N94- 27362

VENI, VIDEO, VICI: THE MERGING OF COMPUTER AND VIDEO TECHNOLOGIES

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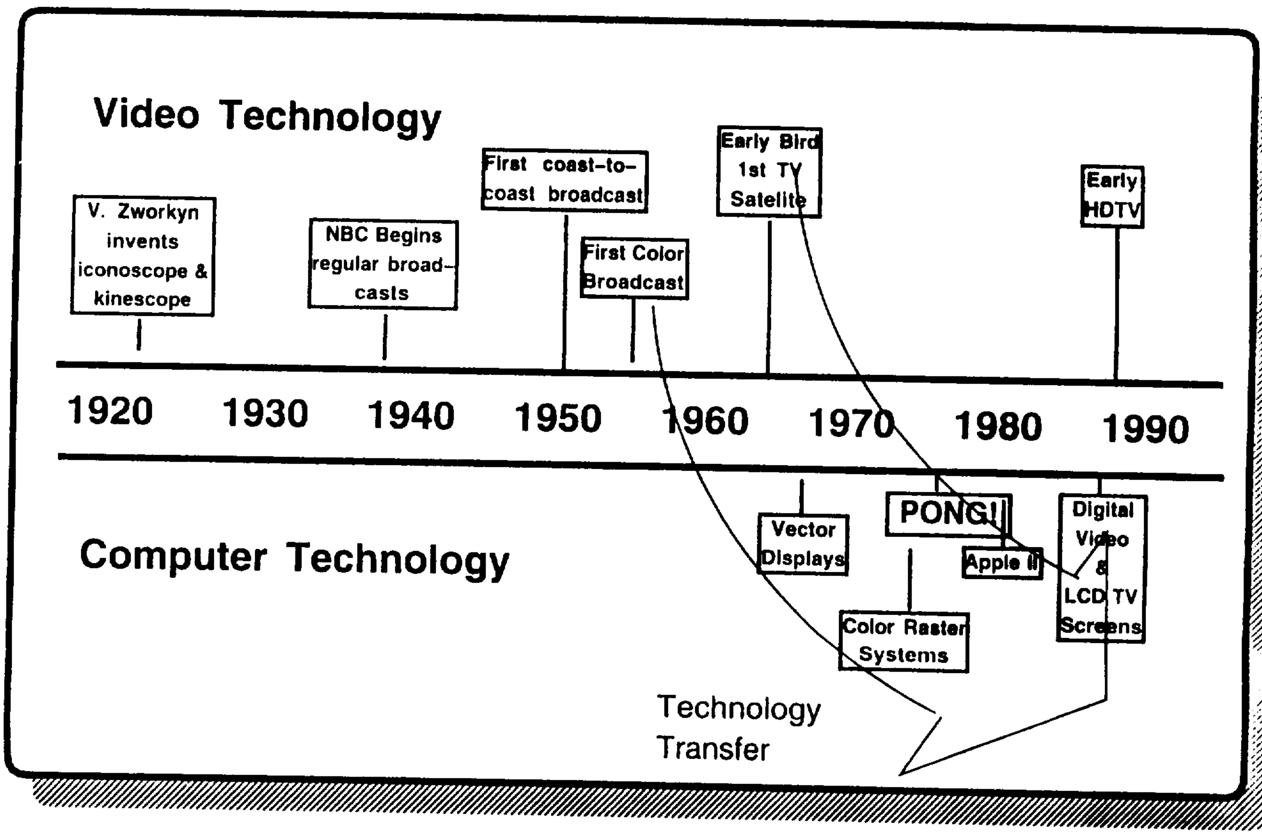
Pre- HDTV Milestones



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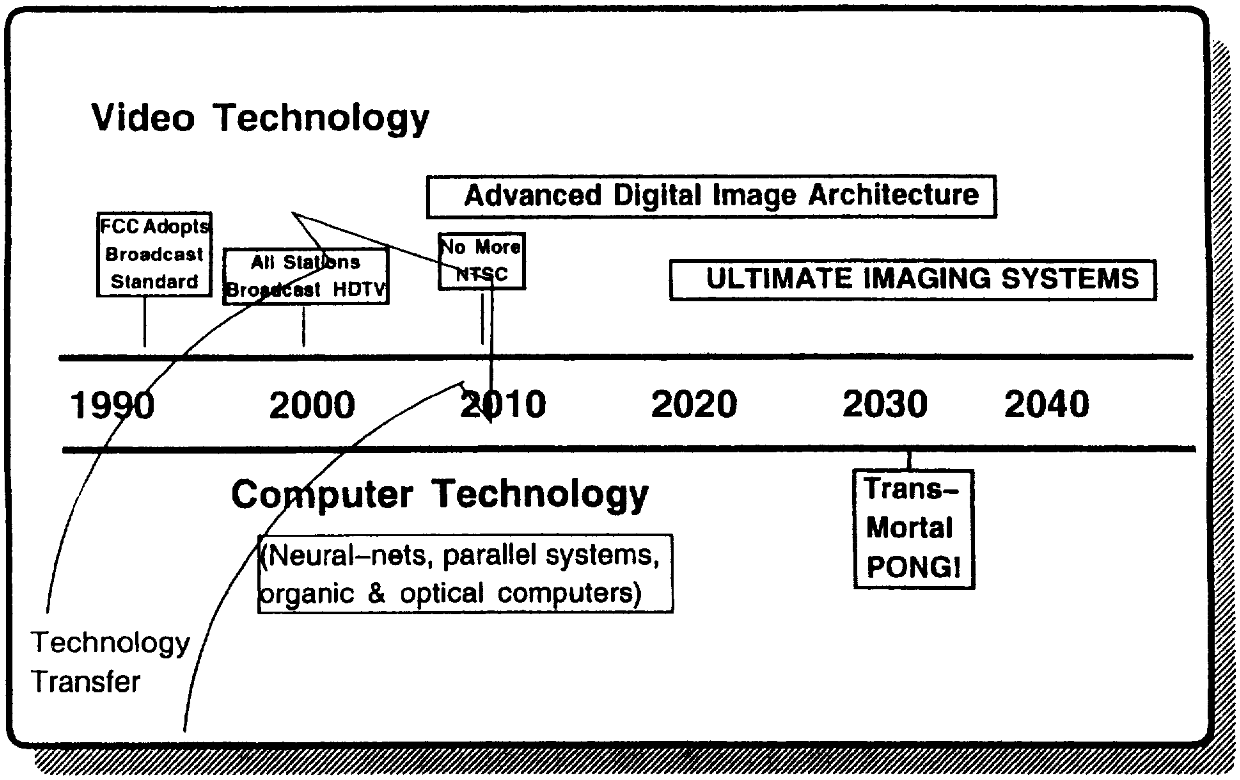
Post- HDTV Milestones



Visual Information Bandwidth

Visual Factors:

Field of View (image size)
Visual Acuity (pixel size & number of pixels)
Dynamic Range (number of bits/pixel)
Color (color components and enoding scheme)
Image Retension (flicker rate, images/sec)

Analog Bandwith (Hz):

= **(Images/sec)*(Lines/image)*('cycles'/line)*(Number of Colors)**
where 'cycle' is minimum horizontally resolvable unit, one 'on-off'

Digital Bandwidth (bps)

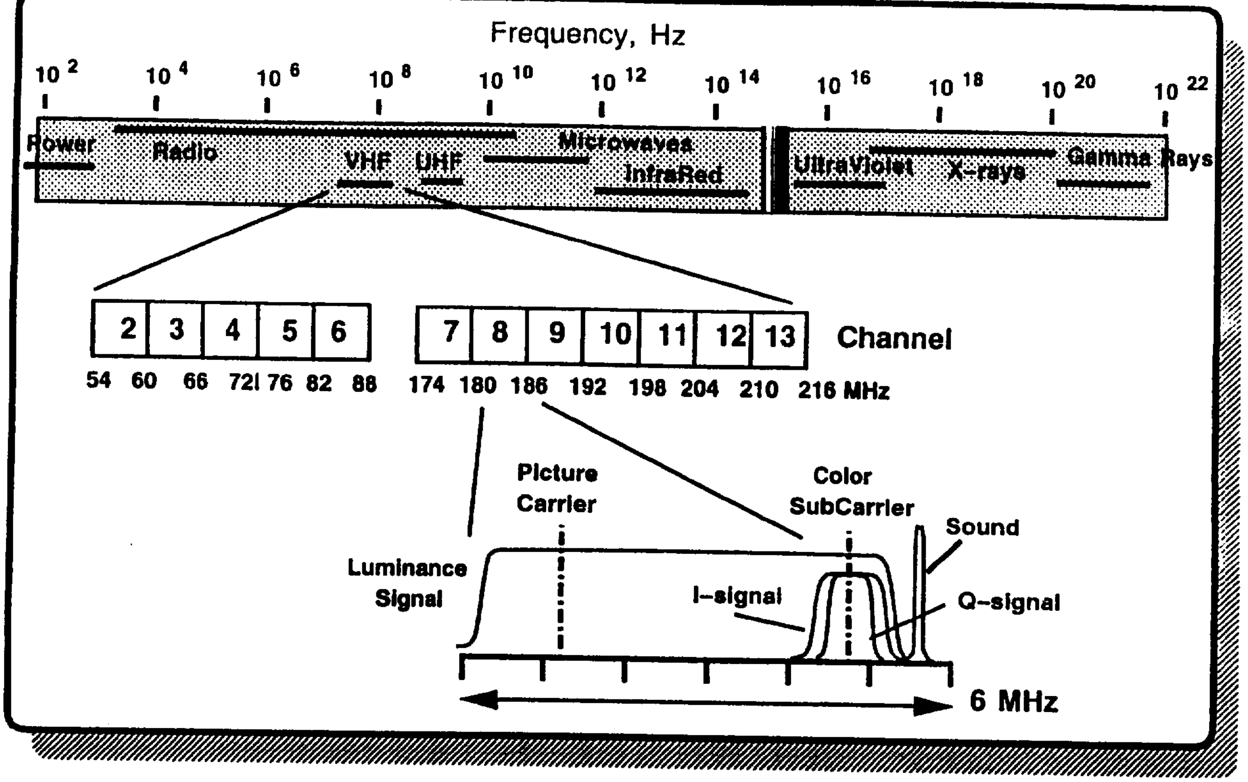
= Analog Bandwidth * 2 pixels/cycle * Number bits/pixel

Example: Monochrome Broadcast TV

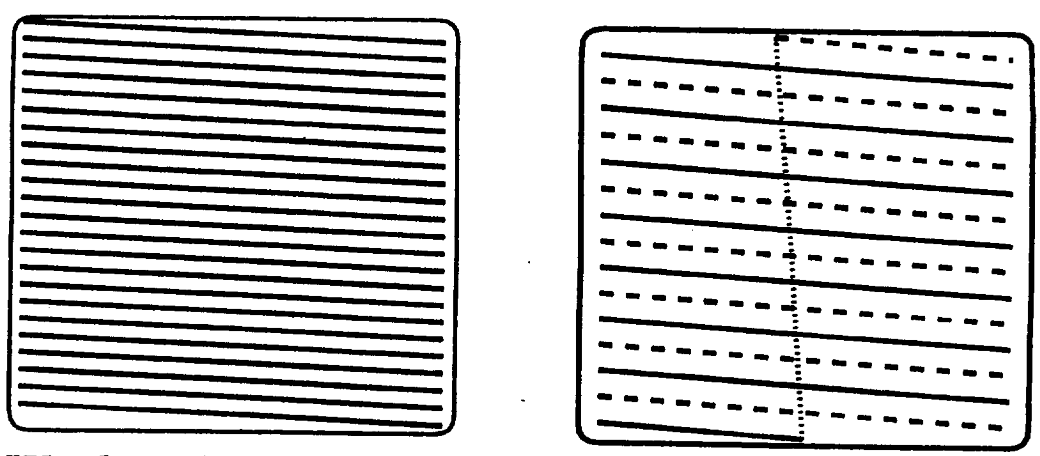
30 frms/sec * 525 lines/frm * 250 'cycles'/line = 4,000,000 cycles/sec = **4 MHz**

at 2 pixels/cycle * 8 bits/pixel = **64 Mbs**

Television Frequency Allocation and Bandwidth



Horizontal Scanning



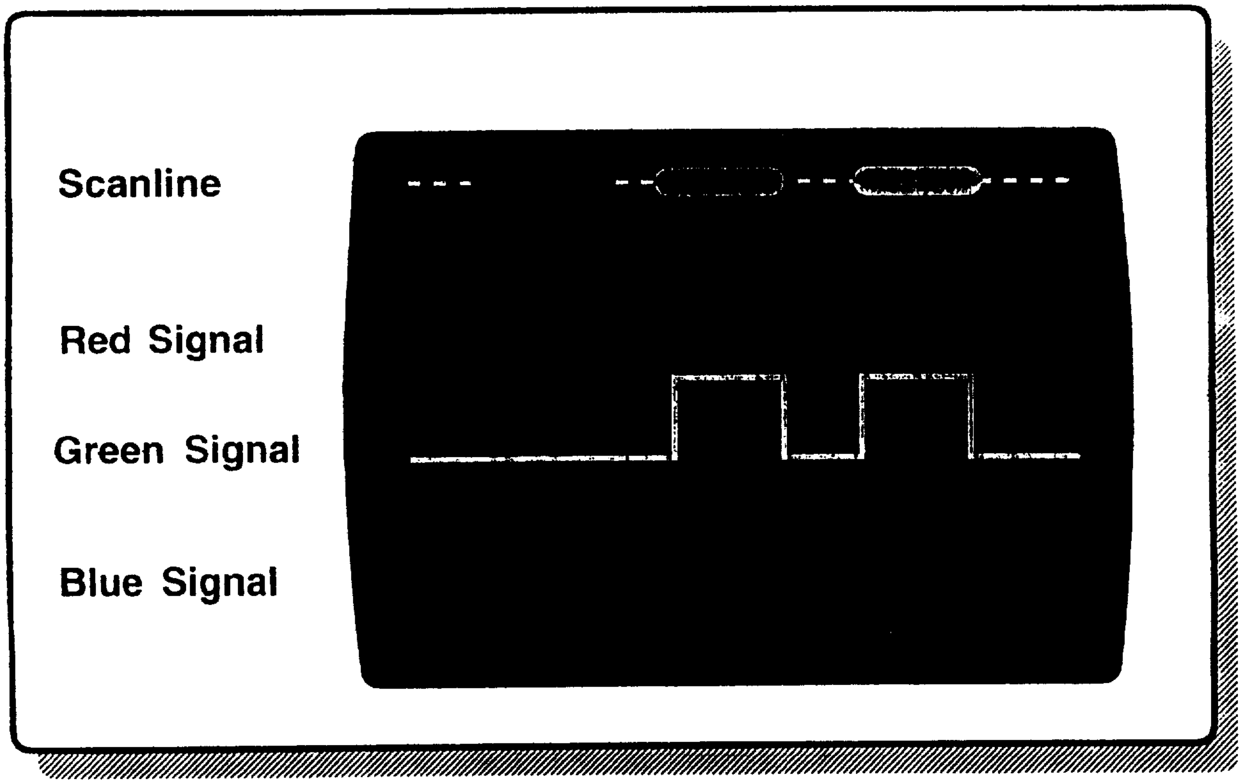
Workstation Video

1024 Scanlines
60 Full Frames/sec
Non–Interlaced

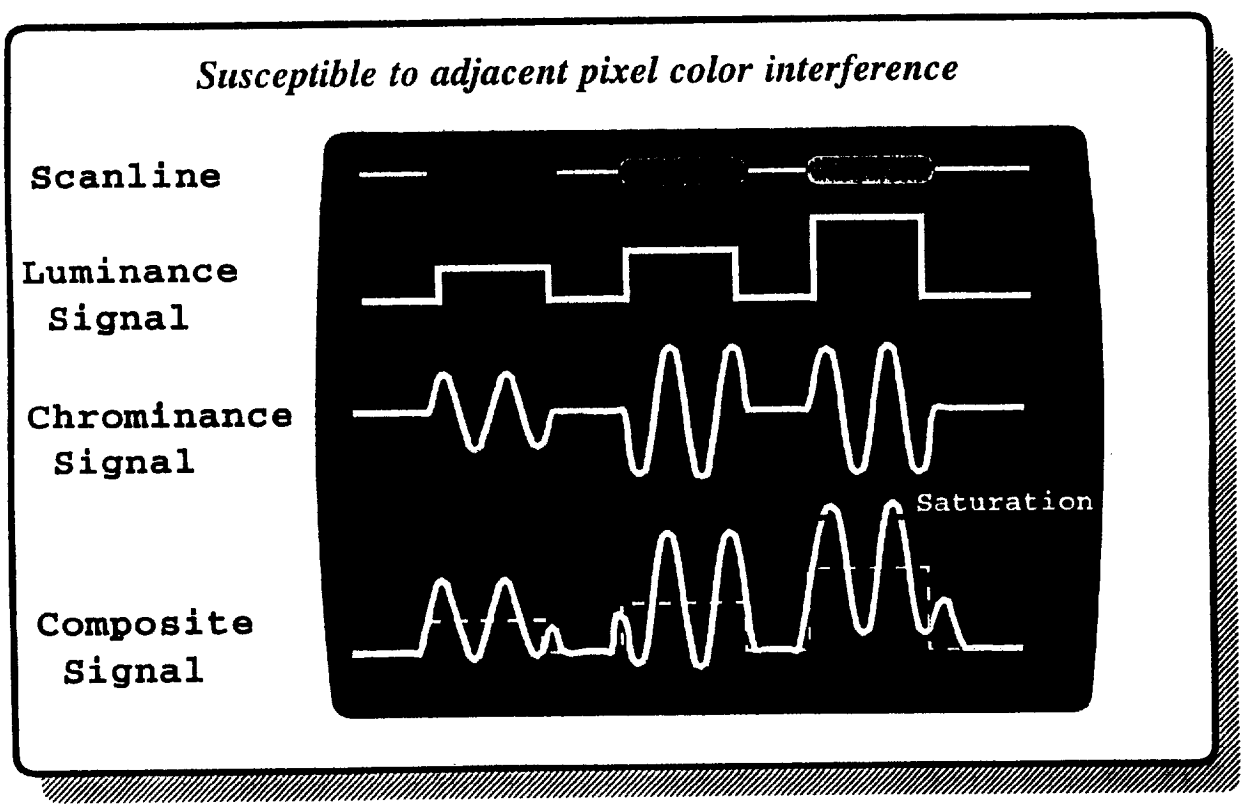
Television

525 Scanlines
30 Full Frames/sec
2 Interlaced Fields

Workstation RGB Color Domain



NTSC Color Domain



American HDTV Time-Table

1988 – Acceptance of 1125/60 SMPTE 240M Analog HDTV Standard

1993 – FCC Selects Broadcast Standard in Aug.
(Already delayed because all proposed standards had problems!)

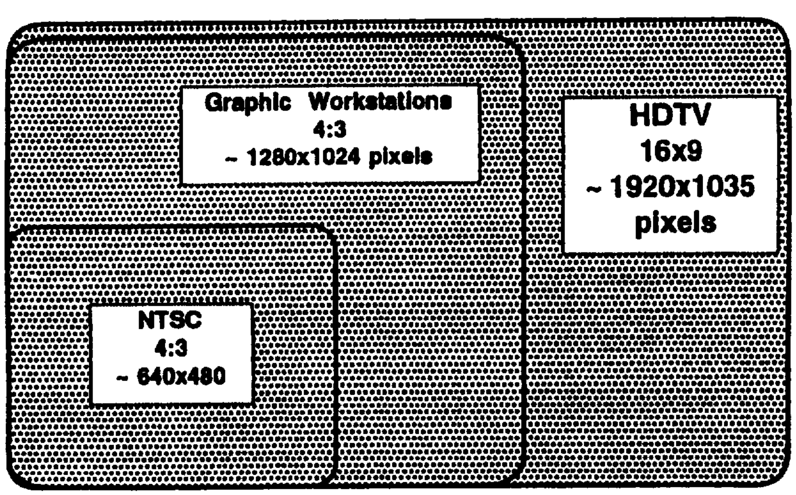
– Begin ON-AIR Testing

1995 – First Commercial receivers/licenced broadcasts
(All stations must also simulcast NTSC)

2000 – All Stations must be HDTV capable
(Simulcast NTSC still enforced)

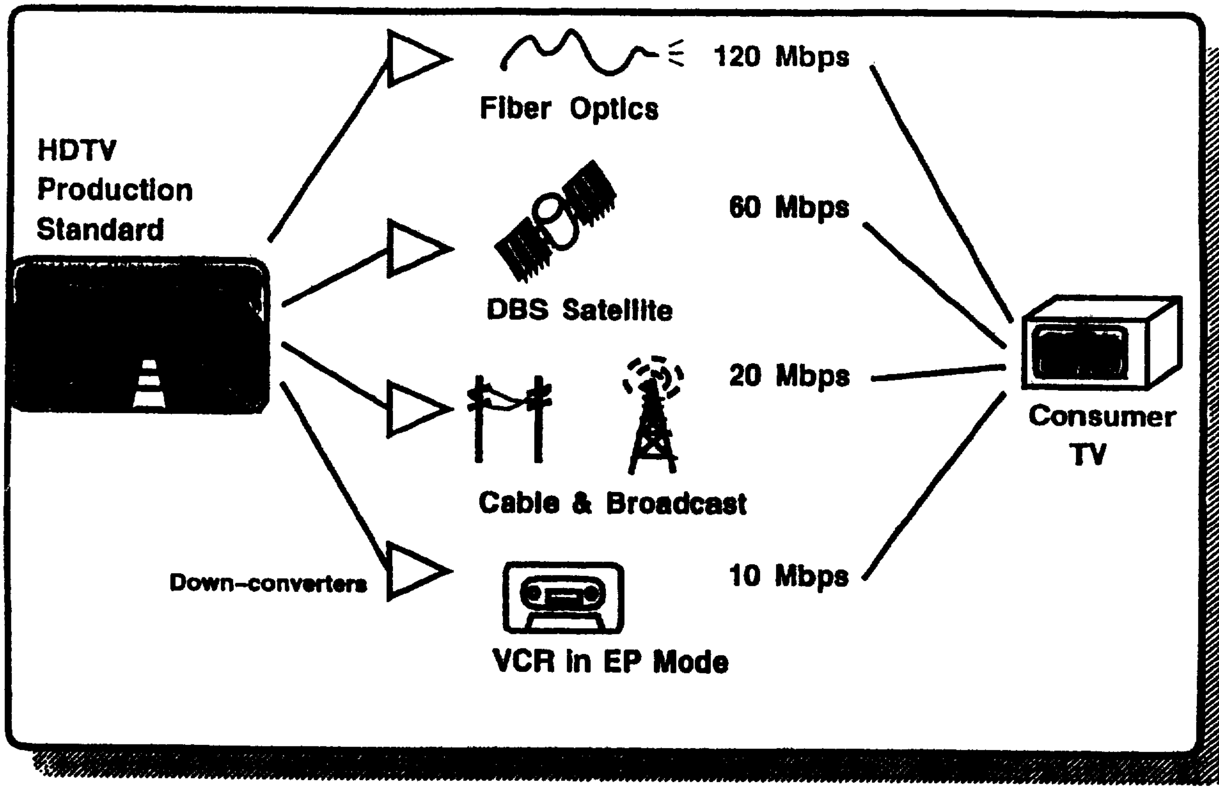
2009 – Shutdown NTSC Broadcasting
(Recoup valuable broadcast frequencies & bandwidth)

HDTV Image Size



Comparisons of Aspect Ratio and Visible Image Size in Pixels

Digital HDTV Heirarchy



Task Force on Digital Image Architecture

Represents input from SMPTE, IEEE, ATSC

(Report Published SMPTE Journal Dec. 1992)

" To develop and propose a structure for a heirarchy of digital standards to facilitate interoperation of high resolution display systems. " [That are:]

Open

- In the Public Domain

Interoperable

- Images move across application/industry boundaries

Scalable

- Wide range of image size, color, speed capabilities

Extensible

- Room for future technology

Compatible

- Incorporate existing imaging/television standards

Open Architecture Model

Image Acquisition/Generation

Processing

Production Quality Storage

↓

Contribution Quality Storage

Transport

Distribution Quality Storage

↓

Reconstruction

Display

Future Displays

Wrist Display
- Low power, wire-less transmission, close viewing

Personal Viewer –
- Eyeglass/visor Heads-Up display, head-tracking

Home Entertainment –
- Flat, wall mounted, typically 6 meter diagonal

Physician's Work Surface –
- X-ray wall, close-viewing, super hi-res, locally magnifiable

Writer's Table –
- Desk-size, multi-page, pen/touch input, cut/paste

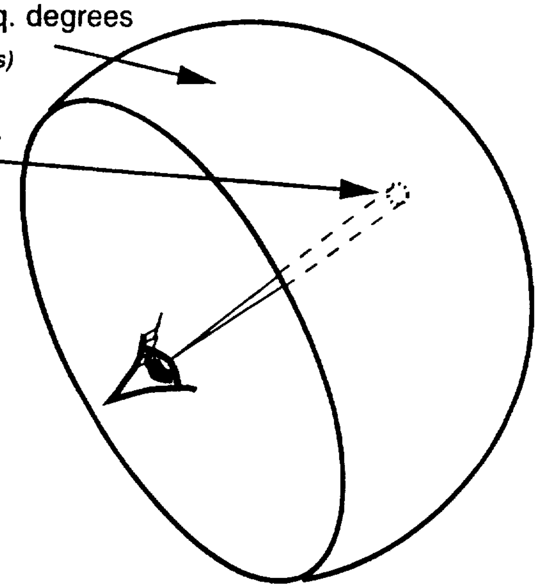
Artist's Canvas –
- Special color/contrast/texture capabilities, unique input/output control

Make-Up Mirror
- 'Through-the-screen' cameras, image processing

The ULTIMATE *Imaging System*

1) **Field of View** ~ 1.5π Steradians = 15,000 sq. degrees

(typical movie screen ~ 1200 sq. degrees)



2) **Spatial Resolution** ~ 0.65 arcmin = .01 deg.
   Assume 2 pixels per minimum resolution
   implies 16 pixels/sq. arcmin

1 & 2) -> 36,000 x 28,000 pixel screen

3) **Color** -- 3 components

4) **Dynamic Resolution** ~ 10^5:1 -> 17 bits

5) **Time Resolution** ~ 60 images/sec

6) **Stereopsis** -> x2

= 771 GBytes/sec (not including digital sound, closed-captioning, etc)