

CSc 461/561

Multimedia Systems

Video Representation

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Video is a sequence of images

- Recorded/displayed at a certain rate
- Types of video signals
 - component video
 - separate RGB signals; e.g., VGA CRT
 - composite video
 - luminance and chrominance in one signal carrier
 - S-video
 - 1 luminance and 1 composite chrominance signal



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Video

- Image
 - picture resolution: e.g., 640x480
 - pixel depth: e.g., 8-bit
- Video
 - frame rate > flicker-free rate
 - movie: 24 frames/second
 - TV: 25 or 30 frames/second
 - VGA CRT: e.g., 50Hz

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We see most video on

- Television
 - PAL (Phase Alternating Line)
 - 625 lines interlaced (576 visible)
 - 25 frames/second
 - aspect ratio 4:3
 - YUV
 - NTSC (National TV Standards Committee)
 - 525 lines interlaced (480 visible)
 - 30 frames/second (29.97 to be exact), 4:3, YIQ

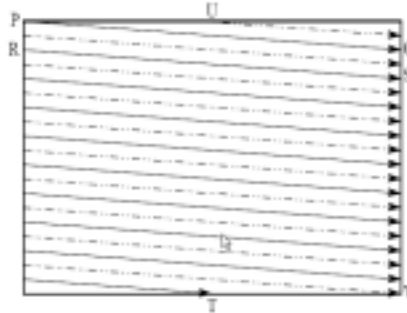
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Interlaced vs progressive

- Interlaced
 - odd line: P => Q
 - Q => R (H retrace)
 - R => S
 - ...
 - T => U (V retrace)
 - even line: dash-dot
- Progressive



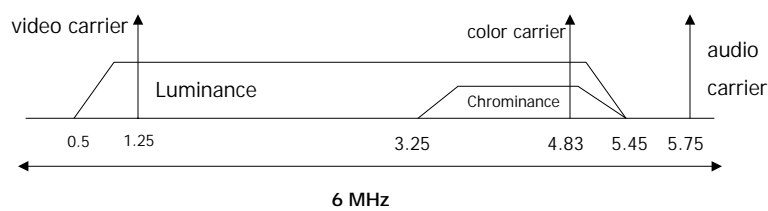
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TV broadcasting

- NTSC (6MHz channel)
 - lower band: guard; upper band: audio (FM)
 - Y: 4.2MHz
 - I: 1.6MHz; Q: 0.6MHz



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Digital video

Standards for Video

	HDTV	CCIR 601 NTSC	CCIR 601 PAL	CIF	QCIF
Luminance Resolution	1920 x 1080	720 x 486	720 x 576	352 x 288	176 x 144
Chrominance Resolution	960 x 540	360 x 486	360 x 576	176 x 144	88 x 72
Color Subsampling	4:2:2	4:2:2	4:2:2	4:2:0	4:2:0
Fields/sec	60	60	50	30	30
Aspect Ratio	16:9	4:3	4:3	4:3	4:3
Interlacing	Yes	Yes	Yes	No	No

CCIR – Consultative Committee for International Radio
 CIF – Common Intermediate Format (approximately VHS quality)

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Chroma subsampling

- 4:4:4: no subsampling
- 4:2:2, 4:1:1: chroma as 1/2 or 1/4 luma
- 4:2:0: vertical subsampling as well



4:2:2



4:1:1



4:2:0

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Chroma subsampling examples

- Common Intermediate Format (CIF)
 - 4:2:0
 - Y: 352 x 288; U and V: 176 x 144
- Quarter CIF (QCIF): 176x144; 4:2:0



Y: 176 x 144



U: 88 x 72



V: 88 x 72

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HDTV

- High Definition TV: better video/audio

# of Active Pixels per line	# of Active Lines	Aspect Ratio	Picture Rate
1,920	1,080	16:9	60I 30P 24P
1,280	720	16:9	60P 30P 24P
704	480	16:9 & 4:3	60I 60P 30P 24P
640	480	4:3	60I 60P 30P 24P

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TV resolution evolution

- **LDTV: low definition**
 - 240i60, 288i50
- **SDTV: standard definition**
 - 480i60, 480p30, 576i50, 576p25
- **EDTV: enhanced definition**
 - 480p60, 576p50, 720i50/60, 720p24/25/30
- **HDTV: high definition**
 - 720p50/60, 1080p24/25/30, 1080i50, 1080i60

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This lecture

- **Video representation**
 - type of video signals
 - picture resolution and frame rate
 - analog & digital & HD video
 - interlaced vs progressive
 - chroma subsampling

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Next lecture

- **Multimedia manipulation**
 - lossless compression [Ref: Li&Drew Chap 7]
 - compressibility [7.2]
 - Hoffman coding [7.4.2]
 - LZW compression [7.5]