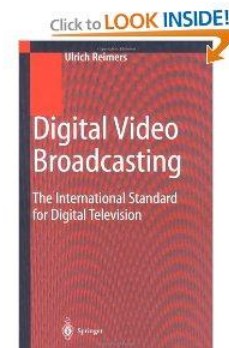


45350 I Digital television techniques (5 sp)

- Lectures
 - Mondays 10-12, Thursdays 10-12, room B3039
- Exercises (5 exercises, 10 h)
 - During lecture hours
 - Electronic submission (on <https://xprog28.cs.abo.fi/ro.nsf/>)
- Exam
 - May 25 2012., OR June 8 2012
- Books:
 - Ulrich Reimers: Digital Video Broadcasting
 - Mark Massel: Digital Television
- Other material
 - Lecture notes
 - Specifications, articles,



Digital television techniques

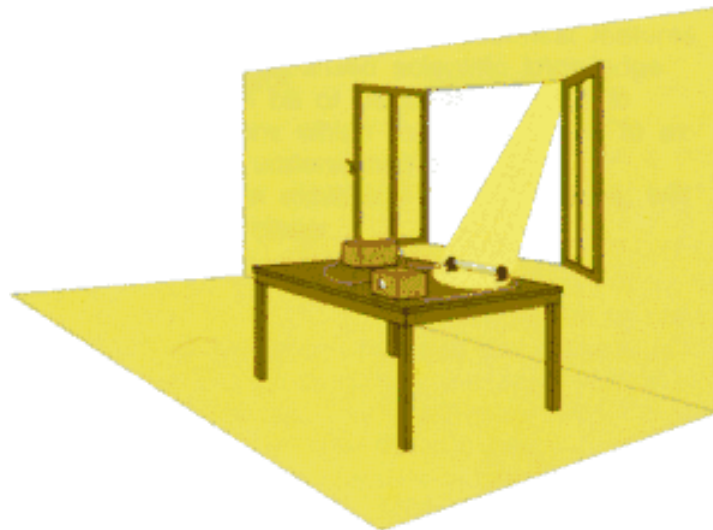
Introductional lecture:

- * Television history
- * Black and white television
- * Color television
- * Sound
- * Progress towards digital television

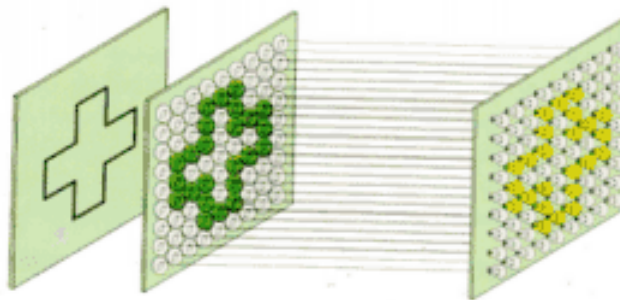
Digital television techniques

- Video broadcasting - historical overview
- Digital TV broadcasting (DVB-T, DVB-C, DVB-S)
- MPEG-2 video compressing basics
- Audio coding
- System / multiplexing
- Forward error correcting techniques (FEC)
- COFDM-broadcasting technique (DVB-T)
- DVB-T2
- DVB-H (DVB-Handheld)
- Measurement techniques
- Implementations

Television history



1873 - Resistance of selenium bar changes in light



Basics for television

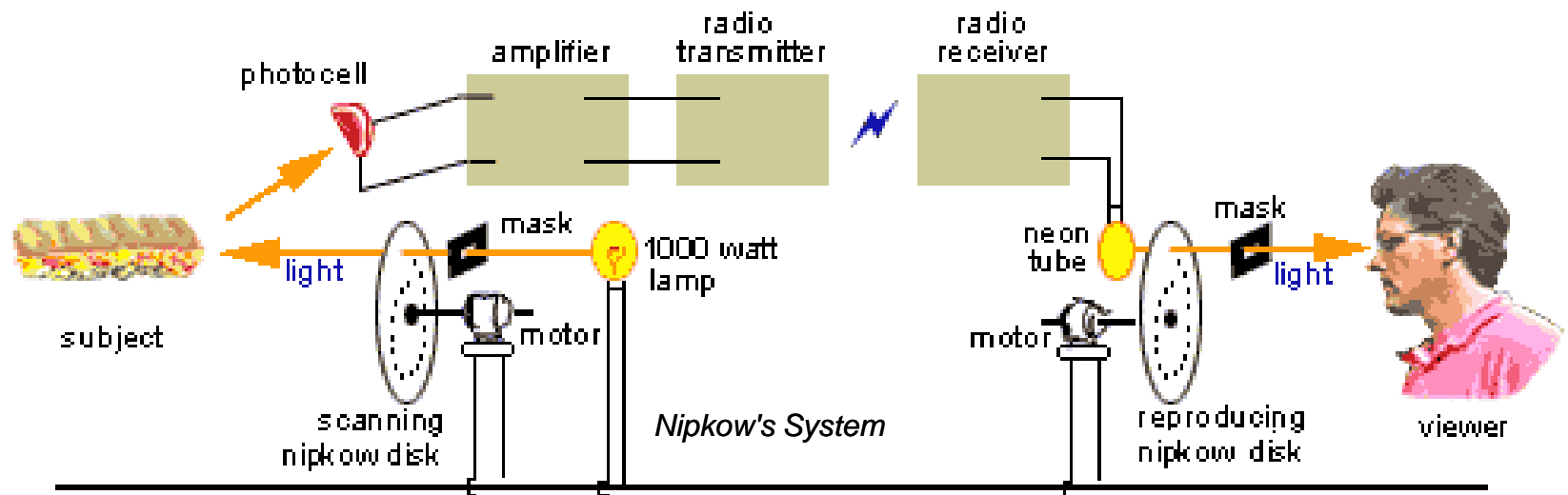
- Using fysiological capabilities of humans
 - Eye will remember for a while
 - 25 screen updates / s
 - Eye/brain will combine dots to a picture
 - Brain will combine a series of still pictures to a continuous motion
 - Color sensing capabilities

Television history – I Generation

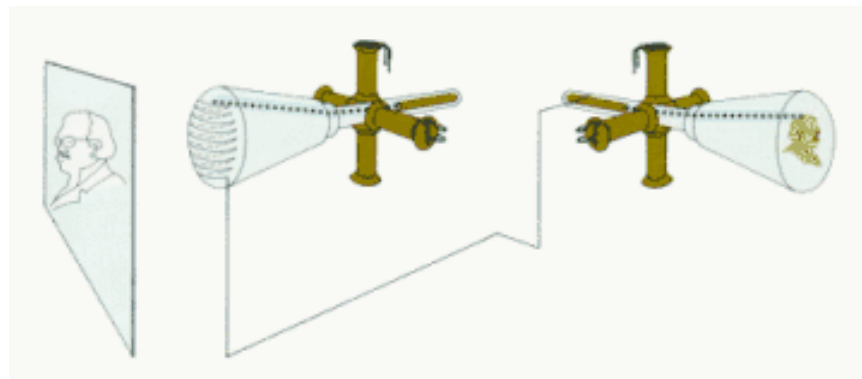
- 1880 First articles appear in Scientific American about the possibility of television.
- 1900 First known use of the word "television" at 1900 Paris Exhibition
- 1907 Boris Rosing (Russia) designs mechanical scanner with CRT receiver
- On January 23, 1926, John Logie Baird (of England) gave the world's first public demonstration of a mechanical television apparatus, license to transmit in London
 - AT&T gives public mechanical television demonstration (USA)



Baird's Mechanical Television System



Electronical system



Television history – II generation – B & W

1928 Takayanagi gives demonstration of CRT

(Cathode Ray Tube) system in Japan

1935 "First television broadcasting system in the World" – Germany

1941 The NTSC announced the recommended USA standard of 525 lines and 30 fps (frames per second).

1946 CBS gave the FCC a demonstration of their mechanical color system

1953 Color TV broadcast begins

1954 RCA first all-electronic TV-set

1956 Time magazine calls color TV "the most resounding industrial flop of 1956"

Television Now Reality; Device Demonstrated

Secretary Hoover First
to Make Use of Latest
Scientific Achievement



HERBERT HOOVER.

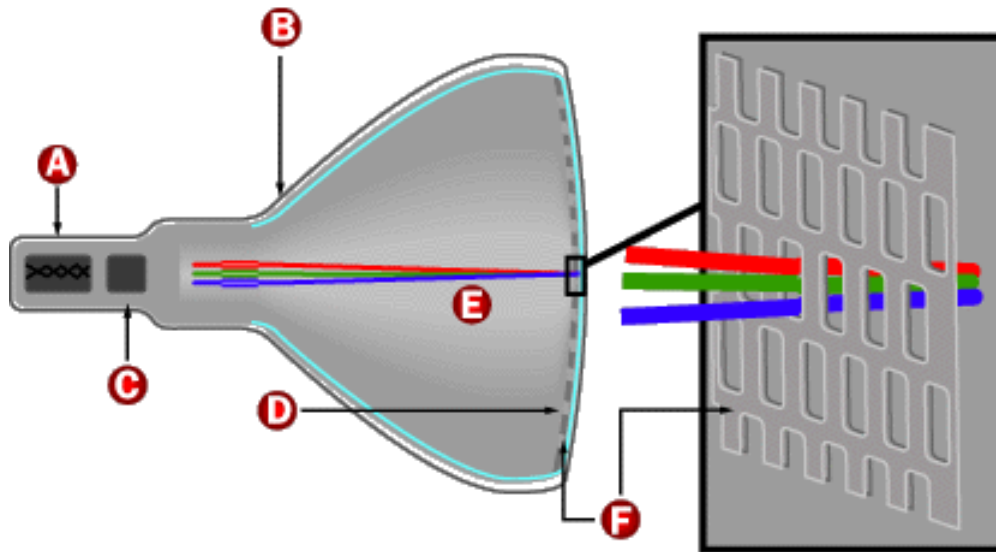
*Image of Speaker is
Carried by Phone
and Radio.*

**RESULT OF YEARS
OF EXPERIMENT**

*New York-Washington
Tests Complete
Success.*

New York, April 7.—(AP).—Television, a scientists' dream ever since the telephone was invented half a century ago, became an actuality today when Secretary of Commerce Herbert Hoover spoke over the telephone in

Cathode Ray Tube



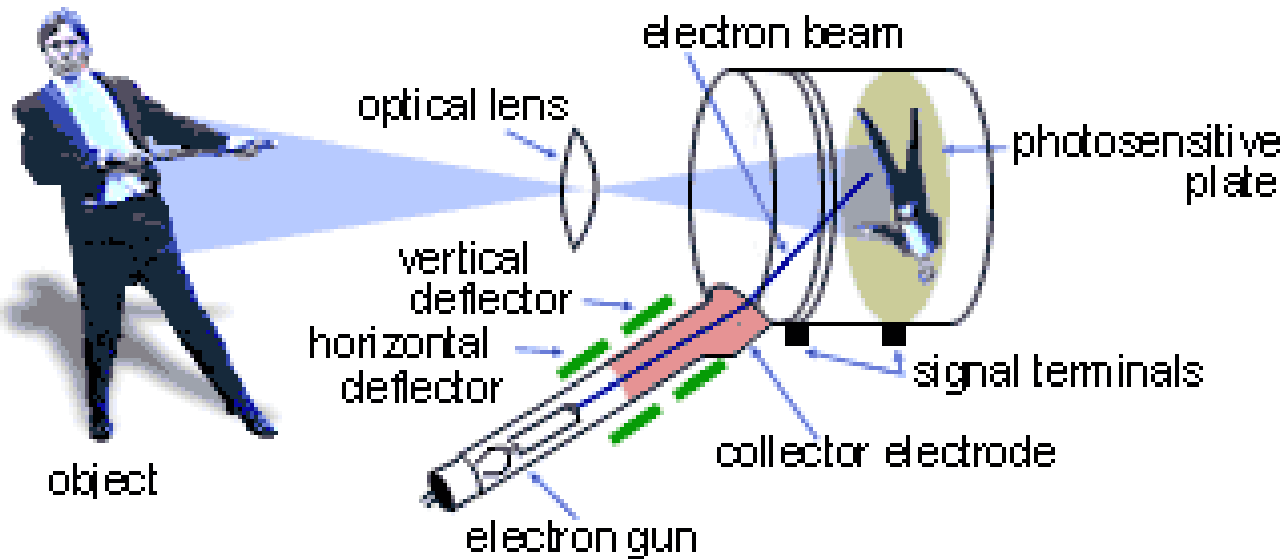
©2000 How Stuff Works

- A** Cathode
- B** Conductive coating
- C** Anode
- D** Phosphor-coated screen
- E** Electron beams
- F** Shadow mask



The Iconoscope

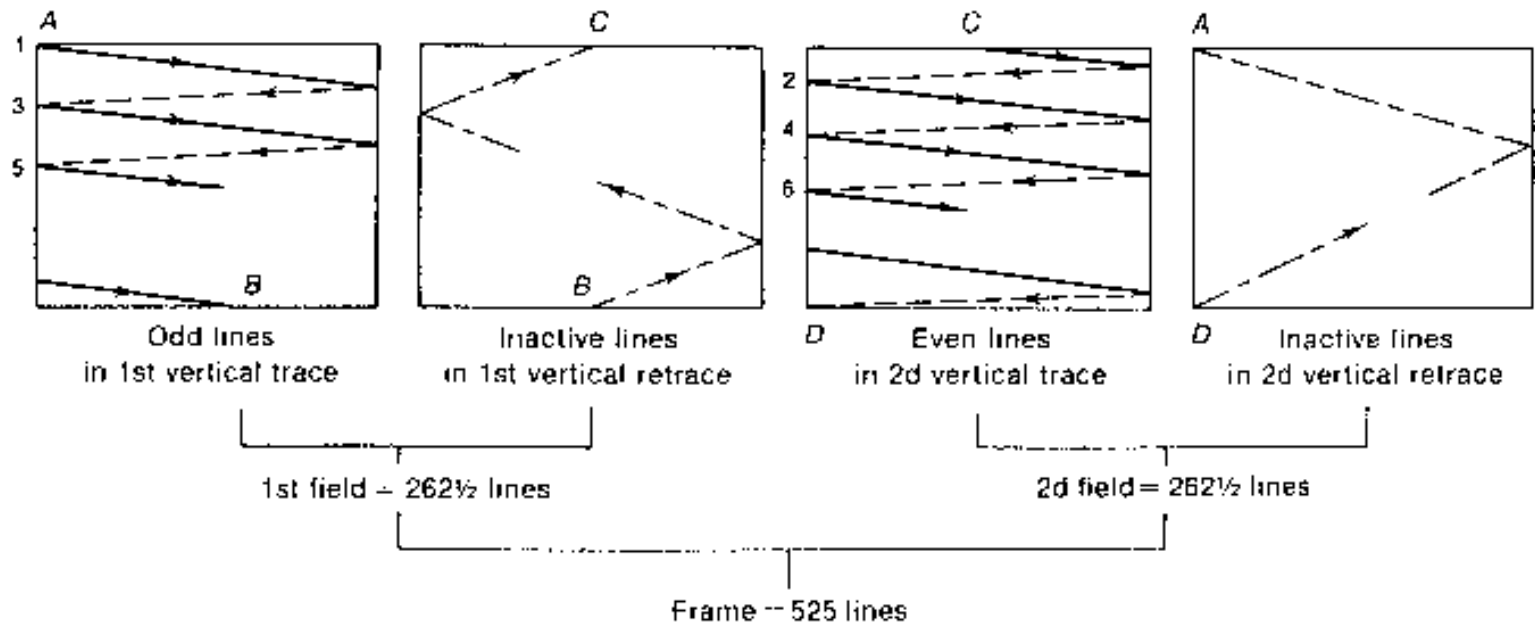
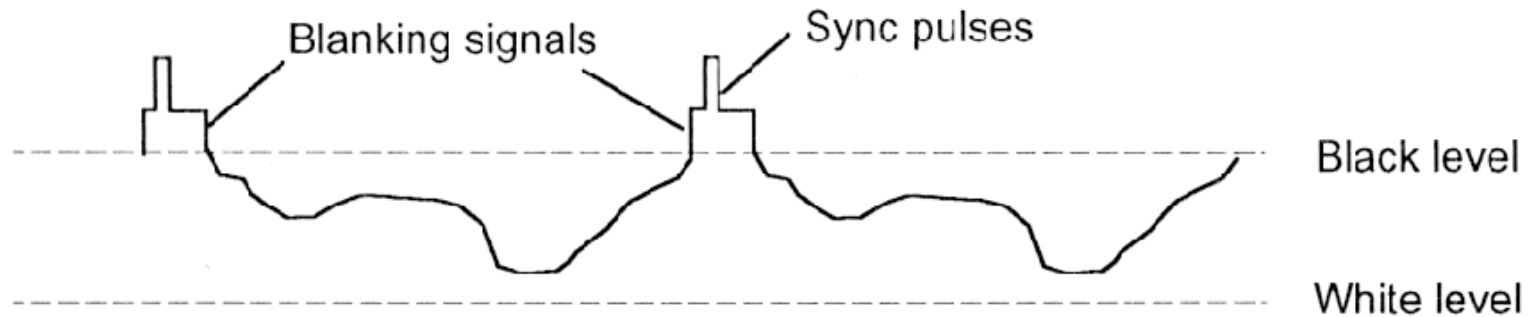
an early electronic camera tube



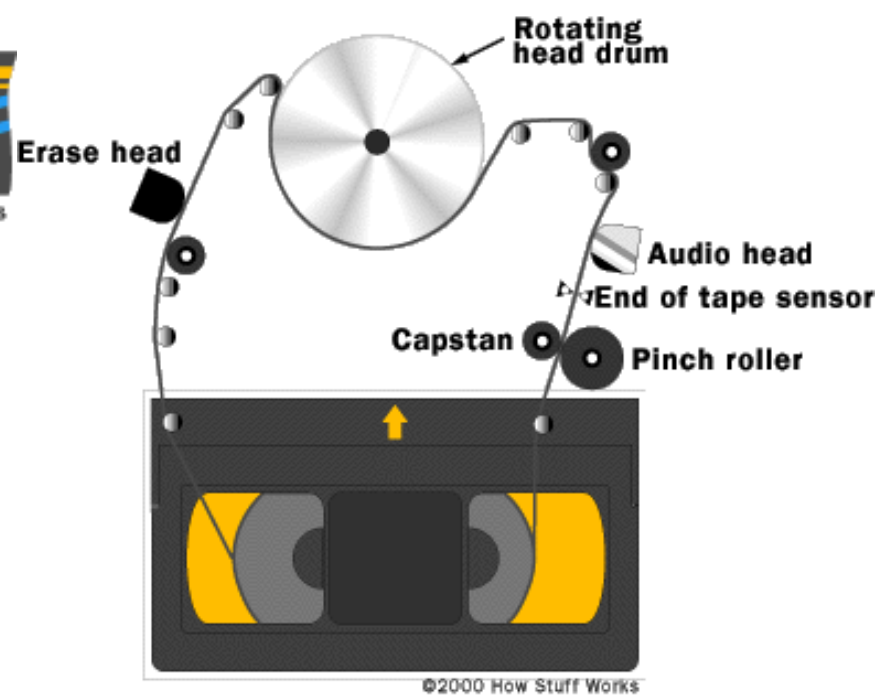
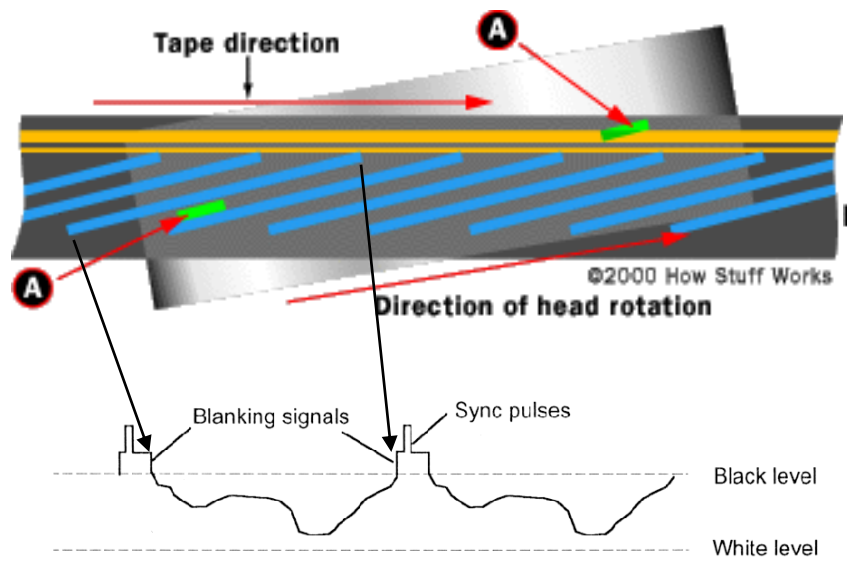
Television history

- 1972 Teletext experiments in UK
- 1974 First microprocessor used in Broadcast
- 1974 Betamax home VCR
- 1975 Work begin on a digital video standard
- 1986 Sony digital videotape recorder (D-1)
- 1990 All-digital HDTV is proposed
- 1995 First television delivered over the Internet

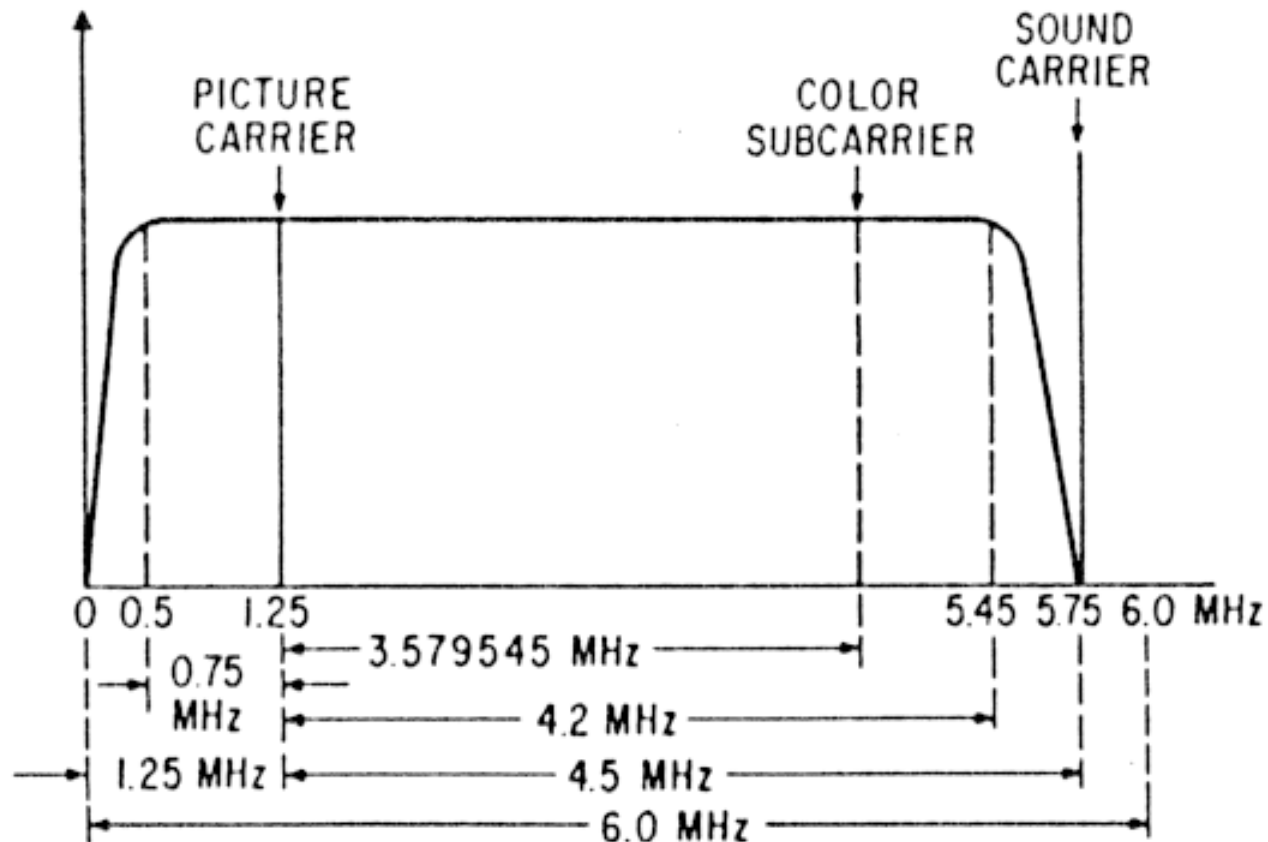
Basic black & white television



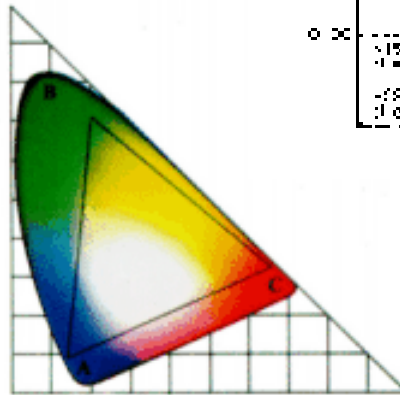
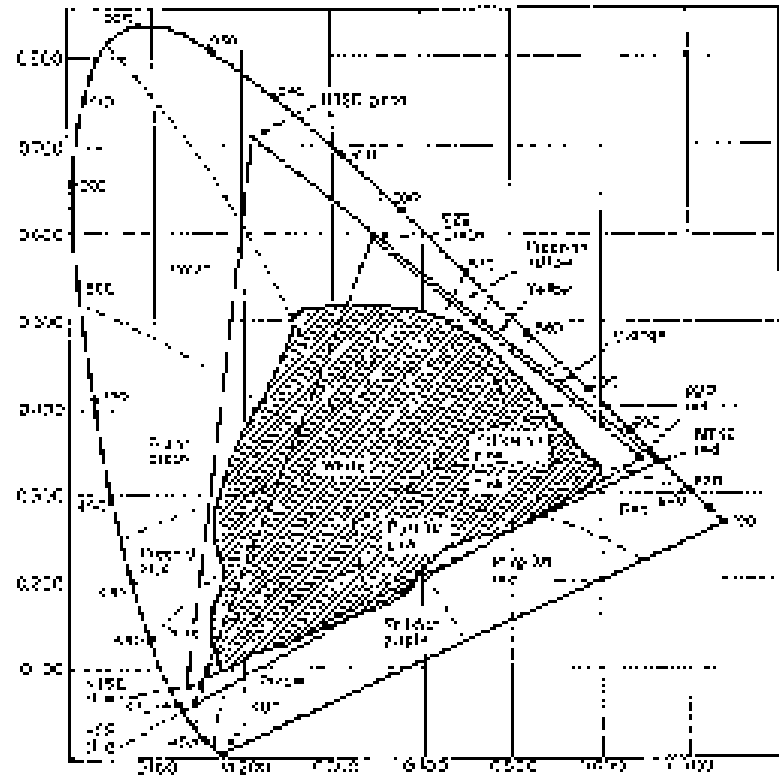
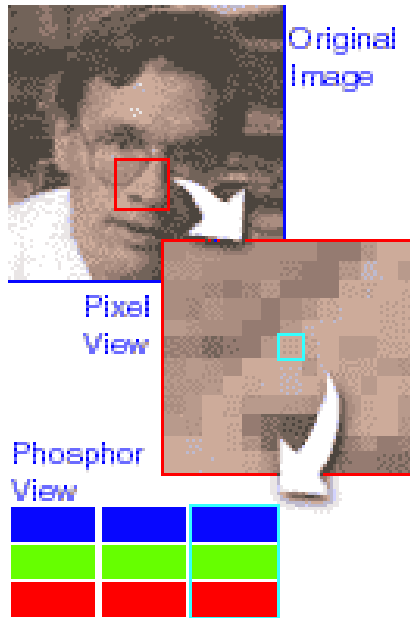
Video Cassette Recorder



PAL "M" –system (6 MHz / but comparable with 8 Mhz system)

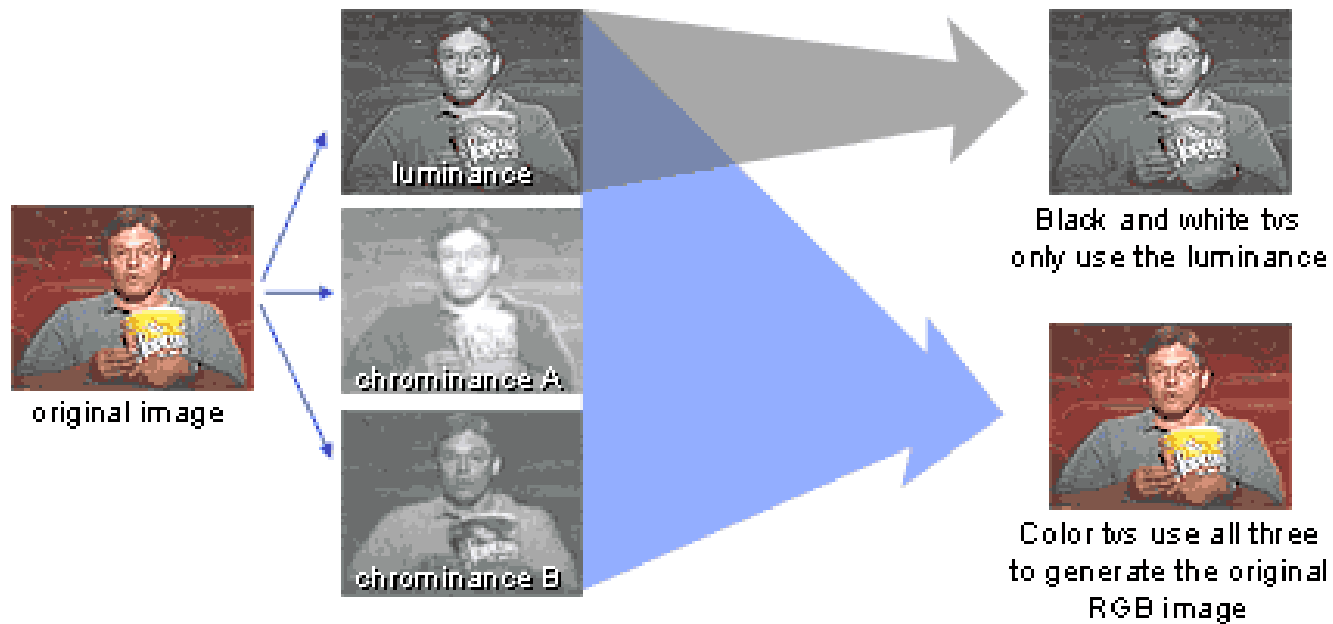


Color television



Color television

RCA's Color TV System compatible with black and white tvs



Color television - B&W compability

Original Red-Green-Blue values RGB separated into:

Luminance – Intensity (3.2 Mhz of 6 MHz)

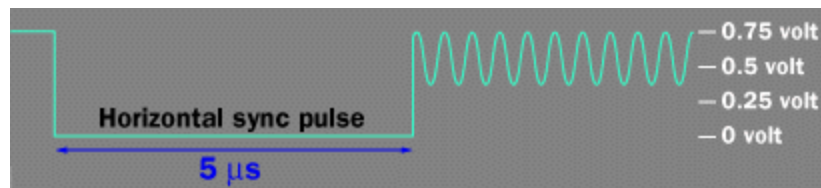
$$Y = 0.3 R + 0.59 G + 0.11 B$$

Chrominance – Color information (on 3.58 MHz carrier)

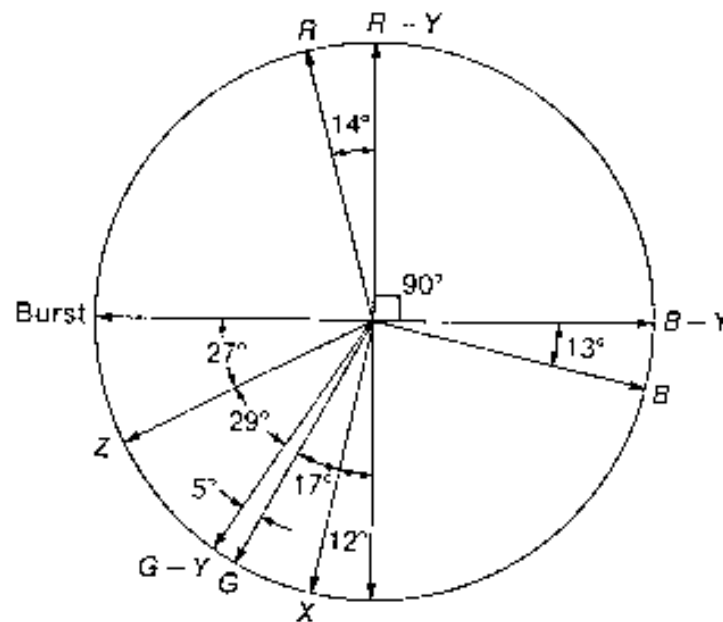
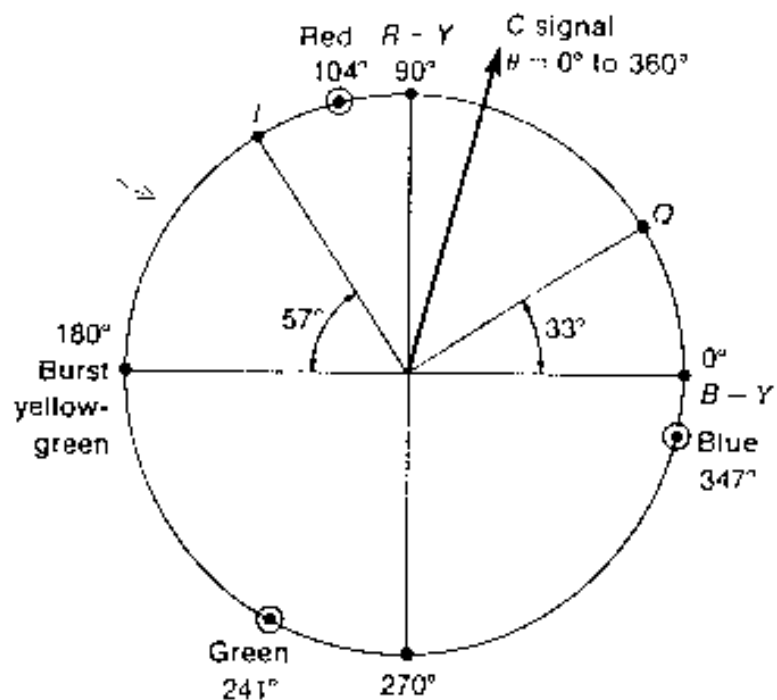
$$Q = 0.21 R + 0.52 G + 0.31 B$$

$$I = 0.6 R - 0.28 G - 0.32 B$$

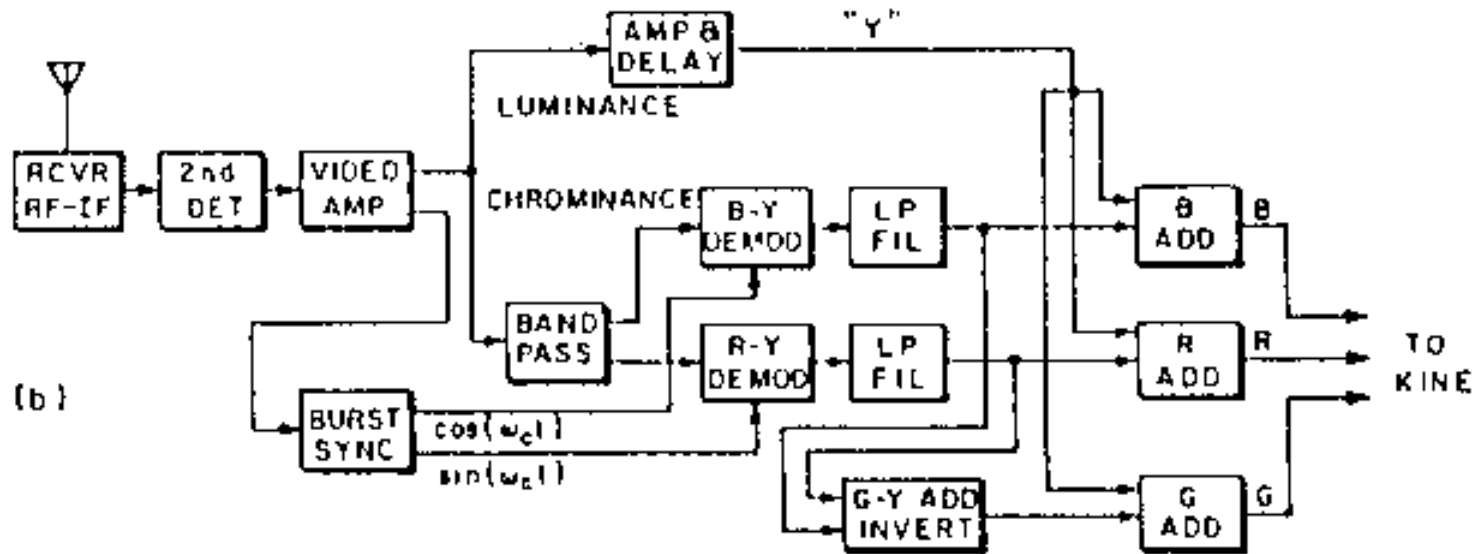
Color television - B&W compability



©2000 How Stuff Works



Receiver block diagram



Existing TV systems

PAL – Phase Alternation Line rate (Main Europe , inc. Finland)

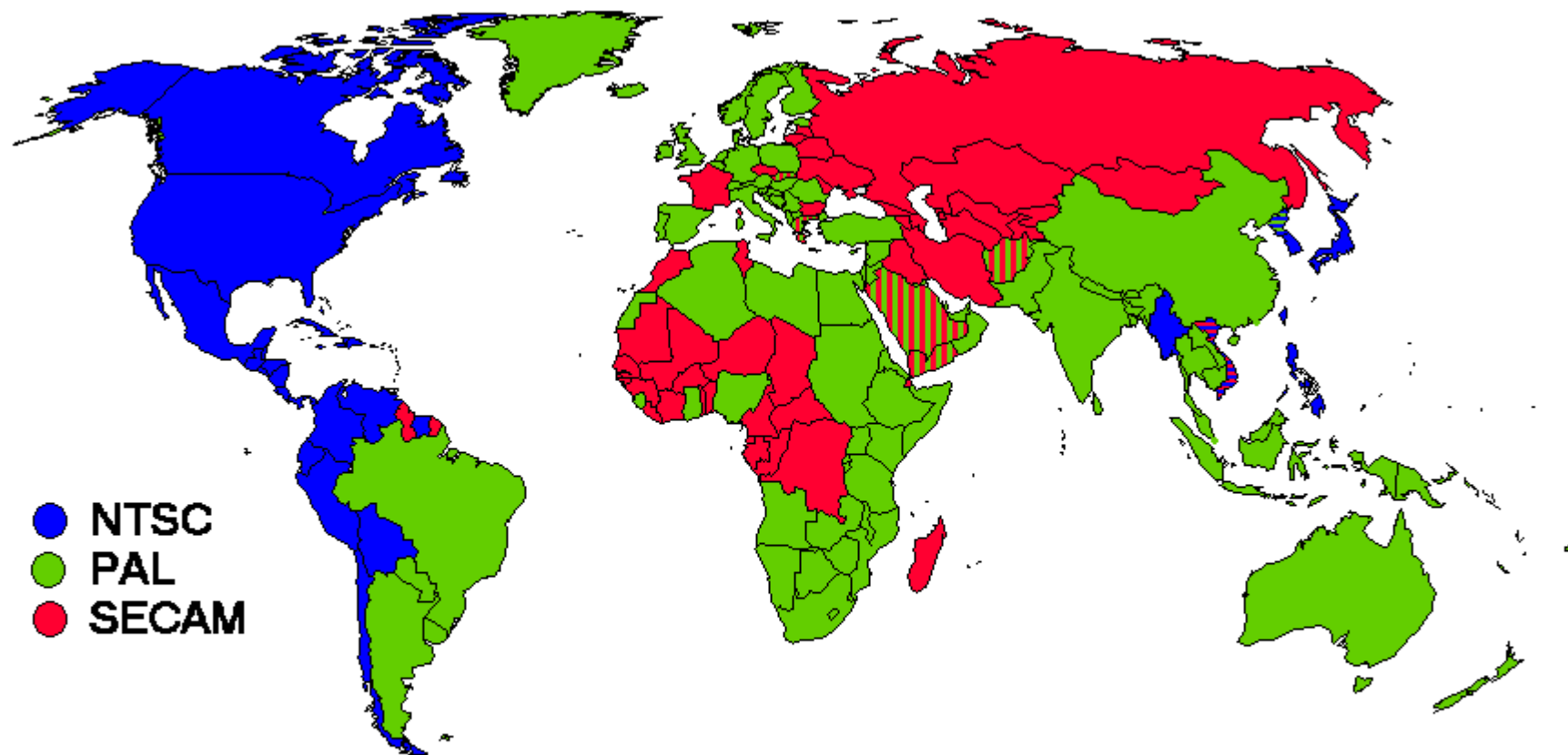
NTSC – National Television Systems Committee (USA & Canada)

SECAM – Sequential Couleur Avec Memoire (France, former Soviet)

	lines	active lines	vertical resolution	aspect ratio	horizontal resolution	frame rate
NTSC	525	484	242	4/3	427	29.94
PAL	625	575	290	4/3	425	25
SECAM	625	575	290	4/3	465	25

History: Analog TV standards in the world

(old information: Finland and Sweden has switched off the analog services)



Colour TV Systems of the World 2000

TV broadcasting

- Terrestrial
 - Roof top antenna
- Cable
 - Modulated on normal channels
- Satellite
 - Modulated on higher frequencies

Television history – IV generation – digital TV

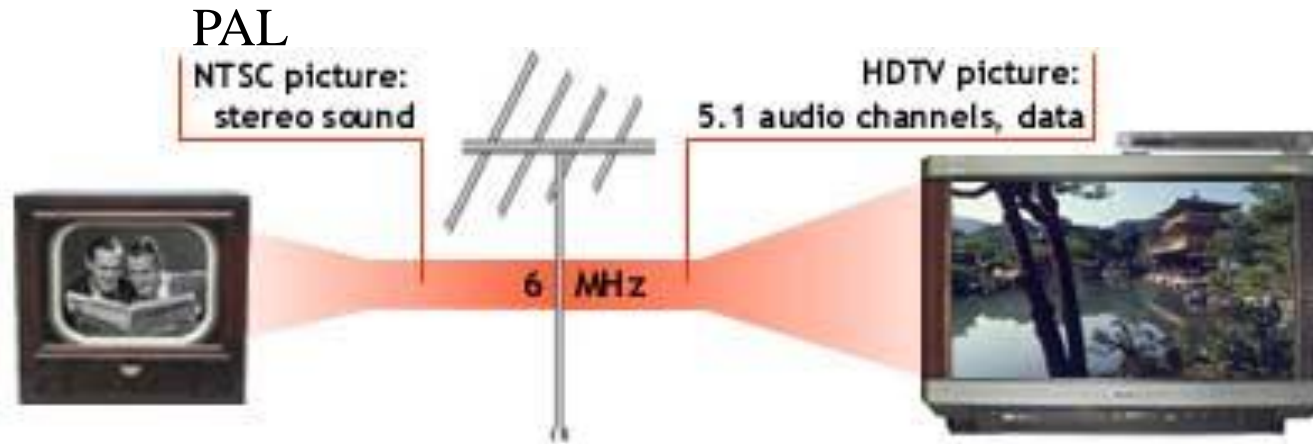
Broadcasting technology

1966 OFDM Patent (Chang)
1992 DVB organization founded
1994 DVB-C
1997 DVB-T
2004 DVB-H
2005 DVB-S2
2009 DVB-T2
2009 DVB-C2
2012 DVB-NGH

Content coding technology

1992 MPEG1 approved
1994 MPEG2 approved
1998 MPEG4/1 approved
1999 MPEG4/2 approved
2003 H.264/MPEG-4 AVC
2007 SVC Standard

DVB broadcasting – basic needs



Standard TV ~ 5Mbit / s

HDTV ~ 20 Mbit / s → Goal 7-8 Mbit/s using video coding

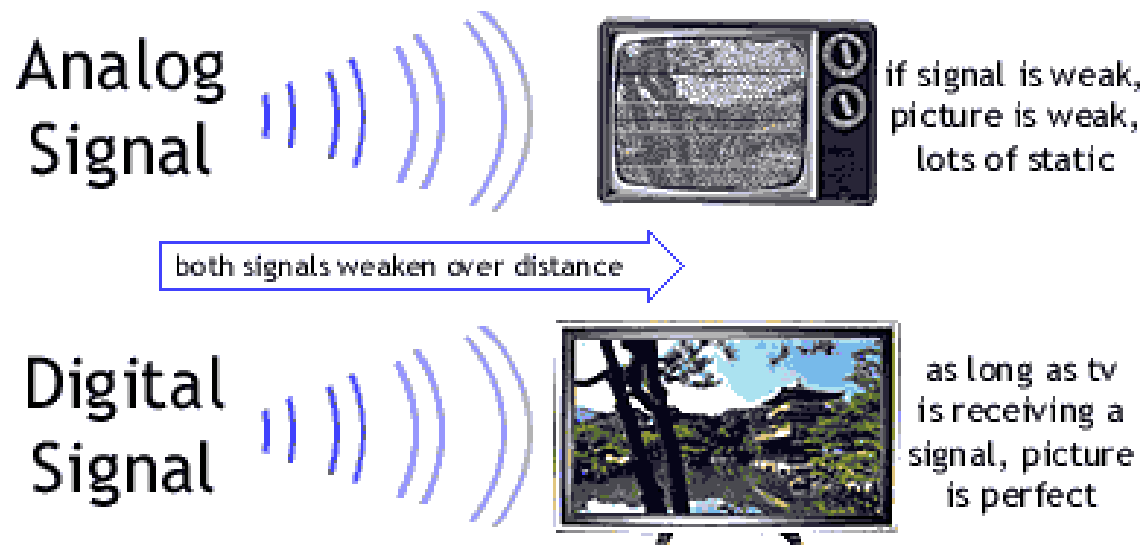
DVB-T2 4-5 HDTV channels at 7-8 Mbit/s

→ Further increased capacity

→ Advanced video/audio coding

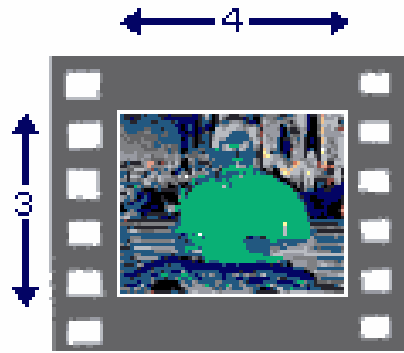
Uncompressed video rates

- Examples (CCIR [ITU-R] 601)
 - PAL signal: 864x625 resolution, YUV4:2:2
20bit/pixel colour, 25fps = 270Mbps
 - PAL signal: 864x625 resolution, YUV4:2:2
16bit/pixel, colour, 25fps = 216Mbps
 - PAL video: 720x576 resolution, YUV4:2:2
16bit/pixel, colour, 25fps = ~166Mbps
(~20MB/s, ~1GB/min)
 - HDTV signal 1920x1080, YUV4:2:2
16bit/pixel, 25 fps = ~830 Mbps
 - DV (Firewire): 400/800Mbps, USB2.0: 480Mbps,
USB3.0 5 Gbps





4 x 3 aspect ratio

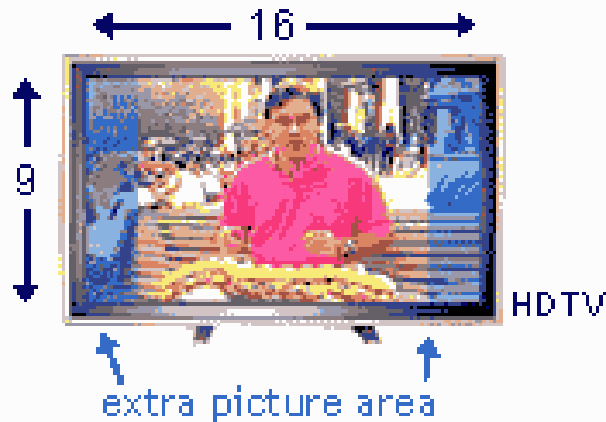


Kinescope film



NTSC standard

HDTV is 1/3 wider than NTSC

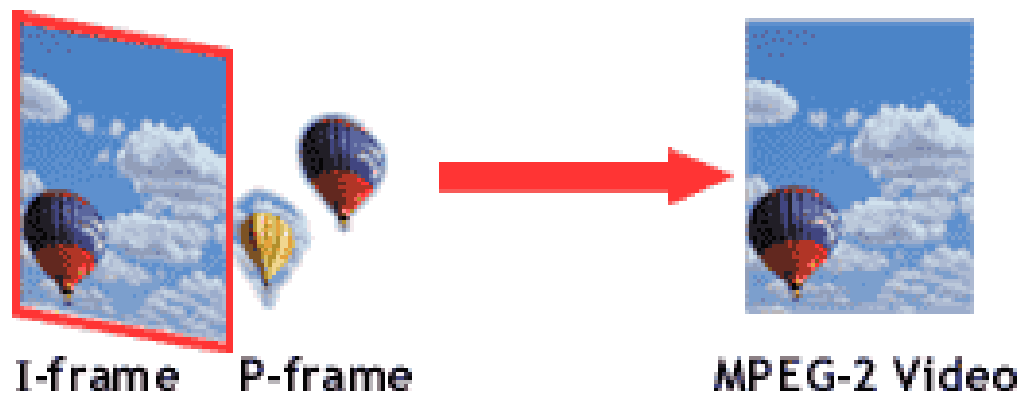


HDTV



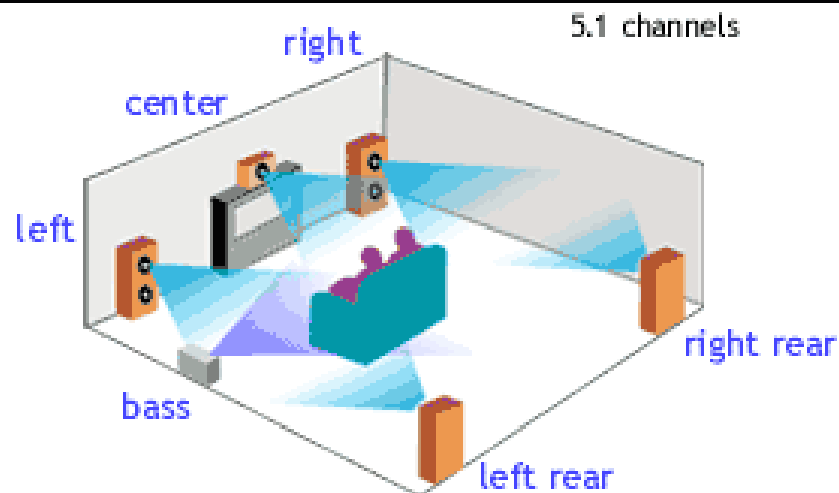
NTSC

MPEG 2 compression



Temporal, spatial compression

Dolby Digital/AC-3 Sound



Digital television requirements

- Bandwidth utilization
 - 4-5 PAL quality programs per "channel"
 - Need for new compression techniques
 - MPEG-2, MPEG-4,
 - Sound compression
 - Need for new modulation techniques
 - DVB-T: COFDM
- Standards
 - EBU, ETSI, DVB