Sistem Komunikasi 1

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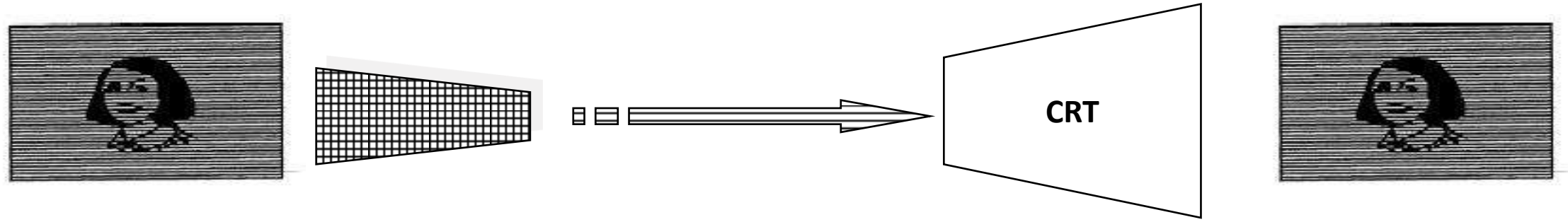
Bab 14
TV Analog & Digital

TELEVISI

- Penemuan tabung sinar katode (1897) menimbulkan gagasan untuk dimanfaatkan sebagai penyaji gambar, namun masih ada kendala teknologi.
- 1920 mulai banyak tersedia perangkat untuk eksperiman TV
- 2 Nov1936 Siaran TV pertama kali oleh BBC

Pembacaan & Penyajian Gambar

- Di Pemancar : gambar → sinyal listrik oleh kamera
- Di Penerima : sinyal listrik → gambar oleh tabung tv



Obyek Kamera Tabung gambar tampilan p:t = 4:3

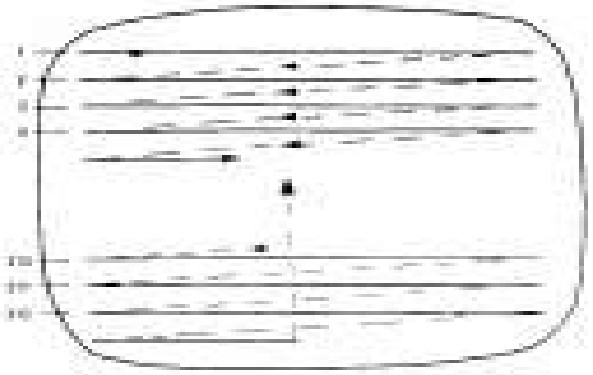
Wide screen = 16:9

Pembacaan &Penyajian Gambar

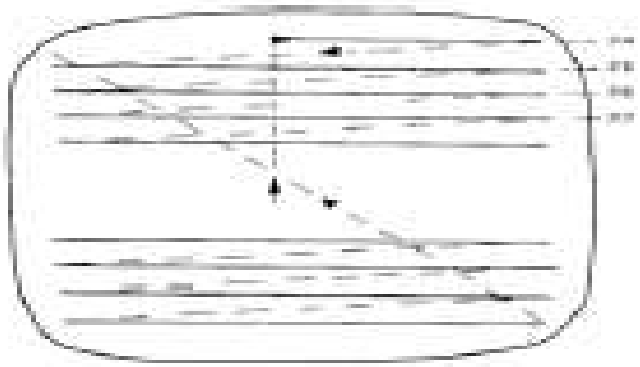
- Di pemancar, kamera membaca gambar obyek titik demi titik dr kiri ke kanan, dari atas ke bawah.
- Di penerima, tabung gambar menyajikan gambar titik demi titik dr kiri ke kanan, dr atas ke bawah sesuai urutan di pemancar.
- Tanggapan mata manusia terlambat 1/18 detik bagi ”menghilangnya” suatu gambar. Jika gambar ditampilkan > 18 kali/detik secara terputus-putus, akan terkesan gambar tsb tertayang secara kontinyu
- Di Eropa, Indonesia 25 frame/detik, di Amerika 30 frame/detik.
- Menembakkan berkas elektron secara beruntun ke layar kamera (di pemancar) atau ke tabung gambar (di penerima) ke arah titik obyek yg dituju (di pemancar) atau ke titik tempat akan ditampilkannya gambar di layar tv (di penerima).
- Di Indonesia, Eropa layar terbagi 625 garis, di Amerika 525 garis

Interlaced Scanning

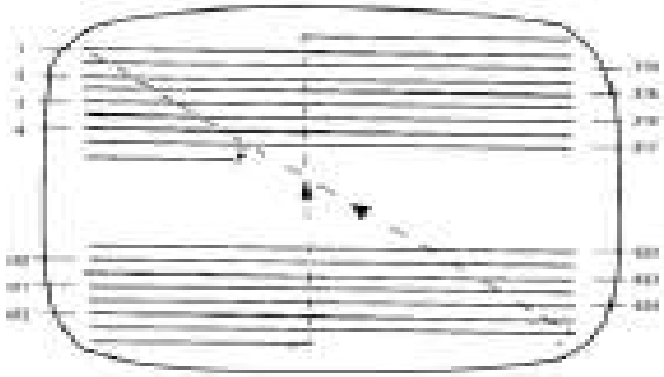
- Proses menembak-nembakkan elektron di kamera maupun di tabung TV ke titik-titik sesuai pola garis-garis shg menyapu seluruh permukaan kamera/layar disebut pemayaran (*Scanning*)



Garis-garis ganjil
m/2 garis



Garis-garis genap
m/2 garis



1 frame
m garis

- 1 frame dpt dibagi menjadi garis-garis bernomor ganjil dan garis-garis bernomor genap.
- Scanning paling sederhana = menampilkan garis-garis 1,2,3,...m dan mengulanginya n kali/detik
- Pemayaran bersisipan (*interlaced scanning*) = scanning diawali dg garis-garis ganjil 1,3,5,.., dan dilanjutkan dg garis-garis bernomor genap 2,4,6,..., Proses ini diulang-ulang n kali

Interlaced Scanning #2

- Interlaced scanning dapat memperhalus tampilan gambar obyek di layar karena obyek dengan n frame per/detik ditampilkan seolah olah 2n frame/detik. Jadi jika n = 25 frame/detik, maka gambar seolah-olah ditayangkan 50 frame/detik. (jauh diatas ambang mata manusia 18 frame/detik)

- Di Indonesia digunakan n = 625 garis/frame, dan n = 25 frame/detik

Pemadaman & Sinkronisasi

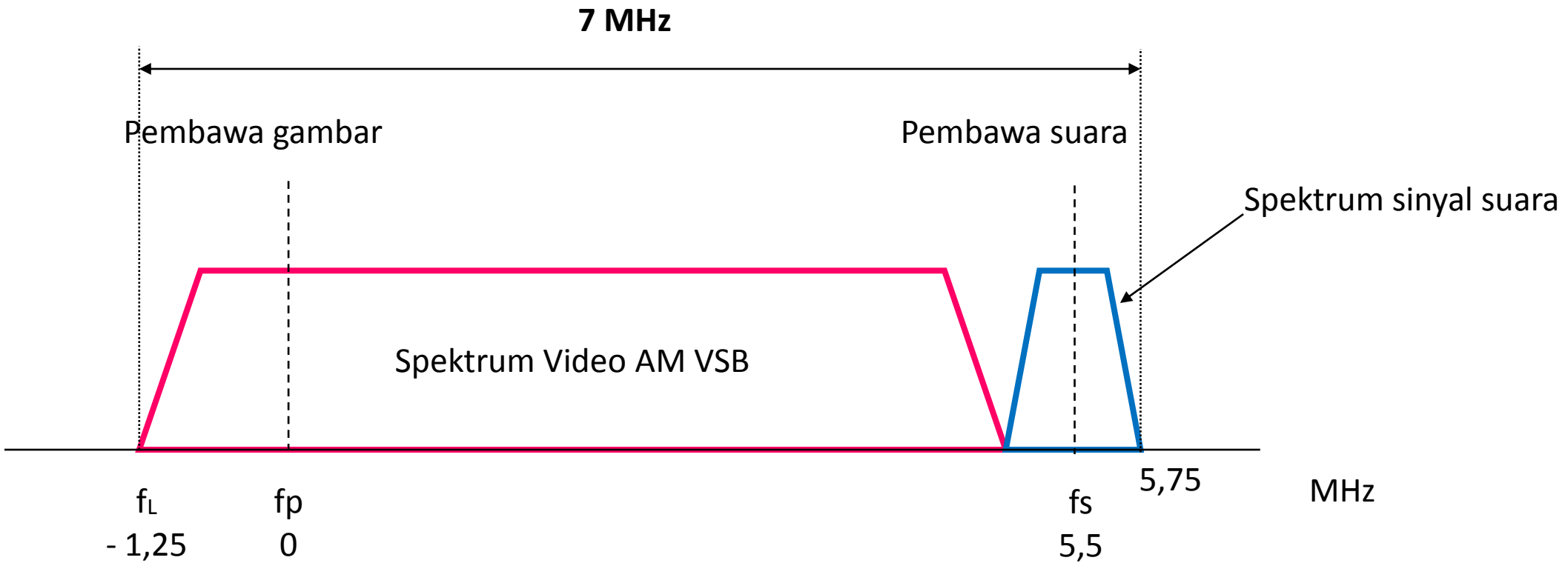
- Gerakan scanning elektron dr kiri ke kanan disebut *trace* horisontal.
- Setelah sampai di kanan, elektron hrs dikembalikan ke kiri → *retrace / fly-back* horisontal
- Gerakan dr atas ke bawah disebut *trace* vertikal
- Gerakan elektron kembali dr tepi bawah ke atas disebeut *retrace* vertikal
- Pd setiap langkah balik (horisontal/vertikal) berkas elektron tidak boleh membekas di layar shg hrs dilakukan pemadaman (*blanking*)
- Agar posisi gambar yg ditayangkan sesuai dgn obyek aslinya, maka gerakan elektron di pengirim dan pemancar hrs serempak/sinkron. → sinkronisasi
- *Retrace* hrs berlangsung sesingkat mungkin. Namun ***retrace* vertikal** membutuhkan waktu 20 garis. Maka 2 X 20 = 40 garis ”hilang” setiap frame. Jd jml grs tiap frame yg efektif dinikmati pemirsa sekitar 625 – 40 = 585 garis.

TV Hitam Putih (monochrome)

- sinyal listrik yg mewakili gambar disebut sinyal video, sedangkan sinyal audio mewakili suara.
- sinyal video dari kamera monochrome dinyatakan dengan gelap & terang dg aras kegelapan yg berbeda beda (*grey-level*).
- sinyal video yg menyatakan gelap-terang ini disebut **sinyal luminansi** (Y)
- sinyal video dilengkapi dg sinyal pemadaman (*blanking*) dan sinkronisasi yg menghasilkan **sinyal video komposit** (Y_{comp})
- sinyal video komposit memodulasi AM thd sinyal pembawa gambar (f_c)
- sinyal audio memodulasi FM thd sinyal pembawa suara (f_a)

Spektrum Dasar sinyal TV monochrome

- Spektrum bidang dasar (baseband) TV hitam putih mempunyai BW 7 MHz seperti yg digunakan di Indonesia & Sebagian besar Eropa.



Spektrum TV Monochrome

- sinyal gambar sudah menempati sekitar 5 MHz, berbeda dg sinyal audio HIFI yg bidang dasarnya hanya menempati sekitar 15 kHz. Jika utk sinyal gambar digunakan modulasi FM, bidang frekuensinya menjadi sangat lebar. Maka digunakan modulasi AM.
- Tidak menggunakan DSB krn juga akan boros frekuensi, sekitar 10 MHz.
- sinyal gambar mengandung frekuensi yg sangat mendekati nol. Maka jika memakai SSB, kesulitan akan muncul dlm hal membuat pemotongan yg tajam didekat frekuensi nol.
- Digunakan AM VSB (Vestigial Side Band), yaitu dengan memancarkan USB dan sedikit LSB-nya.
- Utk menghindari *cross-talk* dan agar suaranya *HiFI,* maka utk suara digunakan modulasi FM dengan BW yg cukup (0,5 MHz)

TV Berwarna

- TV Berwarna harus kompatibel dgn TV monochrome dlm arti siaran TV berwarna harus bisa ditangkap pada penerima hitam putih, dan sebaliknya TV berwarna hrs dapat menangkap siaran TV hitam-putih.
- NTSC (*National Television Systems Committee*), dipakai di Amerika, Jepang
- PAL (*Phase Alteration by Line*), mrpk pengembangan dr NTSC, digunakan di Eropa, Indonesia
- SECAM (Sequential Couleures a Memoire) dipakai di Perancis. Sangat berbeda dgn NTSC atau PAL.

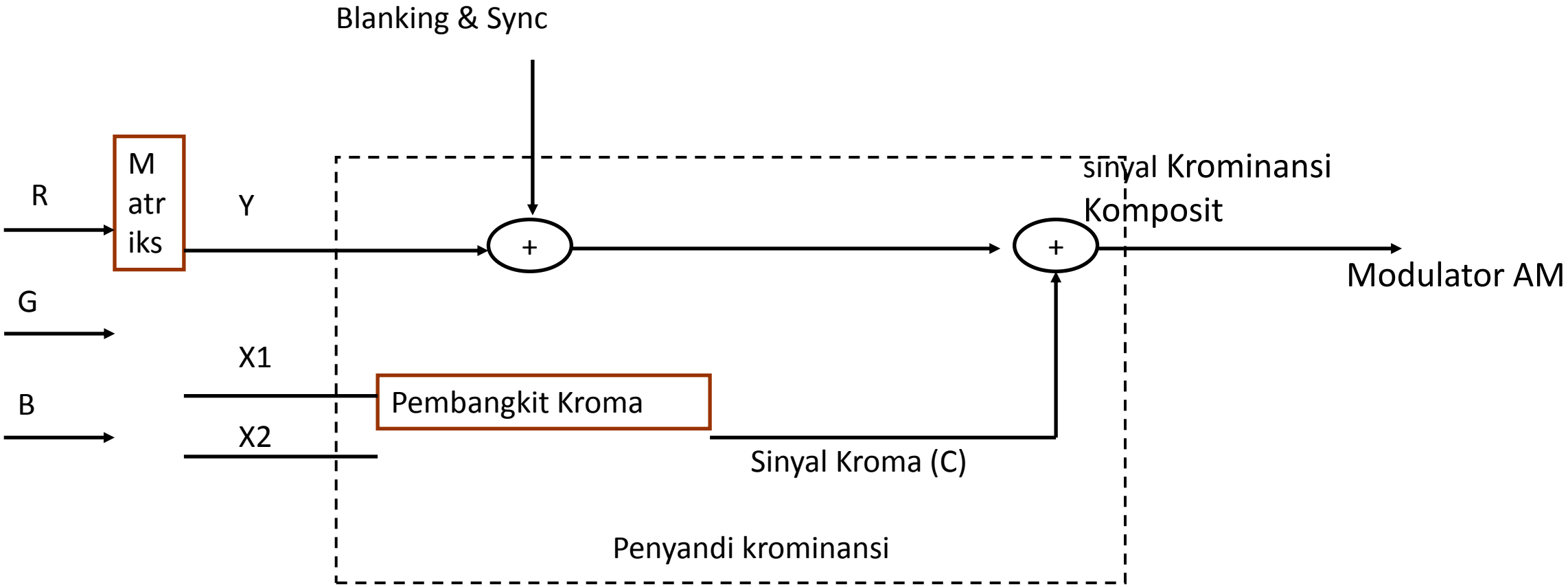
Analog Color television standards

	NTSC	PAL	SECAM
Lines/frame	525	625	625
Frames/s	30 (29.97)	25	25
Active lines	480-496	576-?	576-?
Horizontal sampling rate	858	864	864
pixels	640 × 480	768 × 576	768 × 576
color coding & sampling	YIQ 4:2:2	YUV 4:2:2	YDRDB 4:2:2

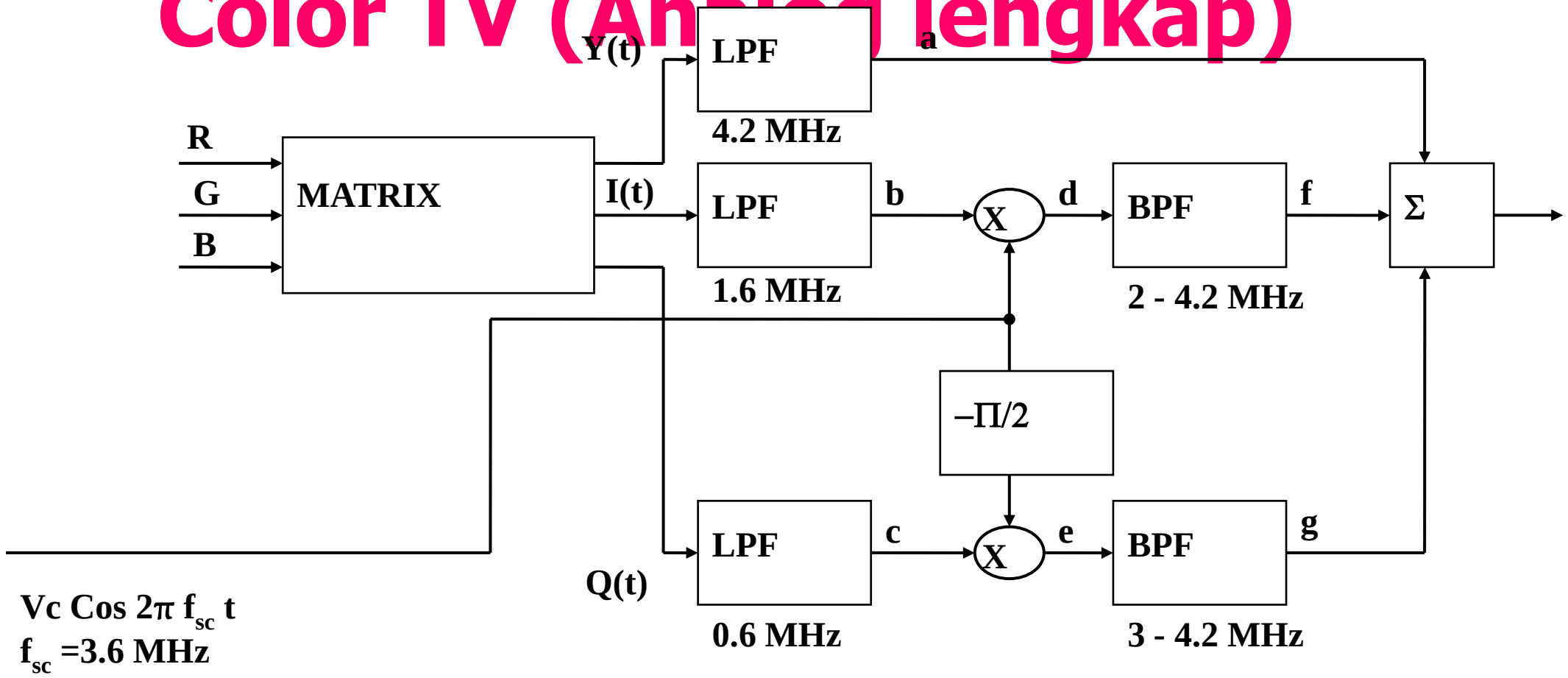
Other parameters of analog TV

- Aspect ratio – 4:3
- Interlace ratio – 2:1
- Lines are discreet, but each is drawn continuously
- NTSC frame rate was originally 30
  - Color caused interference with sound
  - frame rate changed by factor of 1000/1001

Color TV (Analog)



Color TV (Analog lengkap)



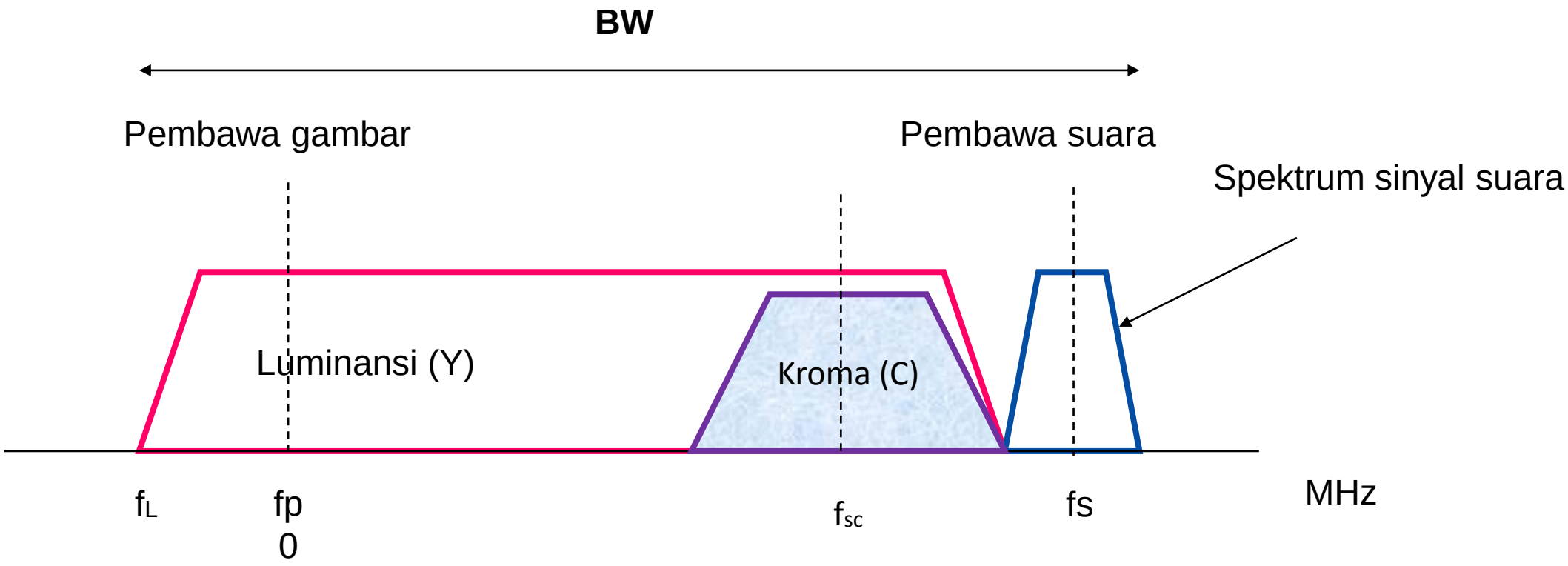
Persamaan Matrix:

Y(t)=0.3 R +0.59 G +0.11 B

I(t)=0.6 R -0.28 G -0.32 B

Q(t)=0.2 R -0.52 G +0.31 B

Spectrum of Color TV (analog)



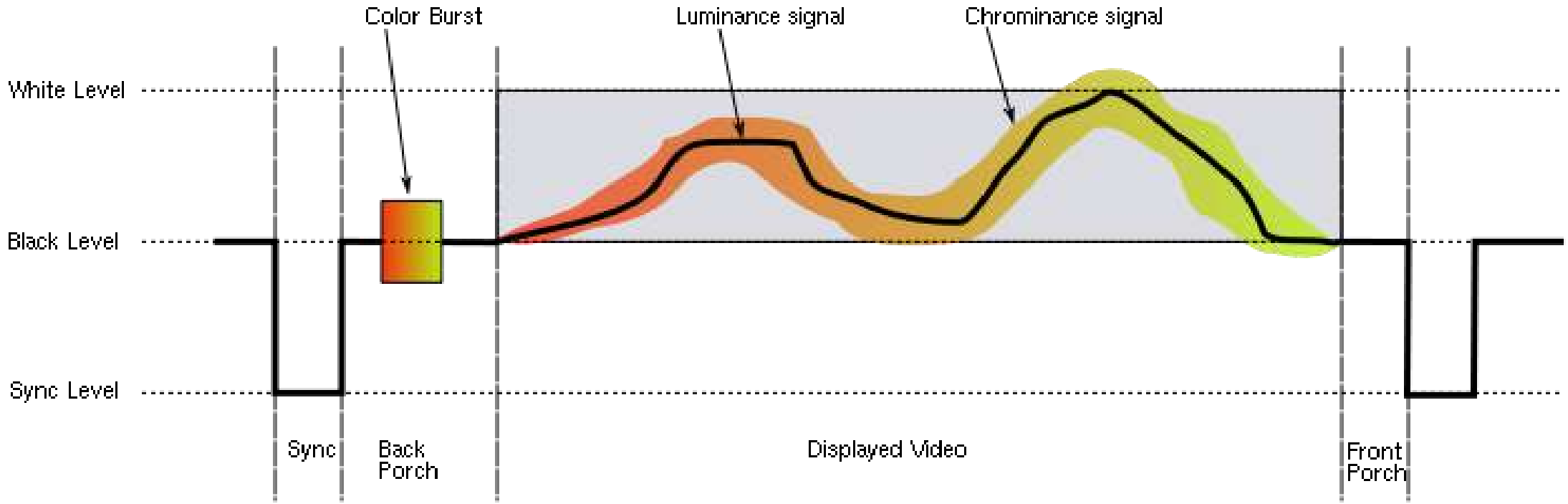
Color TV

	NTSC	PAL	SECAM
BW (MHz)	6	7	8
f_{sc} (MHz)	3,58	4,43	4,43
fs (MHz)	4,5	5,5	6
f_L (MHz)	- 1,25	- 1,25	- 1,75
Modulasi kroma	AM	AM	FM
Modulasi gambar	negatif	negatif	positif

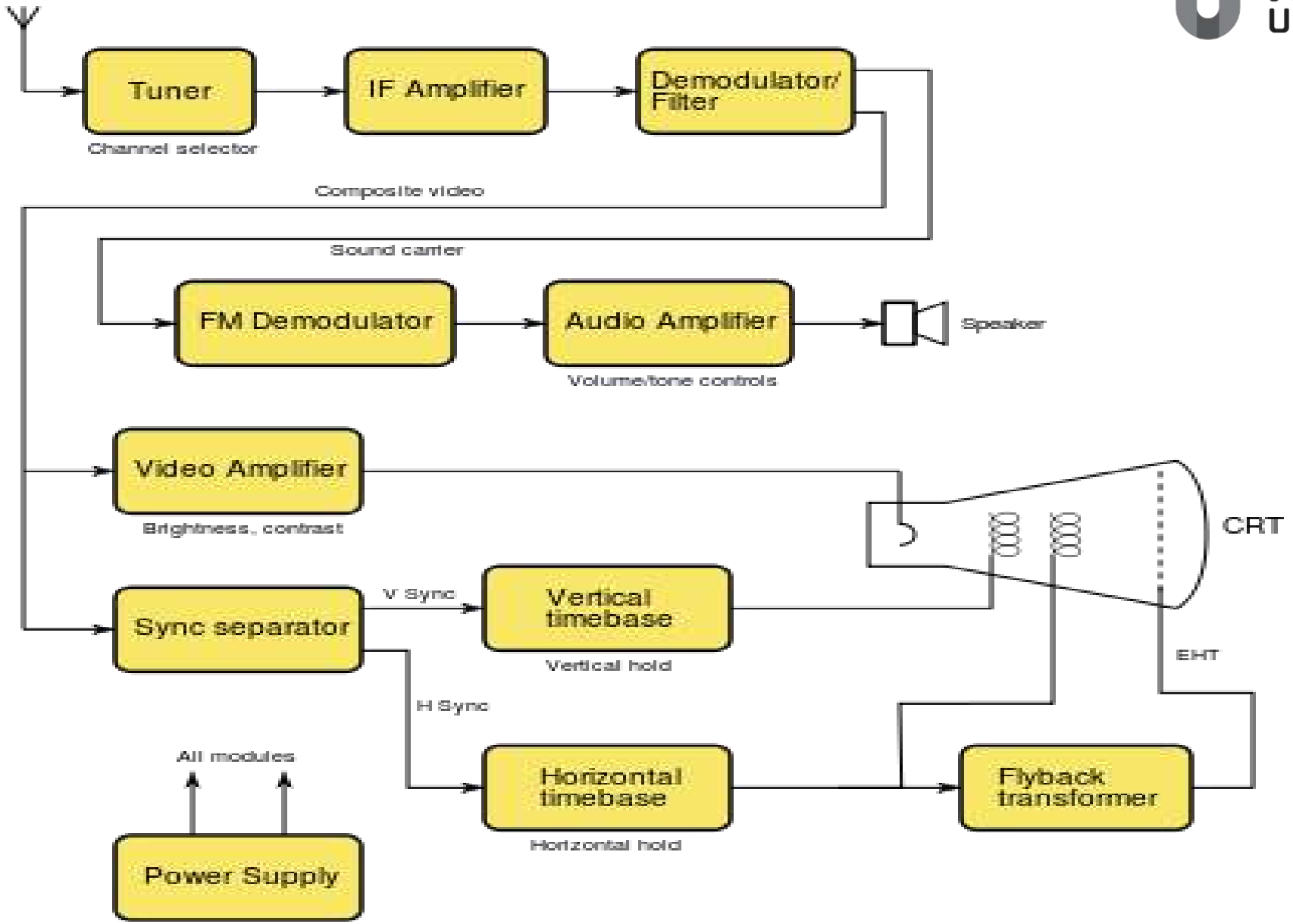
Analog color models & bandwidth

- NTSC
  - Y = 0.30 R + 0.59 G + 0.11 B
  - I = 0.60 R – 0.28 G – 0.32 B (1.3 MHz) (orange-blue axis)
  - Q = 0.21 R – 0.52 G + 0.31 B (0.45 MHz) (purple-green axis)
- PAL
  - U = 0.62 R – 0.52 G – 0.10 B (1.3 MHz)
    or U = 0.492 (B–Y)
  - V = –0.15 R – 0.29 G + 0.44 B (1.3 MHz)
    or V = 0.877 (R–Y)
- SECAM
  - DR = –1.33 R + 1.11 G + 0.22 B (1.3 MHz)
  - DB = -0.45 R – 0.88 G + 1.33 B (1.3 MHz)

Video Signal



TV Receiver


Tuner
Channel selector
IF Amplifier
Demodulator/ Filter
Composite video
Sound carrier
FM Demodulator
Audio Amplifier
Speaker
Volume/tone controls
Video Amplifier
Brightness, contrast
CRT
Sync separator
V Sync
Vertical timebase
Vertical hold
EHT
H Sync
All modules
Horizontal timebase
Horizontal hold
Flyback transformer
Power Supply

Digital television standards

- CCIR 601: conventional TV
  - 720×480 (NTSC) or 720×576 (PAL/SECAM)
  - pixels are not square
  - 4:2:2 color sampling
  - YCrCb color
    - Cr = ((B–Y)/2) + 0.5
    - Cb = ((R-Y)/1.6) + 0.5

Digital television standards (2)

- DV (based on CCIR 601)
  - 4:1:1 chrominance subsampling
- high-quality DVPRO & Digital-S
  - 4:2:2 chrominance subsampling
- MPEG-2 (DVD, HDTV)
  - 4:2:0 subsampling (1 pixel per 2x2 square)
- H.261
  - 4:2:0 and small format (CIF, 352x288)

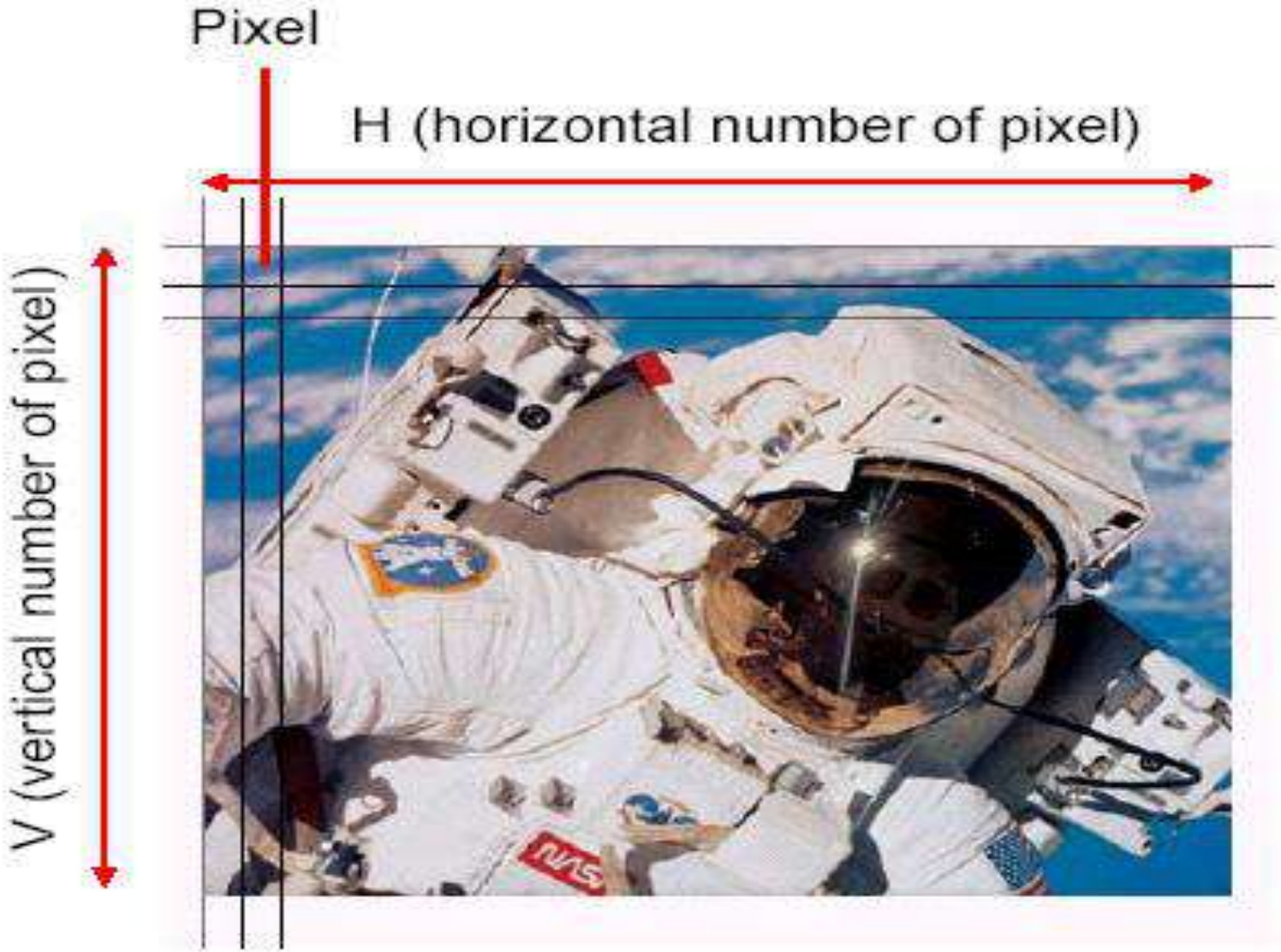
Video bandwidth

Quality	Uncompressed Mbps	Compression standard	Compressed Mbps
HDTV (60 fps, 1920x1080)	2000	MPEG-2	25–34
Studio-quality	166 (~16 bit/pixel)	MPEG-2	3–6
Broadcast		MPEG-2	2–4
VHS quality		MPEG-1	1.2
Video conferencing		H.261	0.1

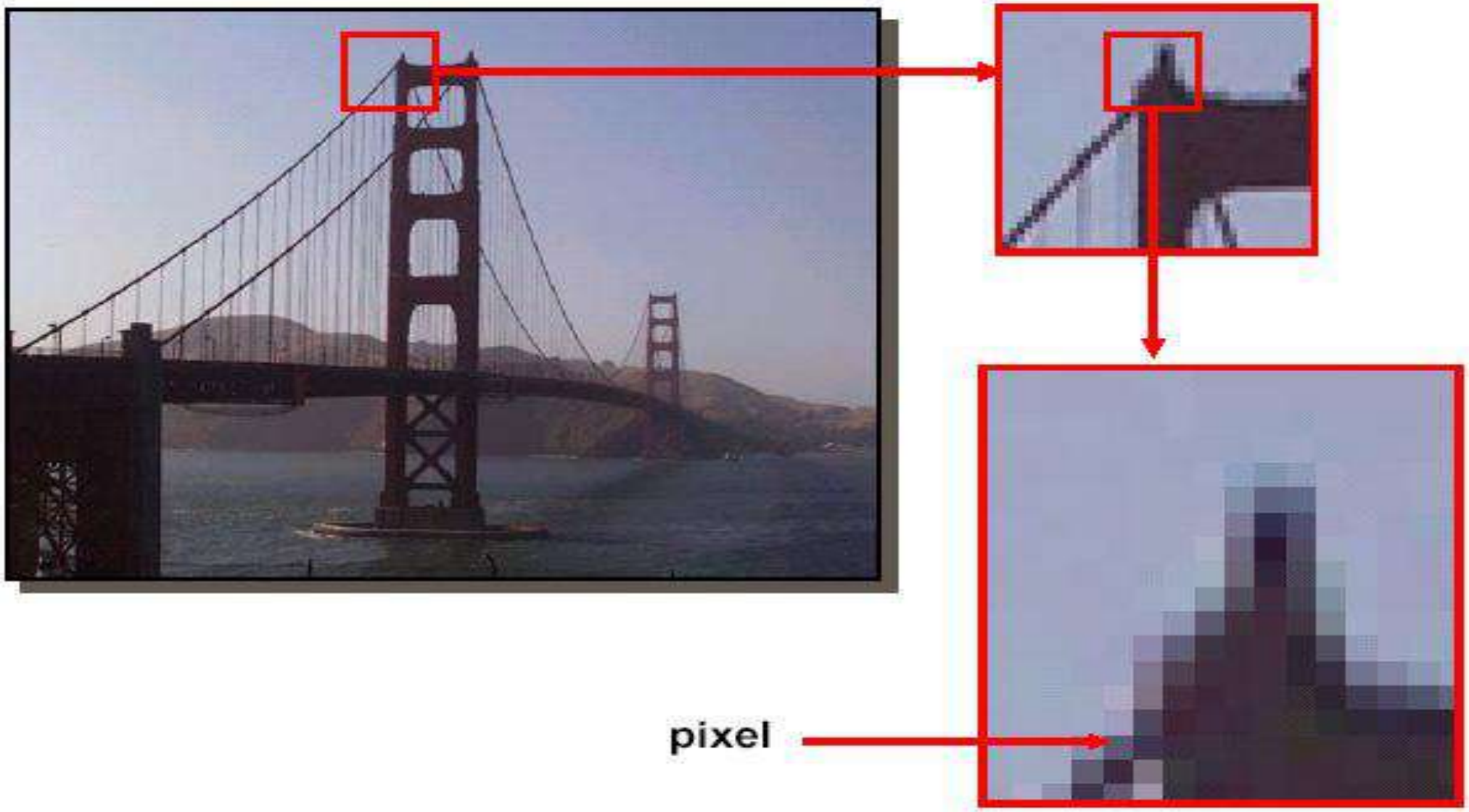
Informasi Gambar

Citra (*Image*)

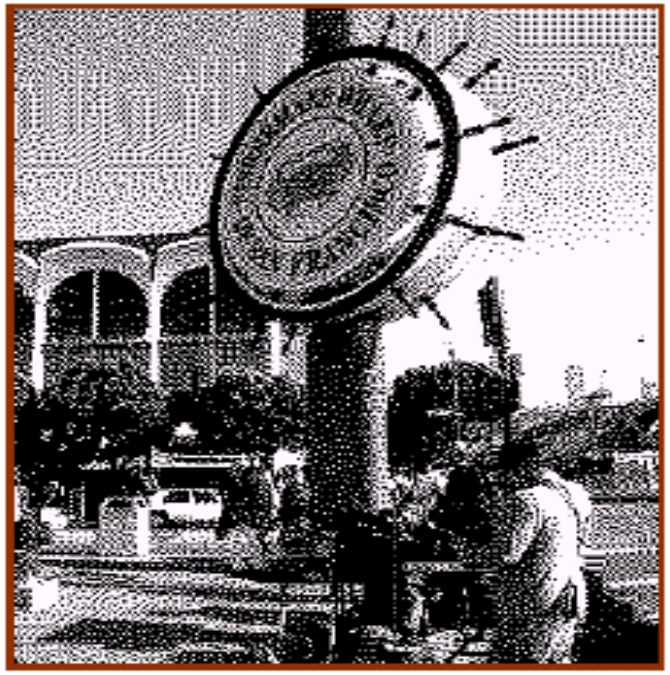
- Image adalah **kumpulan titik-titik (pixel)**
- 1 pixel diwakili oleh bit-bit, semakin banyak bit yang mewakili 1 pixel → semakin bagus image-nya
- Total jumlah pixel dalam satu image = H x V



Informasi Gambar



Informasi Gambar



1 pixel diwakili oleh ….

- **1 bit (black and white)**
- **1 byte (gray scale)**
- **1 byte (256 color)**
- **2 byte (64k color)**
- **3 byte (16M color)**
- **4 byte ….dst**

Semakin banyak bit yg mewakili warna gambar → kualitas gambar semakin baik

Informasi Video

NTSC = 30 fps, PAL = 25 fps

frame

10 minutes NTSC video
consist of 10 x 60 x 30 = 18.000 frames

Video → Example :

- Supaya tidak patah-patah, terdapat konvensi : fps ≥ 25 fps (fps = frame per-second)
- NTSC = 30 fps ; PAL = 25 fps
- **Contoh :**

  Berapa kapasitas dari suatu video 10 menit !

  - PAL ; (353 x 288 pixel) x (3 byte per-pixel) x (25 fps x 10 menit x 60 detik per-menit) **=** ….
  - NTSC ; (352 x 240 pixel) x (3 byte per-pixel) x (30 fps x 10 menit x 60 detik per-menit) ≈ **4,5 GB ! (tanpa kompresi)**

2 jam NTSC VCD → kalikan sendiri !

Digital Television (DTV)

- **Digital television** (**DTV**) is the transmission of audio and video by digitally processed and multiplexed signal, in contrast to the totally analog and channel separated signals used by analog television.
- Digital TV can support more than one program in the same channel bandwidth.
- It is an innovative service that represents the first significant evolution in television technology since color television in the 1950s.
- Several regions of the world are in different stages of adaptation and are implementing different broadcasting standards.

DVB Standards

- Digital Video Broadcasting (DVB) uses coded orthogonal frequency-division multiplexing (OFDM) modulation and supports hierarchical transmission. This standard has been adopted in Europe, Australia and New Zealand.
- Advanced Television System Committee (ATSC) uses eight-level vestigial sideband (8VSB) for terrestrial broadcasting. This standard has been adopted by six countries, United States, Canada, Mexico, South Korea, Dominican Republic and Honduras.
- Integrated Services Digital Broadcasting (ISDB) is a system designed to provide good reception to fix receivers and also portable or mobile receivers. It supports hierarchical transmission of up to three layers and uses MPEG-2 video and Advanced Audio Coding. This standard has been adopted in Japan and the Philippines. ISDB-T International is an adaptation of this standard using H.264/MPEG-4 AVC that been adopted in most of South America and is also being embraced by Portuguese-speaking African countries.

DVB Standards

- Digital Terrestrial Multimedia Broadcasting (DTMB) adopts time-domain synchronous (TDS) OFDM technology with a pseudo-random signal frame to serve as the guard interval (GI) of the OFDM block and the training symbol. The DTMB standard has been adopted in the People's Republic of China, including Hong Kong and Macau.[3]
- Digital Multimedia Broadcasting (DMB) is a digital radio transmission technology developed in South Korea[4][5][6] as part of the national IT project for sending multimedia such as TV, radio and datacasting to mobile devices such as mobile phones, laptops and GPS navigation systems.

DVB-T2

- DVB-T2 adalah singkatan dari " Digital Video Broadcasting - Generasi Kedua Terestrial "; itu adalah pengembangan dari standar televisi DVB-T , yang dikeluarkan oleh konsorsium DVB , yang dirancang untuk transmisi siaran televisi terestrial digital . DVB telah distandarisasi oleh ETSI .

- Sistem ini mentransmisikan audio digital terkompresi, video, dan data lainnya dalam "pipa lapisan fisik" (PLP), menggunakan modulasi OFDM dengan pengkodean dan interleaving saluran yang digabungkan. Bit rate yang ditawarkan lebih tinggi, dibandingkan dengan DVB-T, menjadikannya sistem yang cocok untuk membawa sinyal HDTV pada saluran TV terestrial.

	DVB-T	DVB-T2
Antarmuka Input	Aliran Transportasi Tunggal (TS)	Multiple Transport Stream dan GSE
Mode	Coding & Modulasi Konstan	Pengodean & Modulasi Variabel [21]
Koreksi Kesalahan Maju (FEC)	Conv Code+ Reed Solomon 1/2, 2/3, 3/4, 5/6, 7/8	LDPC + BCH 1/2, **3/5** , 2/3, 3/4, **4/5** , 5/6, 6/7, 8/9
Modulasi	OFDM	OFDM
Skema Modulasi	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, **256QAM**
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, **19/128** , 1/8, **19/256** , 1/16, 1/32, **1/128**
Ukuran (DFT)	2k, 8k	**1k** , 2k, **4k** , 8k, **16k** , **32k**
Pilot	8% dari total	**1%** , **2%** , **4%** , 8% dari total

DTV Format

- LDTV
- SDTV
- HDTV
- UHDTV

LDTV

- **Low-definition television** (**LDTV**) refers to television systems that have a lower screen resolution than standard-definition television systems. The term is usually used in reference to digital television, in particular when broadcasting at the same (or similar) resolution as low-definition analog TV systems. Mobile DTV systems usually transmit in low definition, as do all slow-scan TV systems.

Standard	Class	Resolution	Aspect Ratio	Notes
MMS-Small	96p	128×96	4:3	Lowest size recommended for use with 3GPP video transmitted by MMS to/from cellular phones, matching resolution of smallest generally-used color cellphone screen.
QQVGA	120p	160×120	4:3	Used with some webcams and early colour-screen cellular phones, commonly used in early desktop computer and online video applications. Lowest commonly-used video resolution.
QCIF Webcam	144p	176×144	11:9	Approximately one-sixth analogue PAL resolution (one-half horizontal, one-third vertical). Also the size recommended for "medium" quality MMS videos.
YouTube 144p	144p	256×144	16:9	Also halves replay framerate respective to higher resolution options.
NTSC square pixel	240p	320×240	4:3	Comparable to "low resolution" output of many popular home computers and games consoles, including VGA "Mode X". Used in some webcams and for video recordings in early/budget digital cameras and cameraphones, and low-end smartphone screens. Original YouTube resolution. Maximum recommended size for "large" MMS videos.

Standard	Class	Resolution	Aspect Ratio	Notes
SIF (525)	240p	352×240	4:3	NTSC-standard VCD / super-long-play DVD. Narrow/tall pixels.
NTSC widescreen	240p	426×240	16:9	Same as current YouTube "240p" mode; screen resolution of some budget portable DVD players. Roughly one-third full NTSC resolution (half vertical, two thirds horizontal).
CIF, SIF (625)	288p	352×288	4:3	PAL-standard VCD / super-long-play DVD. Wide/short pixels. Also a common webcam / video conferencing resolution and
PSP	288p	480×272	30:17	Notionally 16:9 with slight left/right edge cropping. Used in many portable DVD player screens and other small-format devices besides.
360p	360p	480×360	4:3	Uncommon, used in some lower-mid-market smartphone screens and as an intermediate screen resolution for some 1990s PC-format videogames.
Wide 360p	360p	640×360	16:9	Current YouTube "360p" resolution, and typically used as base "SD" standard .services due to subjective similarity (and similar pixel counts) to a mid-grade free-to-air broadcast picture. Historically used as an ad-hoc standard for intermediate-quality / CDR-sized MPG4 conversions on P2P file sharing networks. Effectively the resolution offered by any higher-definition 16:9 video being displayed on a standard 640×480 ("VGA") computer screen, the lowest (and least computationally demanding) resolution generally supported by mainstream desktop operating systems. Offers 75% of the pixel count of a true anamorphic NTSC DVD image, or 89% of a letterboxed 16:9 image.

SDTV

- Standard definition TV (SDTV), by comparison, may use one of several different formats taking the form of various aspect ratios depending on the technology used in the country of broadcast. For 4:3 aspect-ratio broadcasts, the 640 × 480 format is used in NTSC countries, while 720 × 576 is used in PAL countries. For 16:9 broadcasts, the 720 × 480 format is used in NTSC countries, while 720 × 576 is used in PAL countries. However, broadcasters may choose to reduce these resolutions to reduce bit rate (e.g., many DVB-T channels in the United Kingdom use a horizontal resolution of 544 or 704 pixels per line).[8]

HDTV

- One of several different HDTV formats that can be transmitted over DTV is: 1280 × 720 pixels in progressive scan mode (abbreviated *720p*) or 1920 × 1080 pixels in interlaced video mode (*1080i*). Each of these uses a 16:9 aspect ratio. (Some televisions are capable of receiving an HD resolution of 1920 × 1080 at a 60 Hz progressive scan frame rate — known as 1080p.) HDTV cannot be transmitted over analog television channels because of channel capacity issues.

UHDTV

- **Ultra HD** (also known as "Ultra High Definition" / "Super Hi-Vision" / "Ultra HDTV" / "UHD" / "UHDTV" / "4K" / "8K"), is a video format conceptualized by the Japanese public broadcasting network, NHK.
- On October 17, 2012, The Consumer Electronics Association (CEA) announced that the official term "Ultra HD" would be used for any display with a 16 x 9 ratio with at least 1 digital input cable carrying a minimum resolution of 3,840 x 2,160 square pixels.

UHDTV

- **ITU Recommendation for Ultra HDTV**
- ITU-R Recommendation BT.2020 (also known as "Rec. 2020") was posted on the International Telecommunication Union (ITU) website on August 23, 2012. Rec. 2020 defines various aspects of ultra high definition television such as display resolution, frame rate, chroma subsampling, color depth, and color space.
- **Ultra HDTV Resolution**

  Currently there are 2 forms of Ultra HD, 4K and 8K, both have an aspect ratio of 16:9:
  - **4K Ultra HD** (2160p) has a resolution of 3840 × 2160 (8.3 megapixels), which is roughly equivalent to 4K cinema or 4 times the number of pixels in Full HD format (1080p).
  - **8K Ultra HD** (4320p) produces an astonishing 7,680 × 4,320 pixel resolution (33.2 megapixels), which is roughly the equivalent of an IMAX film or 16 times the pixel resolution of Full HD (1080p).
- **Ultra HD Frame rate**

  Rec. 2020 allows for Ultra HDTV frame rates of 120p, 60p, 59.94p, 50p, 30p, 29.97p, 25p, 24p, and 23.976p. Only progressive frame rates are allowed.

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End of Module 14