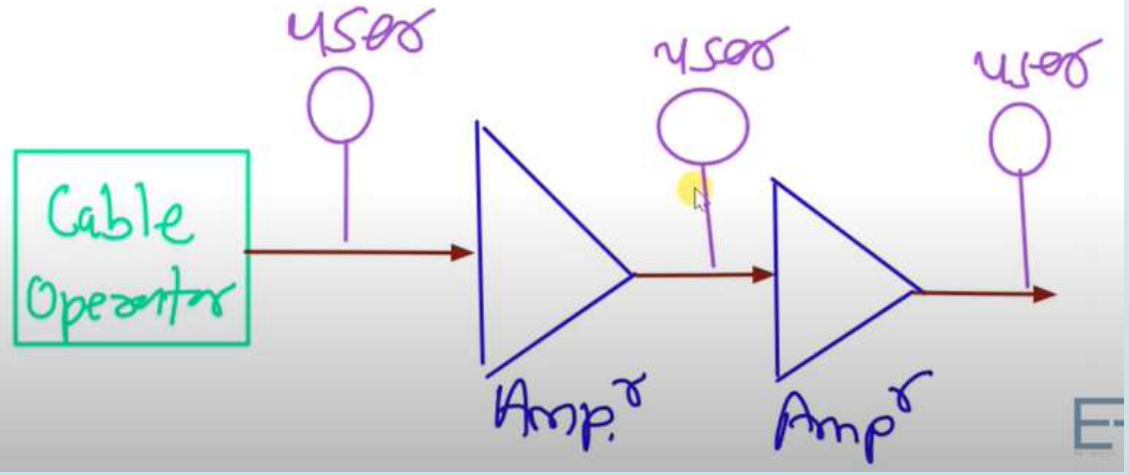
- It can be used in educational institute.
- It can be used in video conference.
- Provides Film on demand
- Games and Music on demand

Basics of CATV

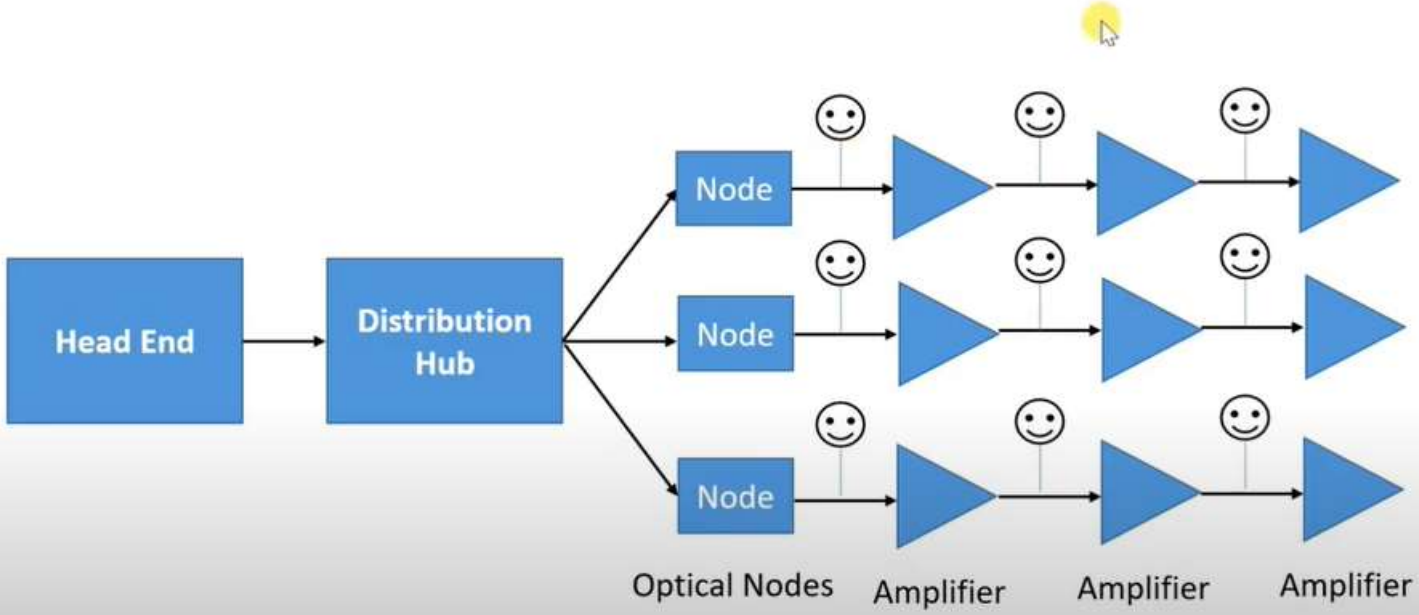
- CATV is also known as cable Television
- In this type of Television system signals are transmitted through coaxial cables and optical fiber cables.
- For CATV, it needs to have distribution system.
- CATV has two standards, older one is Analog TV and newer one is Digital TV

Components of CATV

- Following components are there with CATV system.
  - Cable Network (Coaxial or Optical)
  - Nodes
  - Line Amplifier
  - Power supply



Block Diagram of CATV



Working of CATV

- Television channel transmitted by Head at particular frequency.
- Distribution hub is having amplifier at reasonable distance to keep signal strong.
- Separate TV signals do not interfere here with this channel.

Advantages of CATV

- Cable TV are available at low cost.
- Cable TV gives good service.
- They offers good packages of programs.
- Service cost is cheap.
- Cable TV provides good signals in bad weather conditions like heavy rainfall.

Disadvantages of CATV

- Some privet company has different cost.
- VOD is not available.
- Internet is not available.
- Gaming is not available.