IMPACTING DISPLAYS THROUGH ADVANCES IN NEXT GENERATION VIDEO

BASID '16

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THE NEXT GENERATION
VISUAL EXPERIENCE
VIEWER PREFERENCE
Display size: 23”
0.004 – 20,000 nits
Nomenclature

**BLACK LEVEL**
MINIMUM SCENE LUMINANCE

**DIFFUSE WHITE**
SCENE REFLECTIVE WHITE

**HIGHLIGHTS**
SPECULAR REFLECTIONS & LIGHT SOURCES ABOVE DIFFUSE WHITE
Step 1: Highlight (HL) = Diffuse White (DW)
Step 14: HL = System Max
Viewer Preference – large and small screen

![Graph showing luminance distribution with data points and percentages for black and white stimuli, as well as inferred data for cinema and standard TV BT-1886.]
VIEWERS HAVE TODAY

VIEWERS WANT 200X BRIGHTNESS

AND

4000X MORE CONTRAST THAN CURRENT TV STANDARDS
DYNAMIC RANGE
DISPLAY INNOVATION LAG
THE BIG SQUEEZE
Image Delivery: From Nature to the Human Visual System

Color Contrast

Full Range of human Eye

The Real World

VISUAL DYNAMIC RANGE

BRIGHTNESS

20,000+ NITS

DARKNESS

0.001 NITS
Image Delivery: Capture and Tool Flow

Color  Contrast  Capture  Postproduction  Mastering

Full Range of Human Eye

VISUAL DYNAMIC RANGE

BRIGHTNESS

20,000+ NITs

DARKNESS

0.001 NITs

Camera capture
14+ fstop/bits
16,000:1 range

Production tools
32 bit float
infinite range
Grading Work Flow

**Human Visual Dynamic Range**
- **Brightness**: 20,000+ NITS
- **Darkness**: 0.001 NITS
- **Stops**: 24+ Stops

**Cinema (DCI P3 Range)**
- **Brightness**: 48 NITS
- **Darkness**: 0.024 NITS
- **Stops**: 11 Stops

**Blu-ray (REC 709 Range)**
- **Brightness**: 100 NITS
- **Darkness**: 0.117 NITS
- **Stops**: 10 Stops
Improving the Display

Color Contrast

Capture Postproduction Mastering Distribution Display

Full Range of human Eye

TV SIGNAL

Average Picture Level (APL)

APL

TV STRETCH
Improving the Display

Color Contrast  CAPTURE  POSTPRODUCTION  MASTERING  DISTRIBUTION  DISPLAY

Full Range of human Eye

TV STRETCH

INTENDED IMAGE

Not equal
Bottle neck Forced “Early Rendering Decisions” for the Lowest Common Denominator Display (CRT)
Dolby Solution to the bottle neck

Delivers the intended image

- Uses existing compression technology
- Replaces Gamma with 12bit PQ
- Delivers Full Color, Full Dynamic Range
- Dolby Maps to Displays Full Capability
Perceptual Quantizer: SMPTE 2084:2014 EOTF
PQ vs Gamma

PQ/JNDS

Gamma

13 Intervals

13 Code Intervals

Lost Accuracy

wasted Accuracy
PQ vs Gamma

PQ/JNDs

Resolved PQ code
No. of resolved JND

Gamma codes

banding/contouring

Wasted codes

Lost Accuracy

wasted Accuracy

13 JND Intervals

10 Resolvable Intervals

13 Code Intervals
Rethink Gamut

Color Gamut Volumes
(combine absolute luminance & color gamut)

2D Chromaticity Diagram

3D Color Volume

3D Color Volume (xY Viewpoint)
Rethink Gamut

4000nit Monitor
P3,4000nit

Out of Gamut
Ref Monitor

In Gamut
Ref Monitor

100nit Ref Monitor
Rec709,100nit
Rethink Gamut
Dolby Display Mapping

- Dolby Vision (full DR) mapped down to specific TV capabilities
- Displays best image for that TV
- Uses Meta Data and preserves Directors Intent
Power

Dolby built this Quantum Dot Local dimming Display in 2009

Power ratio

\[
0.96 + (0.04 \times \text{RATIO})
\]

Conclusion: Next Generation Displays Need no major power changes

12% increase
The Next Generation Visual Experience

Higher Resolution, More Pixels
Higher Frame Rate, Faster Pixels
Larger Luminance range, + Larger Color range, Better Pixels
Thank you