

Impact of Future Non-CRT Displays on Broadcasters' HDTV plans

EBU

**HD Technology Briefing
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(H) EUREKA!



(H) EUREKA!

Or: Are we ready for HDTV?



Introduction

- *„EUREKA-95“, more than 15 Years ago buzzword across the technology domains for the HDTV hype in Europe at this time.*
- *Today we do not have a buzzword like this, however the story look more realistic these days.*
- *This seems also true for the display technologies available today, isn't it?*
- *The Candidates we will have a closer look at are namely: LCD (TFT) and Plasma for direct-view und DLP/LCD/LCoS for Projection*
- *Let's try to get some answers on performance parameters to check if they are really up yet.*

Display Characteristics considered

-  Size > 25"

-  Technology

 - Plasma, LCD, DLP Rear projection

-  Brightness/Contrast

-  Resolution

-  Colorimetry

-  Viewing angle

-  Motion rendition and flicker performance

-  Power consumption

-  Connectivity

-  Price

Display Size

- LCD Direct view

2" .. 22" .. 45" .. 65"



- Plasma Direct view

32" .. 42" .. 60" .. 102"








- DLP Rearprojection

44" .. 50" .. 80" .. 100"

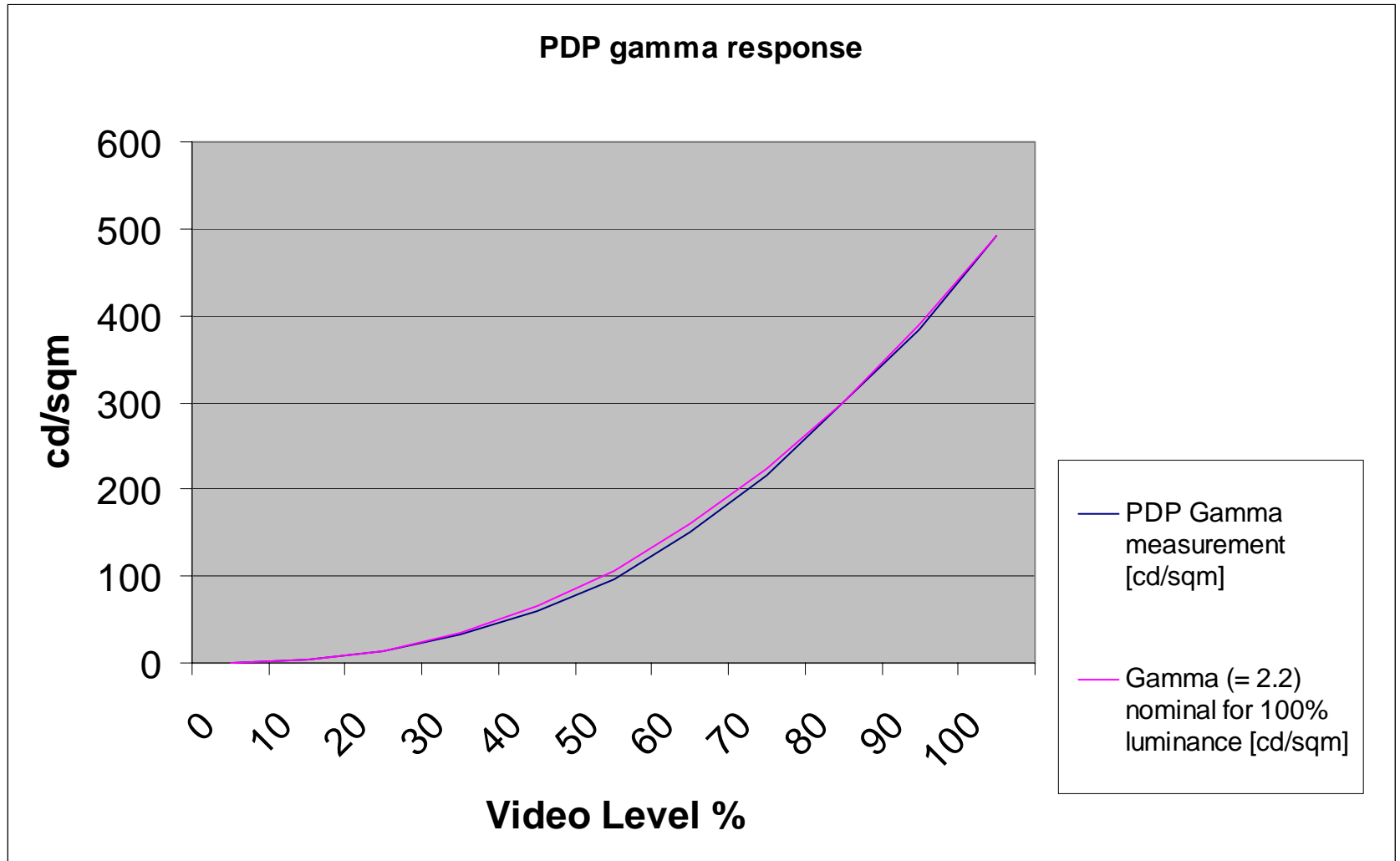


Brightness / Contrast

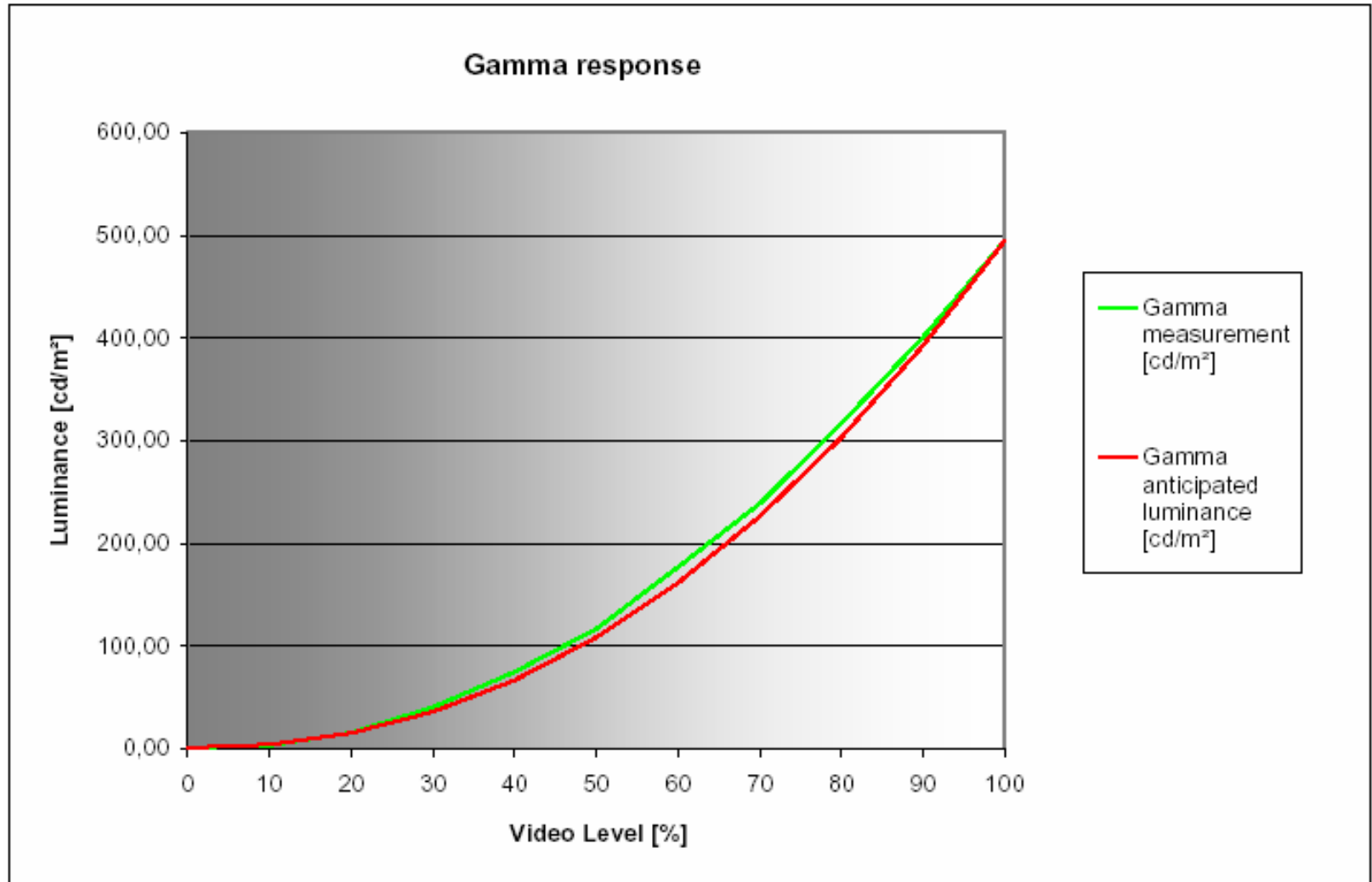
		LCD	PDP	DLP
Full White		300..550	100..150*	450..750
Peak White		300..550	400..600	450..750
Black Level		> 0,4 → 0.0005	> 0,05	> 0,7 → 0.001
DR Contrast		700..1000... 1Mio	1000..10000	< 2000 → 100K
ANSI Kontrast		?	> 700	120..180
Gradation		2.2	2.2	2.2

- Data from Consumer instruments
- *Plasma displays vary depending on picture energy

Gradation PDP example



Gradation LCD example





Brightness and Contrast Summary

PDP

-  Brightness and Contrast getting close or better than CRT
-  Dark level gradation usually use dithering techniques
 - Improvement necessary for professional use
 - Getting irrelevant for normal viewing conditions

LCD

-  Home theatre (Dark environment)
 - Black level to be improved → **controlled back-light on its way**
-  Dark level gradation like Plasma (Dither)
 - Less recognizable than on plasma (resolution, response-time)

DLP

-  Black level and contrast to be improved → **controlled back-light**
-  Viewing angle dependencies require certain room conditions

Resolution



PDP

LCD

DLP

1920 x 1080

1024 x 1024 (i)

852 x 1024 (i)

1366 x 768

1280 x 768

1024 x 768

Horizontal vs. Vertikal

1920 x 1080

1366 x 768

1280 x 768

1280 x 720

1920 x 1080

1366 x 768

1280 x 720

960 x 540
?

640 x 360
?

853 x 480

„EDTV“

1024 x 576

853 x 480

Most Instruments fulfill the EICTA Recommendation

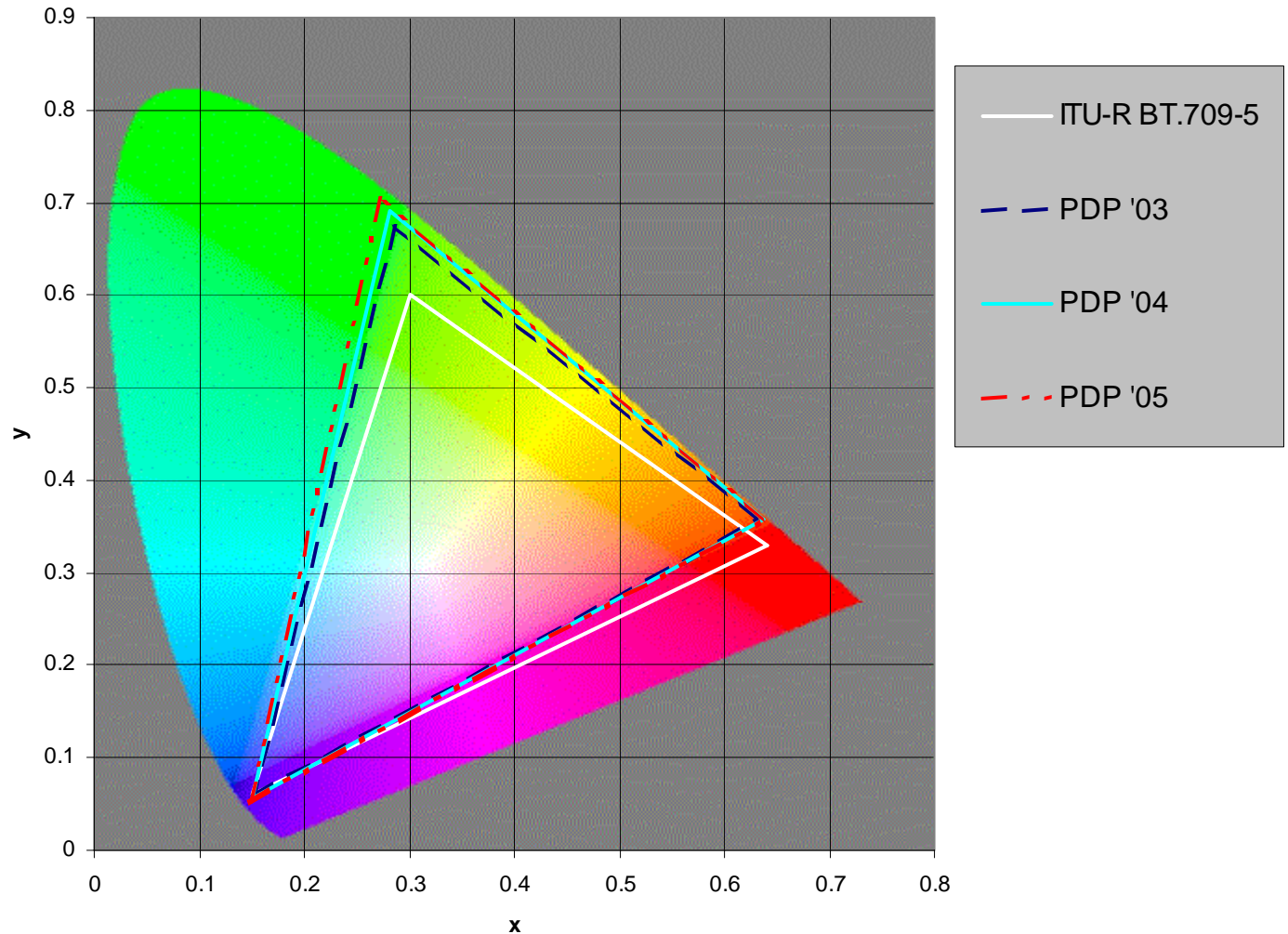


720 lines und 16:9 aspect ratio

„EDTV-Resolution devices“ give good impressions of HDTV material for low profile consumer

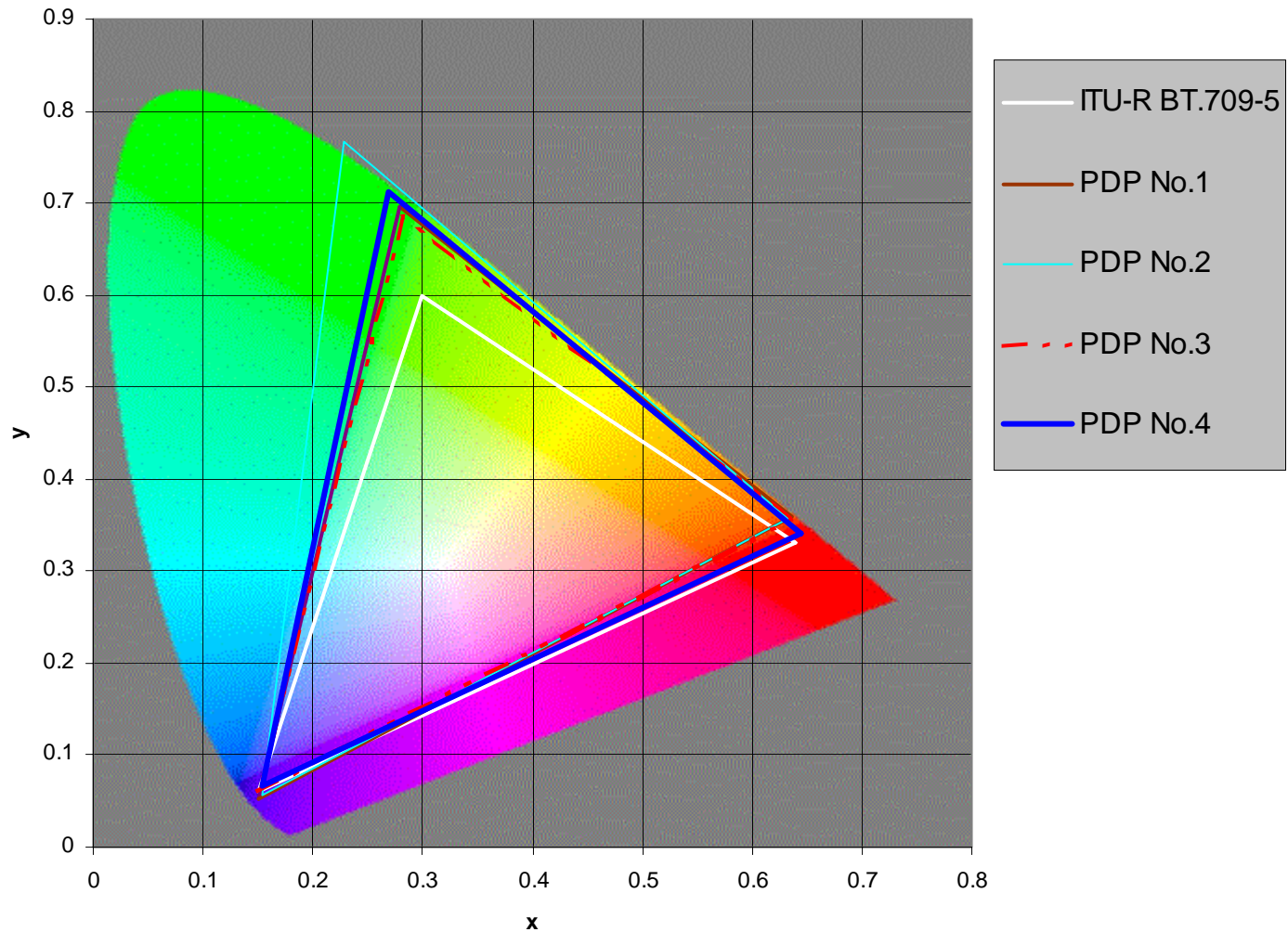
Color Space - PDP Evolution (one Manufacturer)

1964 CIE 10° Observer



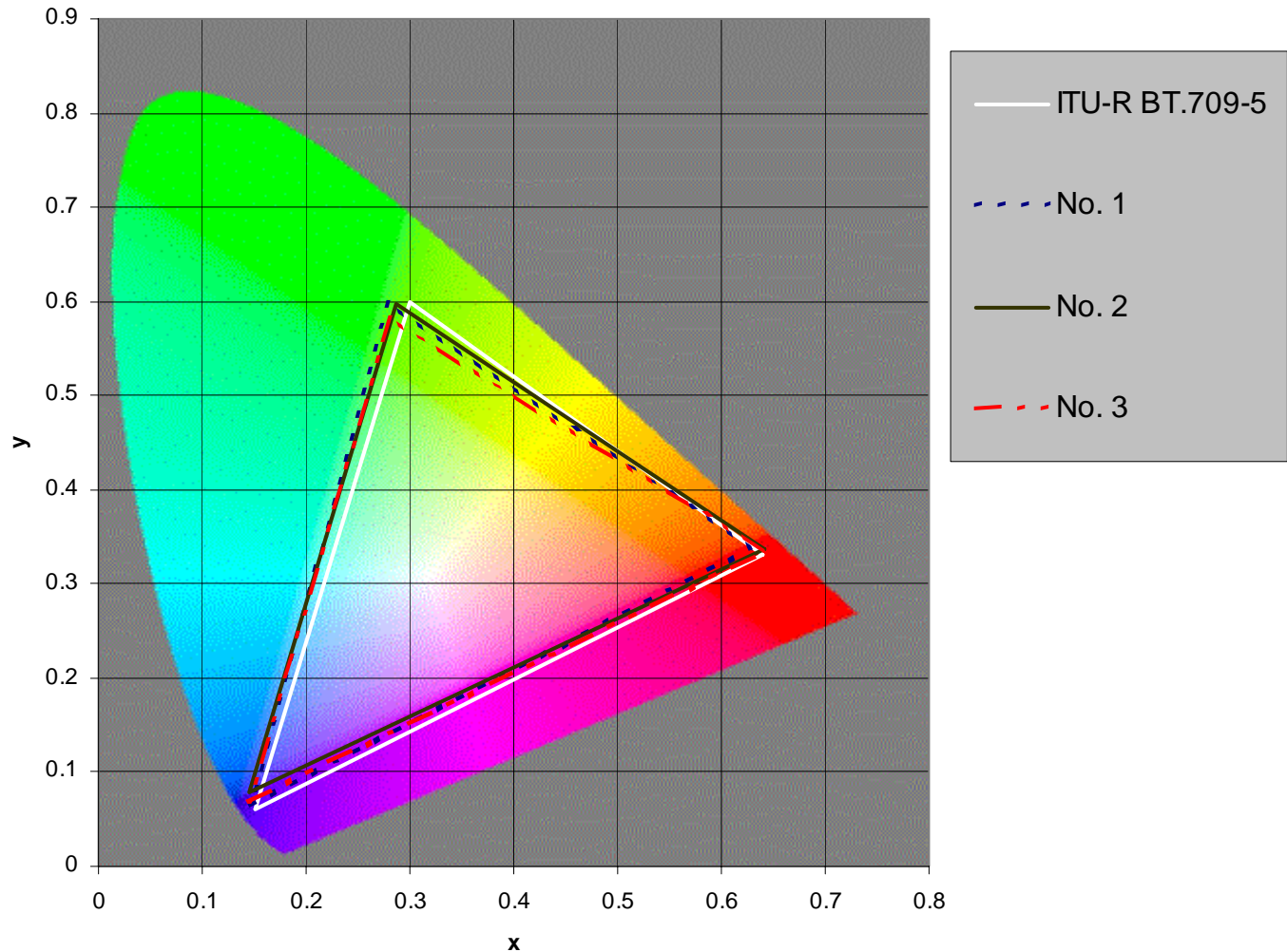
Color Space - PDP 42" „HD“, current Modules

1964 CIE 10° Observer



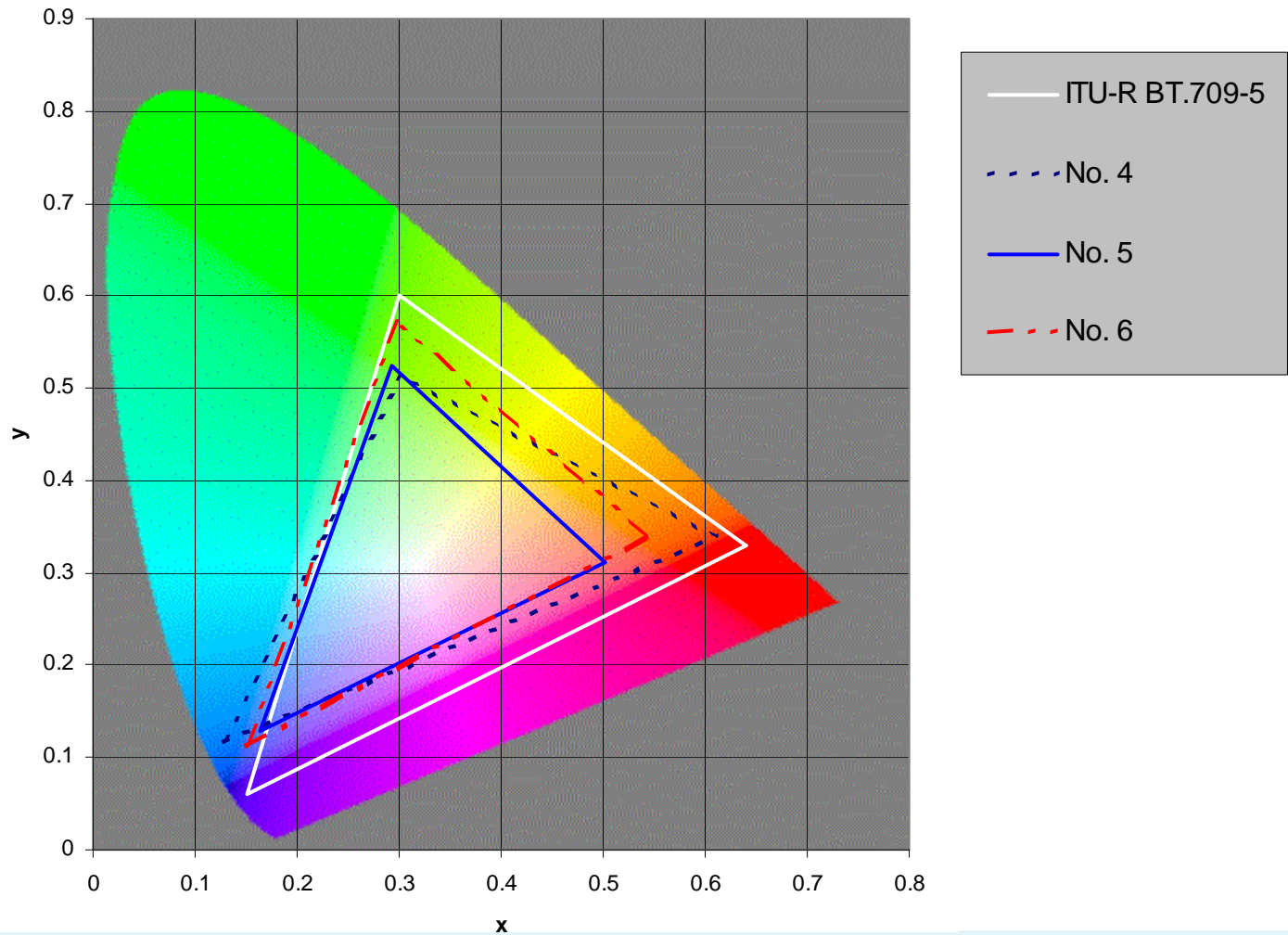
Color Space - LCD (best case)

1964 CIE 10° Observer

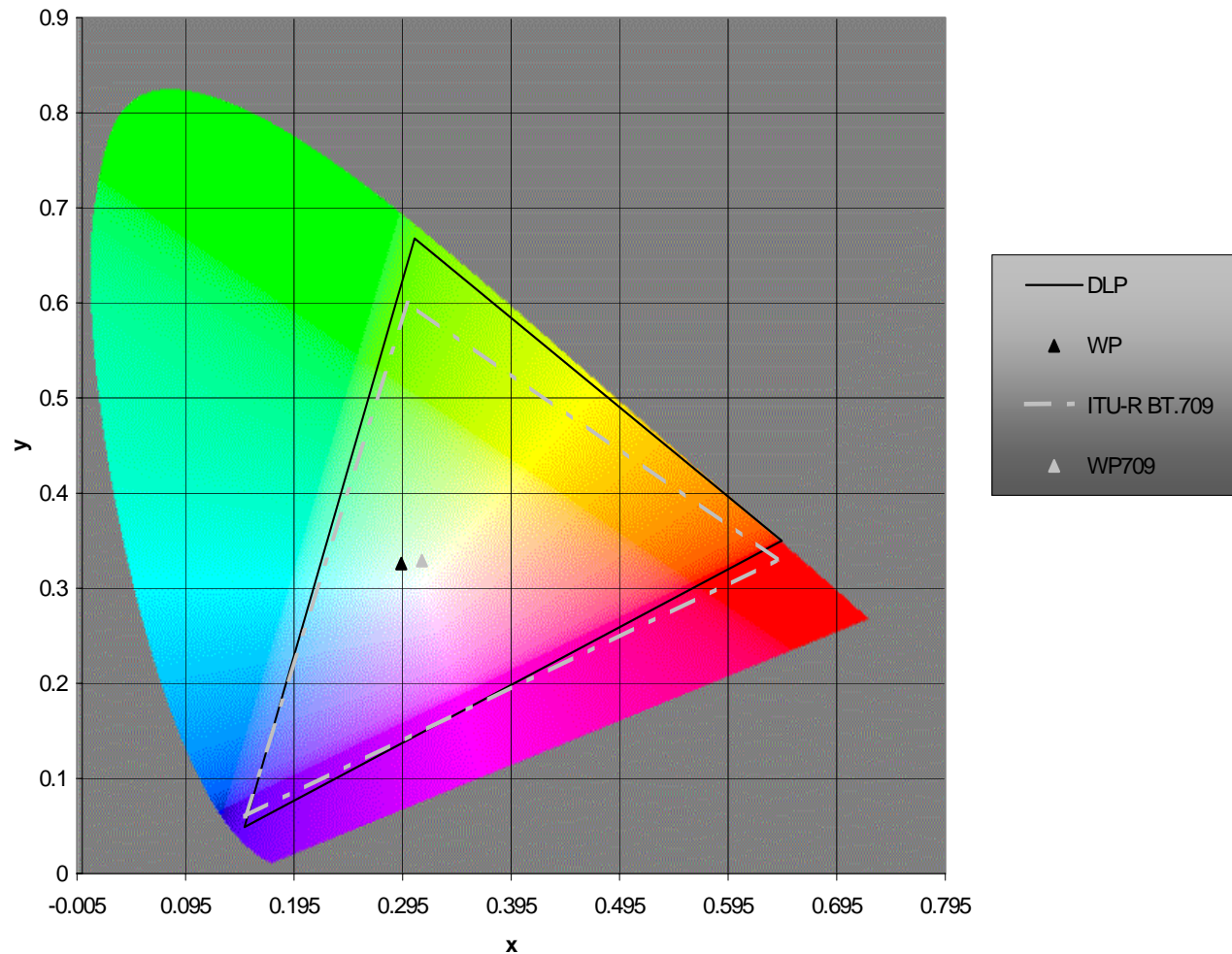


Color Space - LCD (worst case)

1964 CIE 10° Observer

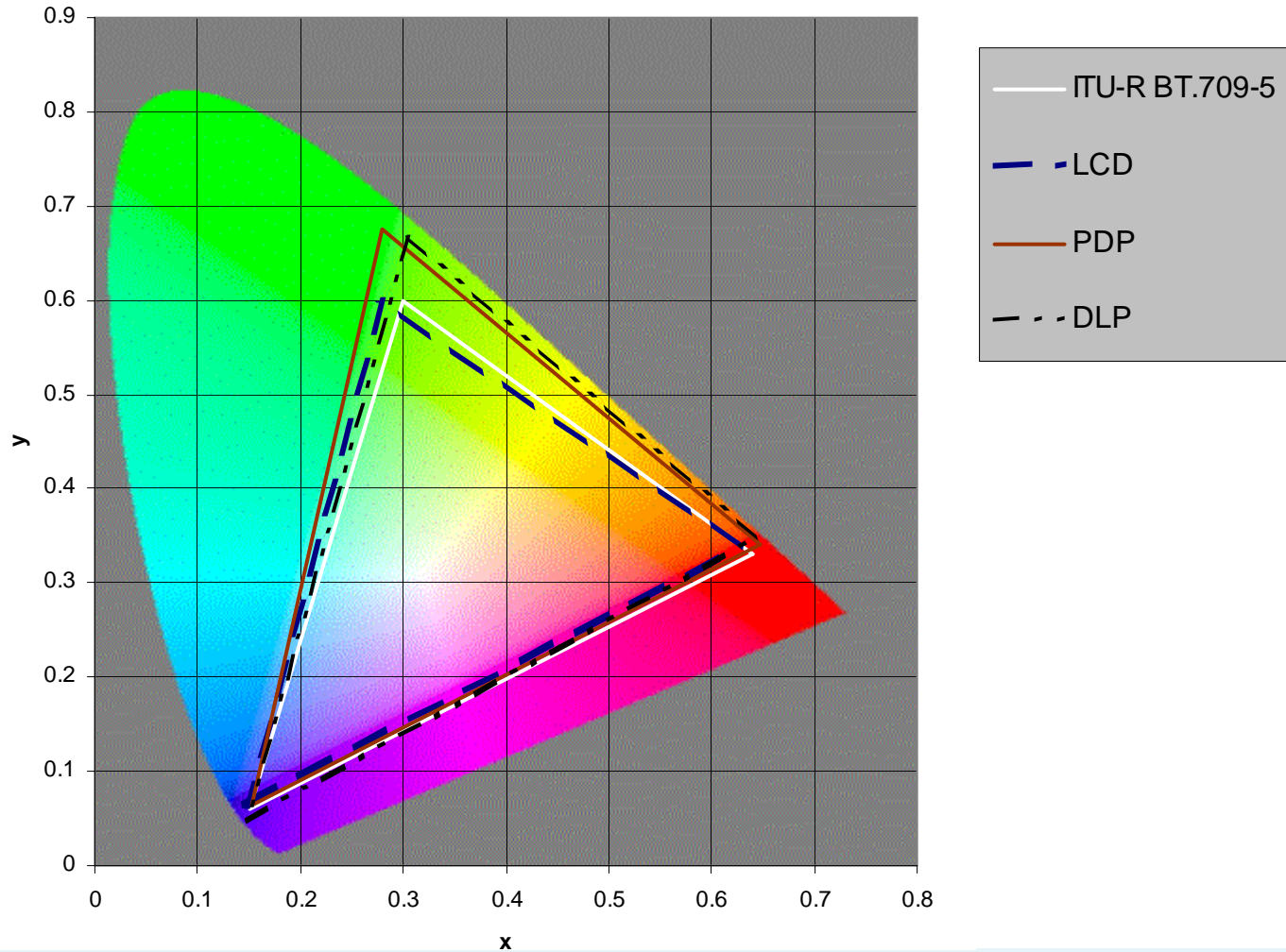


Color Space - DLP



Color Space- best Samples

1964 CIE 10° Observer



Color Space - Summary

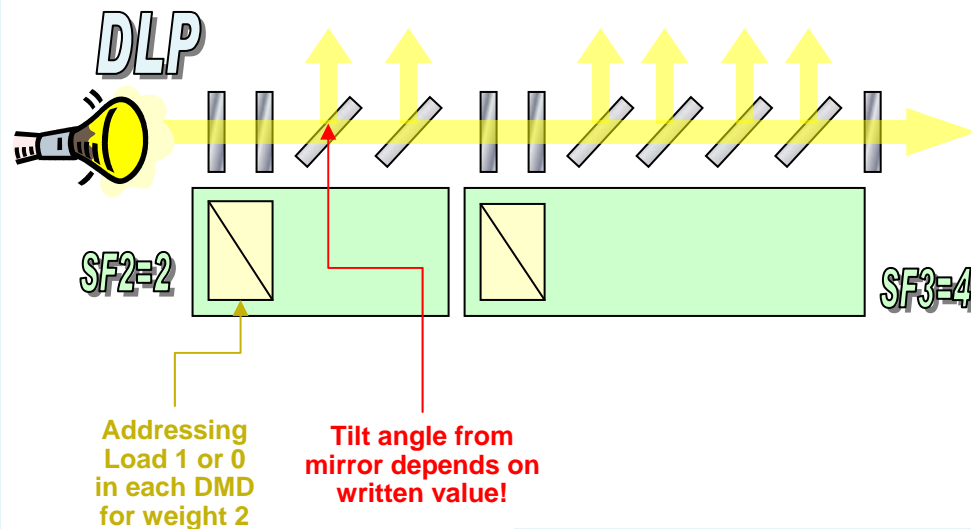
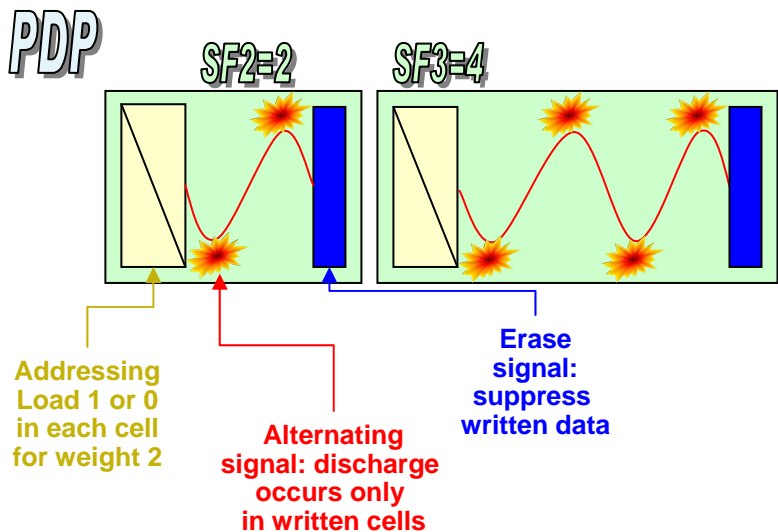
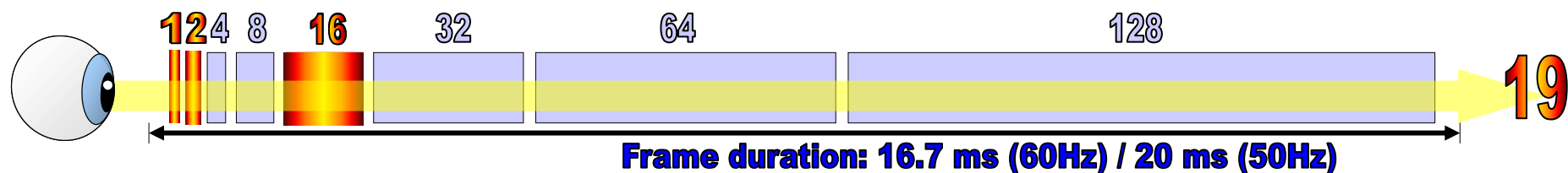
- The top range fulfills HDTV standard requirements
- No fundamental display technology constraints
- Final implementation depends on set-maker
- Potential Wide Gamut Displays for still picture and (new) cinema experience
 - LED-Backlight (LCD)
 - New Color-wheels (DLP)
 - New Phosphors (PDP)

Motion rendition and flicker performance

- 👁️ PWM type Displays (PDP, DLP)
 - 👁️ False contour
- 👁️ Sample and Hold Displays (LCD, OLED)
 - 👁️ Motion Blur/Judder
- 👁️ Large Area Flicker

Gray level rendition method: PDP and DLP based on PWM

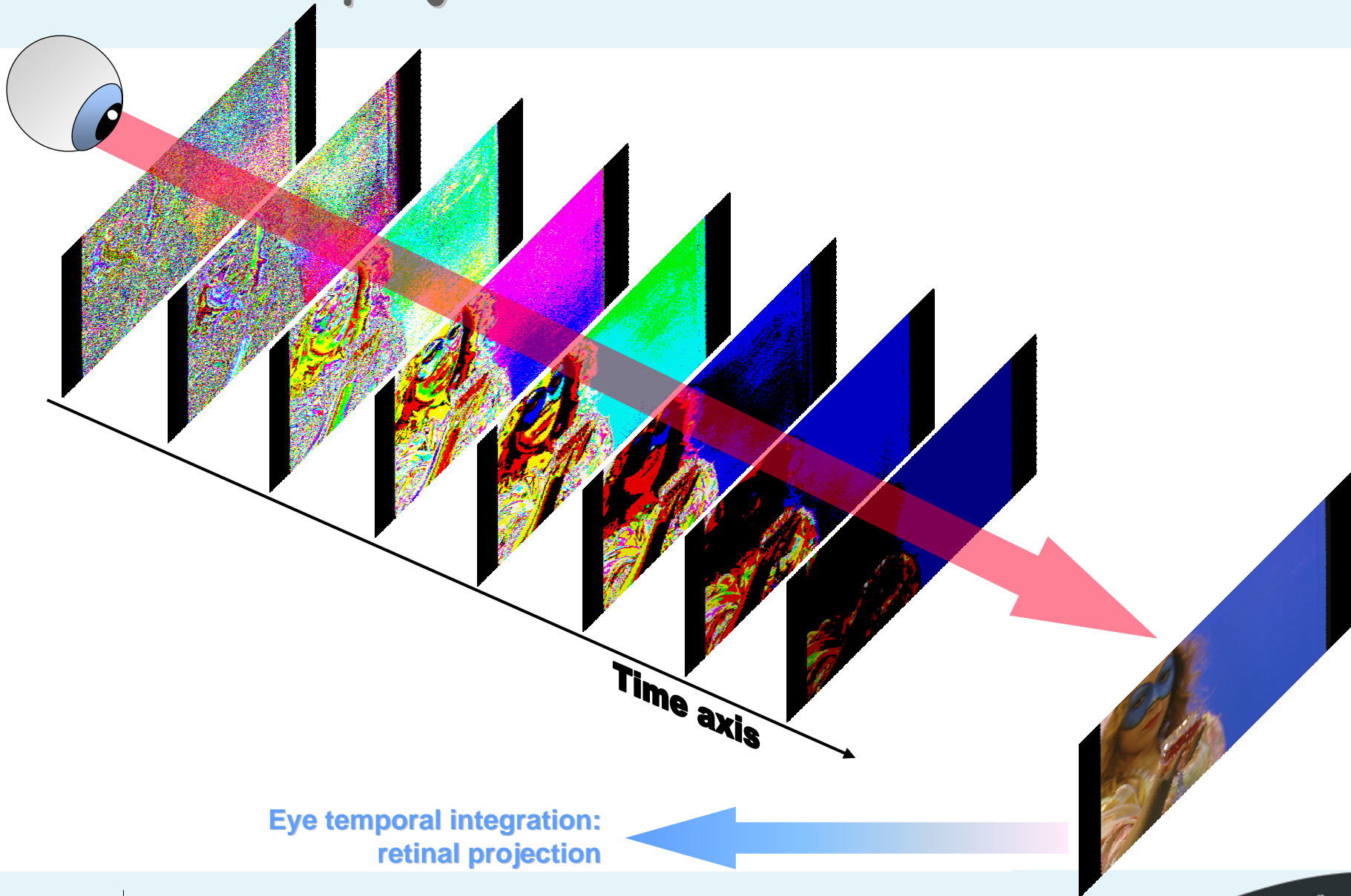
- Standard 8-bit gray scale defined with 8 binary values:
 - Combination of 8 values (weights): 1 - 2 - 4 - 8 - 16 - 32 - 64 - 128
 - Example: value 19 [11001000] = 1 + 2 + 16
- PDP and DLP: 8 bit gray-scale rendition with Pulse Width Modulation (PWM)
 - Decomposition of a frame in different lighting periods (weights): e.g. 1 - 2 - 4 - 8 - 16 - 32 - 64 - 128 called sub-fields
 - Luminance level obtained on the retina through eye temporal integration



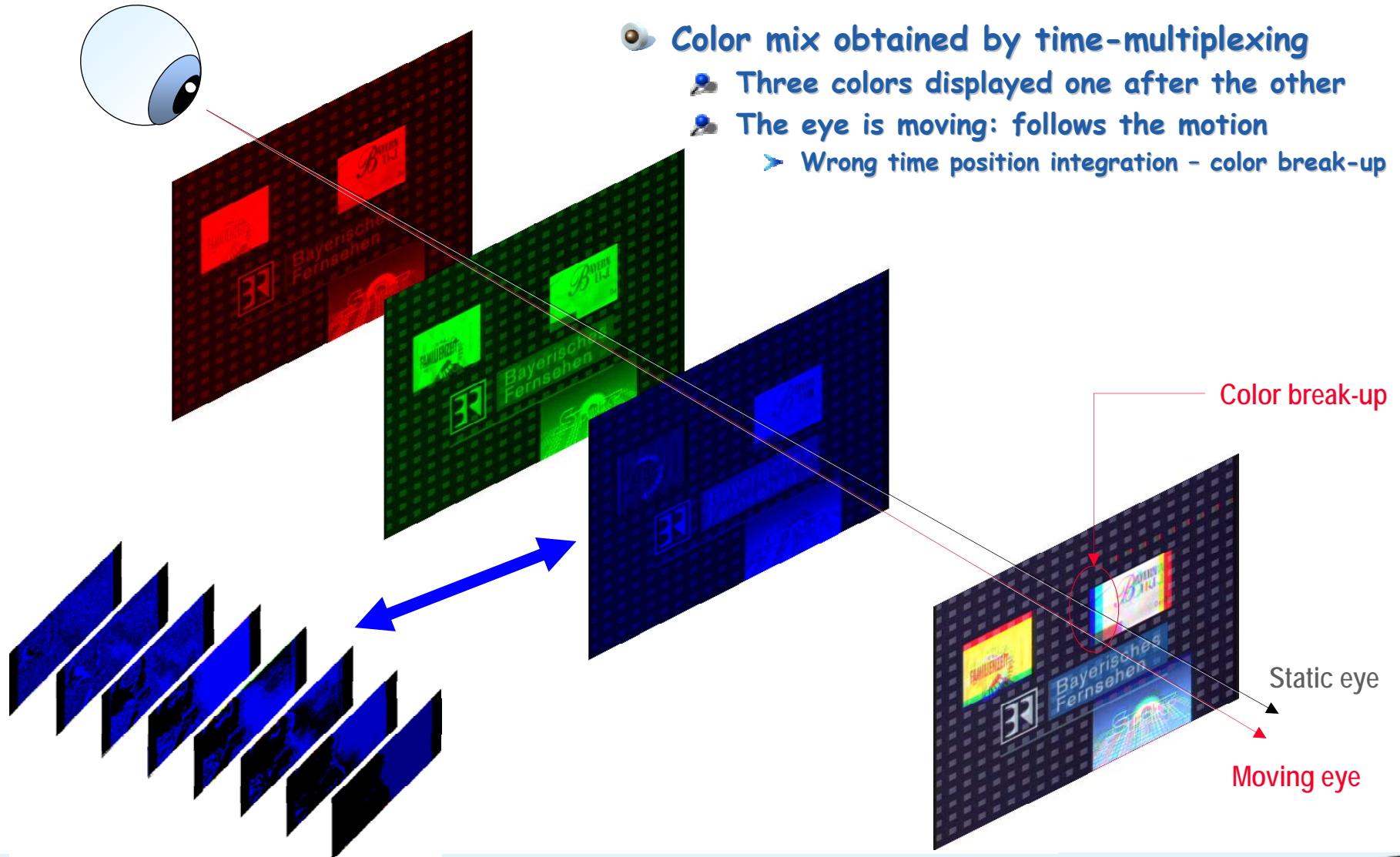
Example of PWR grayscale rendition



PWR retinal projection



Color Break-up artifact - DLP



Motion rendition

👁️ False contour or additional noise



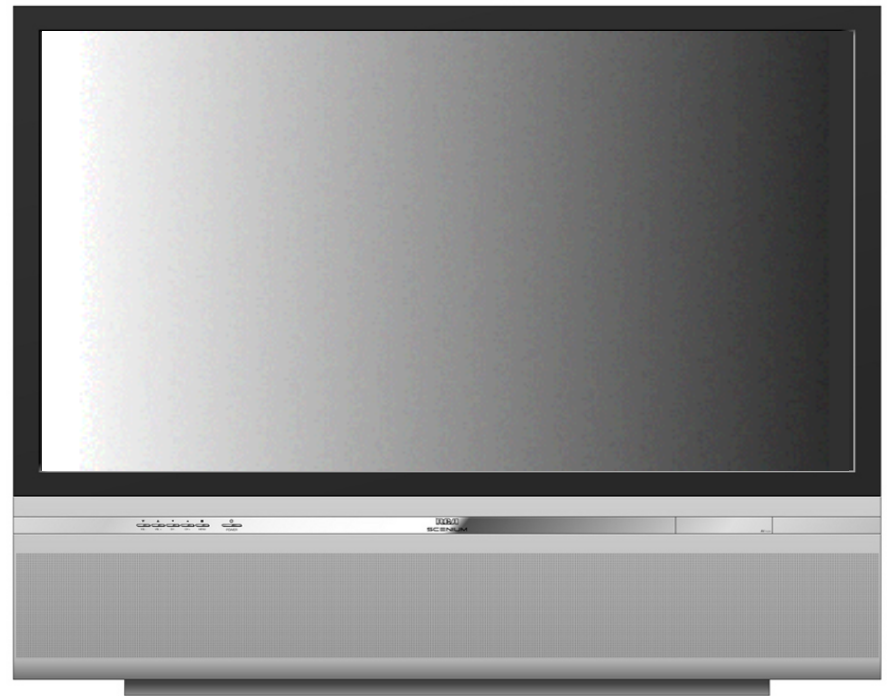
PDP

Motion rendition

👁️ False contour or additional noise



PDP



DLP

The false contour effect: **Natural scene**

- 👁️ **Artifacts appearing differently on each color**
 - 👁️ **Colored false contour effect**
 - 👁️ **Very unnatural**



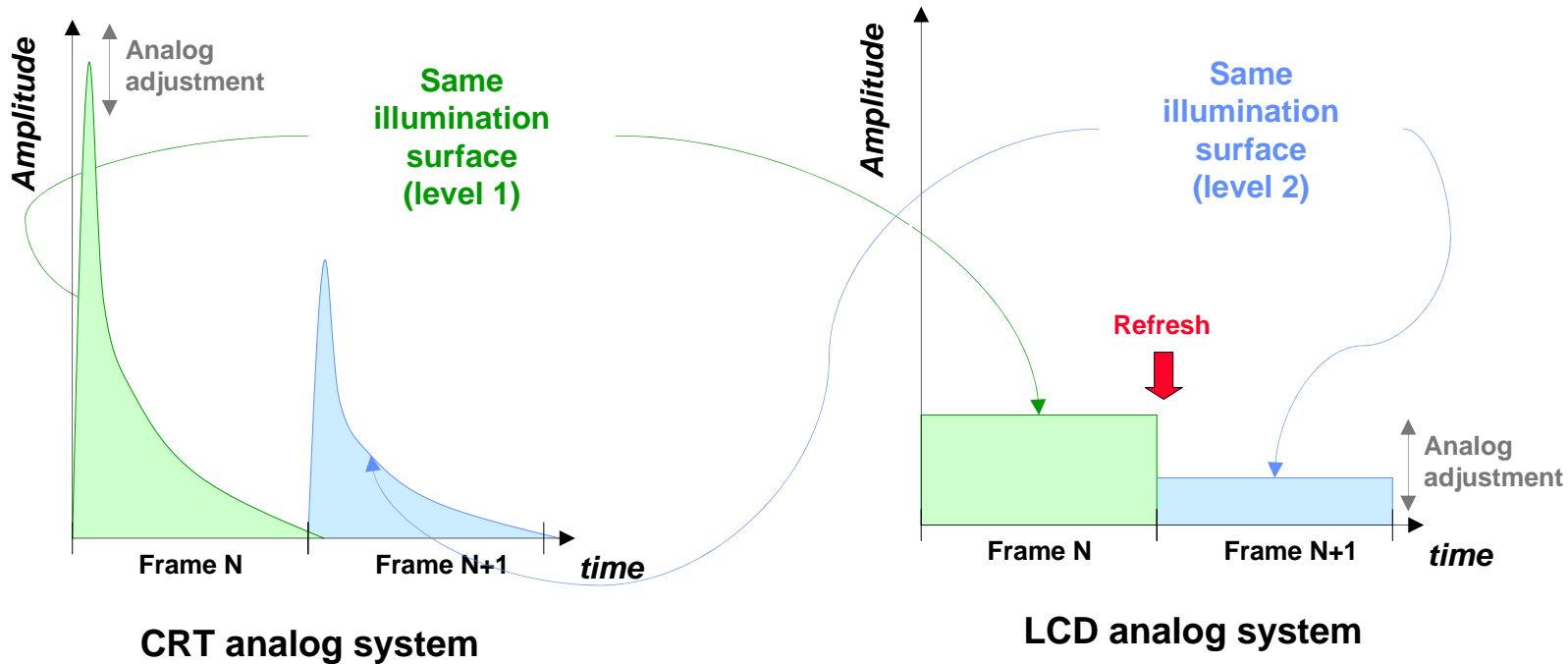
False Contour Summary

- **Advanced Coding (Bit-Sequencing) methods and technology advances (address speed up) reduce this effect to irrelevance for high end consumer panels**
- **Other Artifacts resulting from phosphor lag are normally less visible but still matter of research and development.**

Video level rendition: S&H vs. CRT

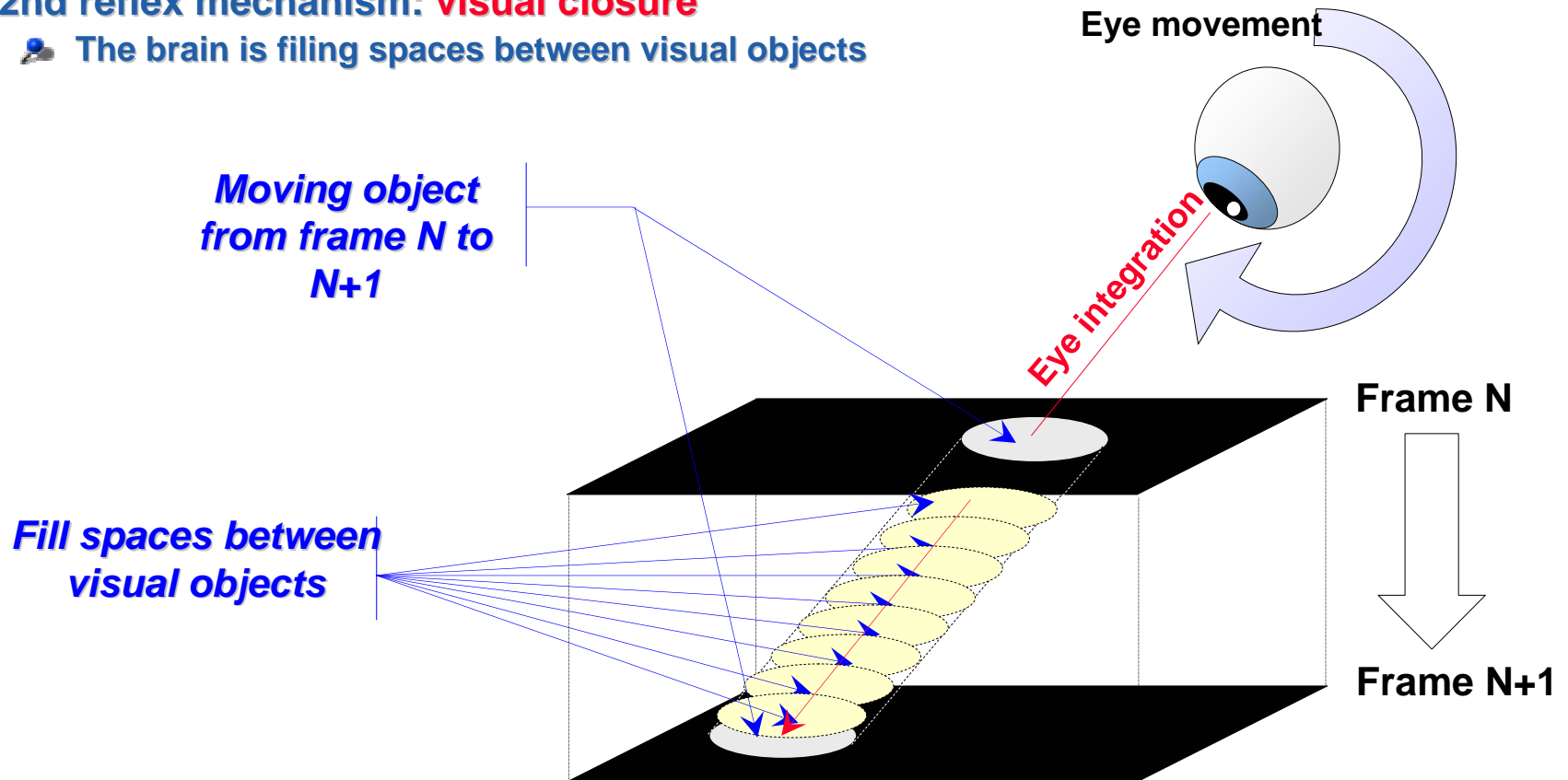
👁 Different illumination even if both are analog displays

- 👁 CRT: illumination as **short pulse for each pixel** & phosphor remanence
- 👁 S&H: **stable illumination during a whole frame period** before value update
 - Example of extreme fast switching LCD or AMOLED



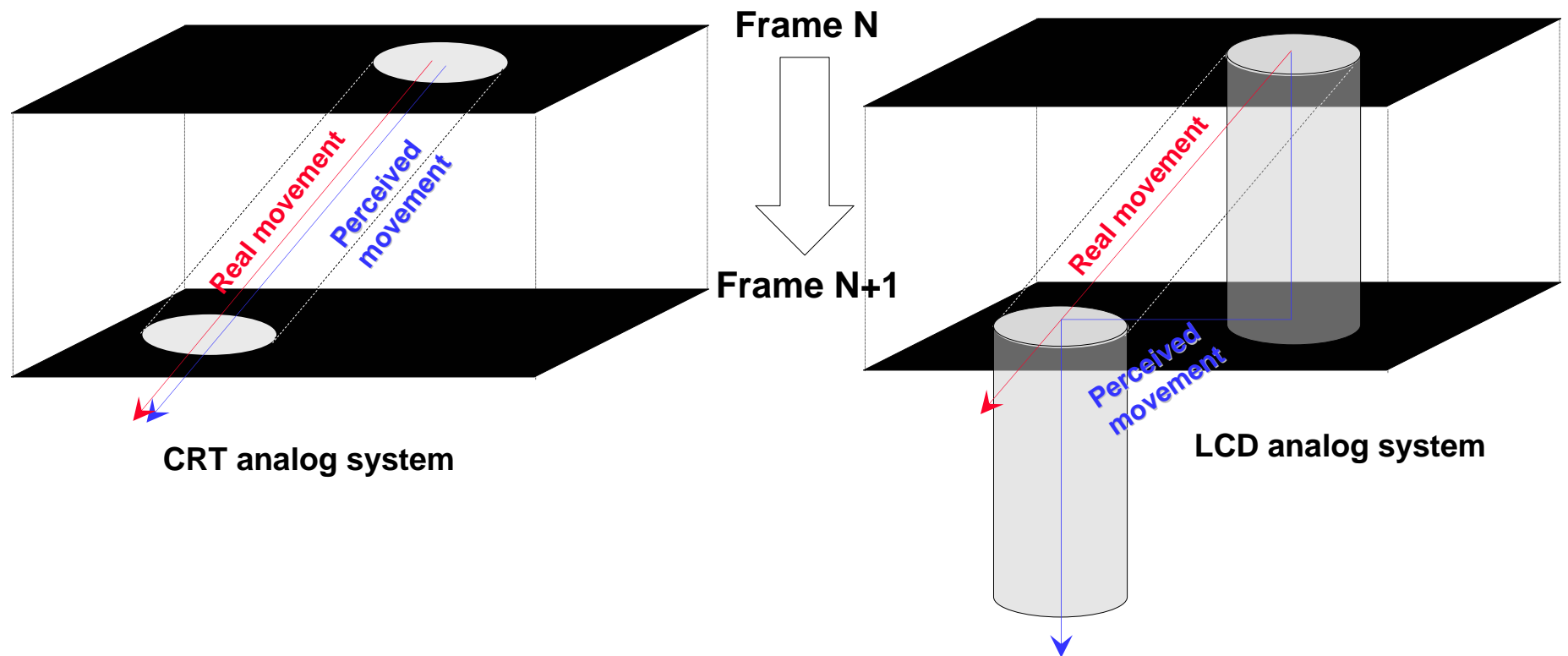
The human movement perception

- 👁️ 1st reflex mechanism: **optokinetic nystagmus** (eye tracking)
 - 👁️ The eye is following the movement
- 👁️ 2nd reflex mechanism: **visual closure**
 - 👁️ The brain is filling spaces between visual objects



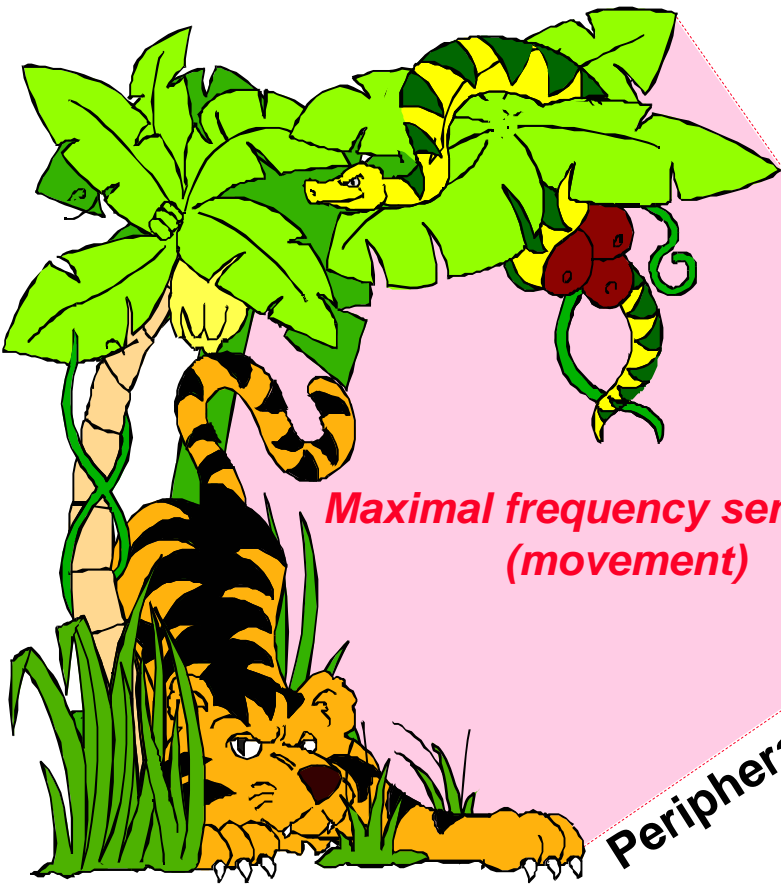
Moving rendition: LCD vs. CRT

👁 From smooth CRT movement to jerky LCD/AMOLED movement...

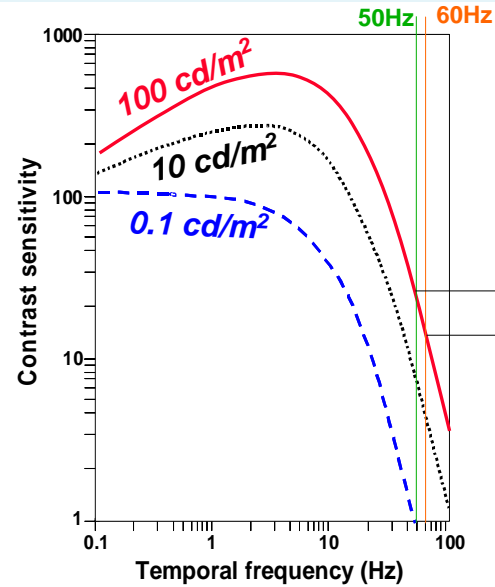
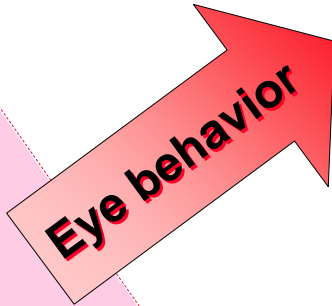


The human frequency perception

- Functional specification of human retina
 - Specific ASF solution mandatory for 50Hz countries

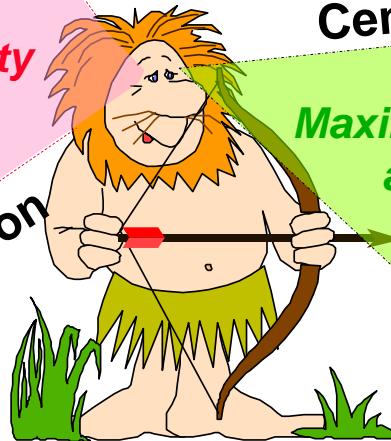


Maximal frequency sensitivity (movement)



Human eye quite sensitive to 50Hz refresh rate

Peripheral vision



Central vision

Maximal visual acuity



Motion rendition and flicker performance

👁️ Double or multiple contours at steep gradients

📍 First solutions picture repeat technologies

➤ Flickerfree 100 Hz CRT

➤ Double contour (PDP) or multiple contours (DLP) fast Motion

📍 in 2005/2006 more sophisticated solutions are expected using motion compensation



CRT/PDP 100 Hz
(NO Motion Compensation)



DLP 5X



Motion Rendition Summary

- Large area flicker invisible for most new products
- Motion rendition especially for fast motion inferior to 50/60Hz camera material displayed on a CRT
- Different Motion compensation schemes will be adopted in High End Plasma / LCD / DLP?
- LED backlight has potential to improve motion blur considerably but makes motion compensation schemes mandatory like for PWM-technologies

Connectivity

👁️ “HD-Ready” devices shall support

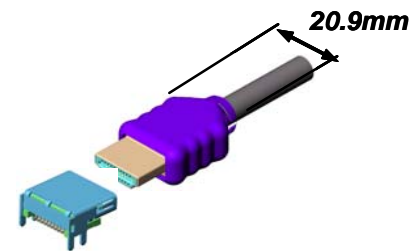
- 👤 Component YPrPb AND
- 👤 DVI-HDTV (with HDCP) or HDMI (with HDCP)



YPrPb



DVI



HDMI

👁️ “HD-Ready” compatible displays are available on further are on its way

Price Tags



899.-

+ 6,90 € Versand

AL 2671W
 WOWB-Technologie mit TRUBASS® und FOCUS®
 sowie der 3D Motion Adaptive Dithering-Technologie für
 erstklassige und wirtlichkeitsnahe Bild- und
 Tonqualität.
Sofort ab Lager lieferbar.



61 DLY 644

2,280.00 EUR



2199.-

+ 29,90 € Versand

37 PF 9946
 Eleganter absolut flacher Breitbild-Plasma-TV mit
 nur 9 cm Tiefe liefert konkurrenzlose Bildqualität für
 Ihr Home Entertainment. Auch für Wandmontage
 geeignet.

50 DLY 644

1,788.00 EUR

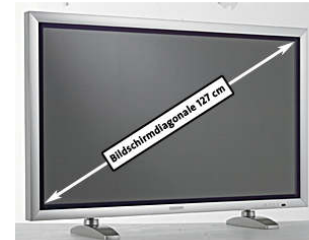
stückpreise/ incl. MwSt

zzgl. Versandkosten von 49.00 EUR

stückpreise/ incl. MwSt
 zzgl. Versandkosten von 49.00 EUR



Ähnliche Funktion



Leistung:

3.084.-

Produkt weiterempfehlen

GERICOM
 MULTIMEDIA

Lieferkostenfrei
 plus Aufbauservice

Bild in Bild-Funktion

Integrierte Lautsprecher

(Modell ähnlich Abbildung)



1939.-

+ 29,90 € Versand

30 LB 020 S 4
 Hochauflösender LCD-Fernseher mit DVI- und VGA-
 Anschluss zur alternativen Nutzung als Monitor.
Sofort ab Lager lieferbar.



Panel LG PDP 50X2

3999.-

+ 29,90 € Versand

42 WP 36 P
 Neue Entertainment Technologie - kompakt und
 superflach, randscharf bis in die Ecken. Genießen
 Sie brillante Bilder in zukunftsweisendem Design
 auf dem Plasma-Display bei einer
 Bildschirmdiagonale von 107 cm.
Sofort ab Lager lieferbar.
 Ohne Montage und Anschluss. Lieferservice bis zur
 ersten Tür durch Spedition. Verbringung an
 Aufstellort nicht möglich!

Price Tags - € (Internet Research)

	LCD	PDP	DLP
25"-29"	1000..1600	--	--
30"-34"	1400..2900	2300	
35"-39"	2500..5200	1800..2800	--
40"-44"	3700..7900	2600..5500	
45"-49"	9000	--	1600..1900
50"-54"	--	3000..6300	1800..4200
55"-59"	--	--	--
60"-64"	--	10000..20000	2200..5800

Summary

Ready for HDTV !

The achievable performance data equal the respective standards for HDTV and allow for high quality picture representation.

All size variations are offered.

Prices, which still on downward pace, are already attractive for volume sales to enter the world of high definition pictures.

New Technology trends, like OLED, LED Backlight, will offer further improvement steps and will lead to never known display characteristics

Where's the journey to go?

→ Extended Color Gamut, High Dynamic Range, Ultrahigh Resolution, Super-Slim, Flexible...