History Defined

**Digital Video**
- A video recording system that works by using a digital rather than an analog video signal.

**Digital**
- A system uses discrete (discontinuous) values to represent information for input, processing, transmission, storage, etc.
- In short – transmission of symbols.

**Analog**
- A system that uses a continuous range of values to represent information.

History Film

**Film**
- Film encompasses individual motion pictures produced by recording images from the world with cameras, or by creating images using animation techniques or special effects.
- Made up of a series of individual images called frames.
- Viewer has the illusion that motion is occurring.
- No blurring between frames due to an effect known as persistence of vision.
- Beta movement – a perceptual illusion, described by Max Wertheimer in 1912 – two or more still images are combined by the brain into perceived motion.
History Film

Film
- In the 1860s, mechanisms for producing artificially created, two-dimensional images in motion were demonstrated with devices such as the zoetrope and the praxinoscope.
- Early versions use print attached to a drum that were hand cranked.
- Speed then about 5 to 10 frames a second.
- Later introduced a reel and motion pictures as we know them with a projected light to magnify them.
- In 1927 The Jazz Singer added sound “talkies” were born.

Film Today
- Until very recently the highest resolution storage format.
- Various frame sizes used, 16mm, 35mm & 70mm - Imax.
- Difficult to produce, store, handle and display.
- Easily degraded due to contamination and scratches.
- Generally recorded at 24 fps.
- Generally displayed at 72 fps (each frame 3x) to reduce flicker.
- Use a device called a Telecine to convert to television formats.

At far left and far right, outside the perforations, is the DTS soundtrack as an image of a digital signal. Between the perforations is the Dolby Digital soundtrack (note the tiny Dolby “Double D” logo in the center of each area between the perforations). Just inside the perforations, on the left side of the image, is the analog optical soundtrack, with two channels encoded using Dolby SR noise reduction that can be dematrixed into four channels using Dolby Pro Logic. The optical soundtrack used to synchronize a DTS soundtrack, which sits between the optical soundtrack and the image, is not pictured. Finally, the image here is an anamorphic image used to create a 2.39:1 aspect ratio when projected through an anamorphic lens.
History Television

Television – a telecommunication medium for sending (broadcasting) and receiving moving images, either monochromatic ("black and white") or color, usually accompanied by sound

- Commercially available since the late 1930s

In 1884 Paul Gottlieb Nipkow, a 20-year old university student in Germany patented the first electromechanical television system which employed a scanning disk.

Scanning Disk

- A lens projects an image of the scene in front of it directly onto the disk.
- Each hole in the spiral takes a horizontal "slice" through the image which is picked up as a pattern of light and dark by a sensor.
- Scan lines limited by number of holes.
- If a light powered by a signal from the sensor is placed behind a second Nipkow disk rotating in sync at the same speed and direction.

Nipkow's design would not be practical until advances in amplifier tube technology became available in 1907.

Really only useful for transmitting still halftone images.

Later designs used a rotating mirror drum.

1890 Ferdinand Braun developed the Cathode Ray Tube.
Cathode Ray Tube - a vacuum tube containing an electron gun (a source of electrons) and a fluorescent screen, with internal or external means to accelerate and deflect the electron beam, used to form images in the form of light emitted from the fluorescent screen:

- Electrical waveforms (oscilloscope)
- Pictures (television, computer monitor)
- Radar targets

1897: developed the Cathode Ray Oscillograph, the precursor to the radar screen and the television tube.

1907: First use of cathode ray tube to produce the rudiments of television images.

1925: Scottish inventor John Logie Baird demonstrated the transmission of moving silhouette images in London. Scanning was done mechanically with a Nipkow disc. The first 30 line picture transmitted was a Maltese cross.
History Television

- Cathode Ray Tube
  - 1927 John Logie Baird also demonstrated video recording
  - 1928 transatlantic television
  - 1937 the broadcast of high definition color pictures
  - 1941 stereoscopic television in color
  - 1944 the multi-gun color television tube, the forerunner of the type used in most homes today

- In 1923 Vladimir Zworykin of RCA made a patent application for a camera device, and by 1933 had developed a camera tube he called an Iconoscope. Although Zworykin submitted his patent application first after many years of legal battle Farnsworth was acknowledged as the inventor of electronic television.
  - By the end of 1923 he had also produced a picture display tube, the “Kinescope”
These inventions were the underlying basis of the development of Television as we know it today.

1927 - Russian inventor Léon Theremin developed a mirror drum-based television system which used interlacing to achieve an image resolution of 100 lines.

1927 - Herbert E. Ives of Bell Labs transmitted moving images from a 50-aperture disk producing 16 frames per minute. From Washington, DC to New York City, and via radio from Whippany, New Jersey. Ives used viewing screens as large as 24 by 30 inches. Subjects included Secretary of Commerce Herbert Hoover.

1928 - Philo Farnsworth made the world’s first working television system with electronic scanning of both the pickup and display devices, which he first demonstrated to news media on 1928-09-01, televising a motion picture film.
History Television

- Farnsworth painted a square of glass black and scratched a straight line on the centre. The slide was dropped between the Image Dissector (the camera tube that Farnsworth had invented earlier that year) and a hot, bright, carbon arc lamp.
- On the receiver they saw the straight-line image and then, as the slide was turned 90 degrees, they saw it move. This was the first all-electronic television picture ever transmitted.

First TV displays were round
- Rectangular rasters easier to generate
- Television developed a 4:3 aspect ratio
- Cinematic formats are much wider
- World now moving to 16:9 aspect ratio

4:3 (12:9)  16:9

First television pictures were black & white referred to as luminance (brightness)
- Video refers to the linear base-band signal that contains the image

Front  Back
Porch
Grey
Black
White
White
Pulse
Sync
Sync
Black
Stripe
Grey
Stripe
Background
Front
Back
Porch

0 mV
-300 mV
700 mV
Frame Rate
- A frame represents a complete TV picture
- Our analog TV frame consists of 625 lines
- A frame is usually comprised of 2 fields each containing 1/2 the picture information
- Our system has a frame rate of 30 Hz
- The field rate is 60 Hz
- Pictures displayed at 30 Hz exhibit obvious flicker
- Interleaving the fields reduces flicker

Frame Rate
- To reduce the perceived screen flicker (30 Hz) on a television, a technique called 'interlacing' is employed.
- Interlacing divides each video frame into two fields; the first field consists of the odd scan lines of the image, and the second field of each frame consists of even scan lines.
- Interlace was also used to decrease the requirement for video bandwidth. It is a form of compression

Television
- Progressive Scanning
  - Simplifies the interpolation and filtering of images
  - Allows MPEG-2 compression to work more efficiently by processing complete pictures
  - Direct processing of progressively-scanned sources
  - 24 frame/second progressive film mode can be provided
  - Assists video conversions with different:
    - numbers of scan lines
    - numbers of samples per line
    - temporal sampling (i.e., picture rate)
  - Progressive doubles raw data requirement
Television

- The number of picture elements resolved on the display
- Resolution in TV is limited by:
  - Capture device
  - Sampling Rate
  - Transmission System / Bandwidth
  - Display Device
  - Dot Pitch, Phosphor
  - Focus & Convergence
  - Viewing distance / Display size
  - Human Eye
- Typical SDTV systems attempt to transfer 720 x 480 pixels per line
- HDTV now 1920 x 1080

Television

- First TV signals were only luminance
- John Logie Baird demonstrated the world’s first color transmission on July 3, 1928, using scanning discs at the transmitting and receiving ends with three spirals of apertures, each spiral with filters of a different primary color; and three light sources at the receiving end, with a commutator to alternate their illumination
- 1938 - first color broadcast
- NBC made the first coast-to-coast color broadcast when it telecast the Tournament of Roses Parade

Television Now
High-definition television (HDTV) is a digital television broadcasting system with higher resolution than traditional television systems (standard-definition TV, or SDTV). HDTV is digitally broadcast because digital television (DTV) requires less bandwidth if sufficient video compression is used.

Not exactly defined - number of systems
System with a higher picture resolution
Greater than 1000 lines resolution
Picture with less artifacts or distortions
Bigger picture to give a viewing experience
Wider aspect ratio to use peripheral vision (16:9)
Progressive instead of interlaced pictures

National Television Systems Committee (NTSC)
First world wide color system adopted (1966)
Generally used in 60 Hz countries
Predominantly 525 line TV systems
AM modulation of luma & syncs (4.2 MHz)
U & V chroma AM quadrature modulated (IQ)
Chroma Subcarrier 3.579545 MHz
FM or Digital subcarrier modulation of Sound
**SECAM**
- Sequential Couleur Avec Memoire (SECAM)
- Developed by France before PAL
- 625 line 50 Hz color system
- Uses AM modulation for luminance & sync
- Line sequentially sends U & V chroma components on alternate lines
- Receiver requires a 1H chroma delay line
- Uses FM for color subcarrier 4.43361875 MHz
- Uses FM for sound subcarrier

**PAL**
- Phase Alternation Line-rate (PAL) color system
- Developed in Europe after NTSC & SECAM
- Generally associated with 50 Hz countries
- Predominantly 625 line system
- AM modulation of luma & syncs (5 MHz)
- U & V chroma AM quadrature modulated with V (R-Y) component inverted on alternate lines
- Chroma subcarrier 4.43361875 MHz
- FM or digital subcarrier modulation of sound

**Television Standards**
- North America: NTSC
- Europe: PAL
- France: SECAM
- PAL/SECAM
- PAL/NTSC
- Unknown