Enabling HDR Broadcast

Jason Power, Dolby

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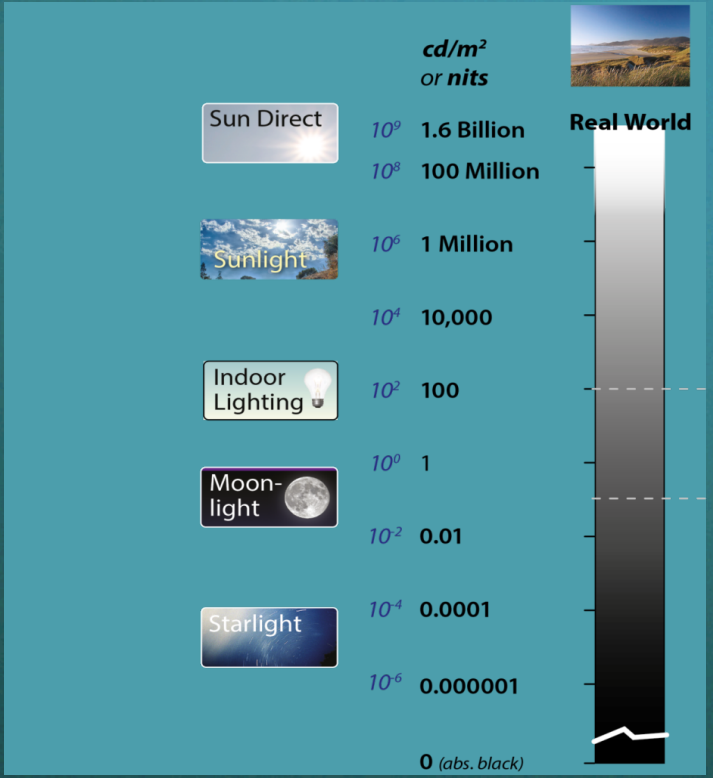
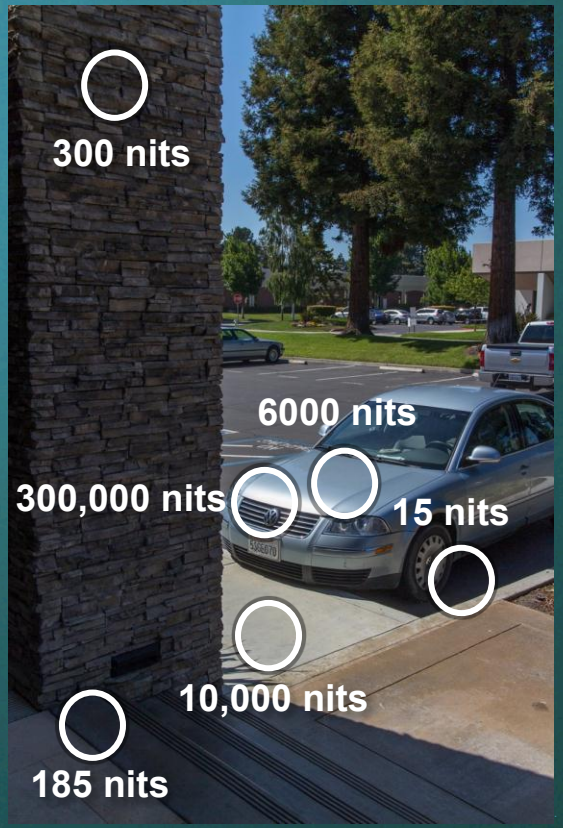
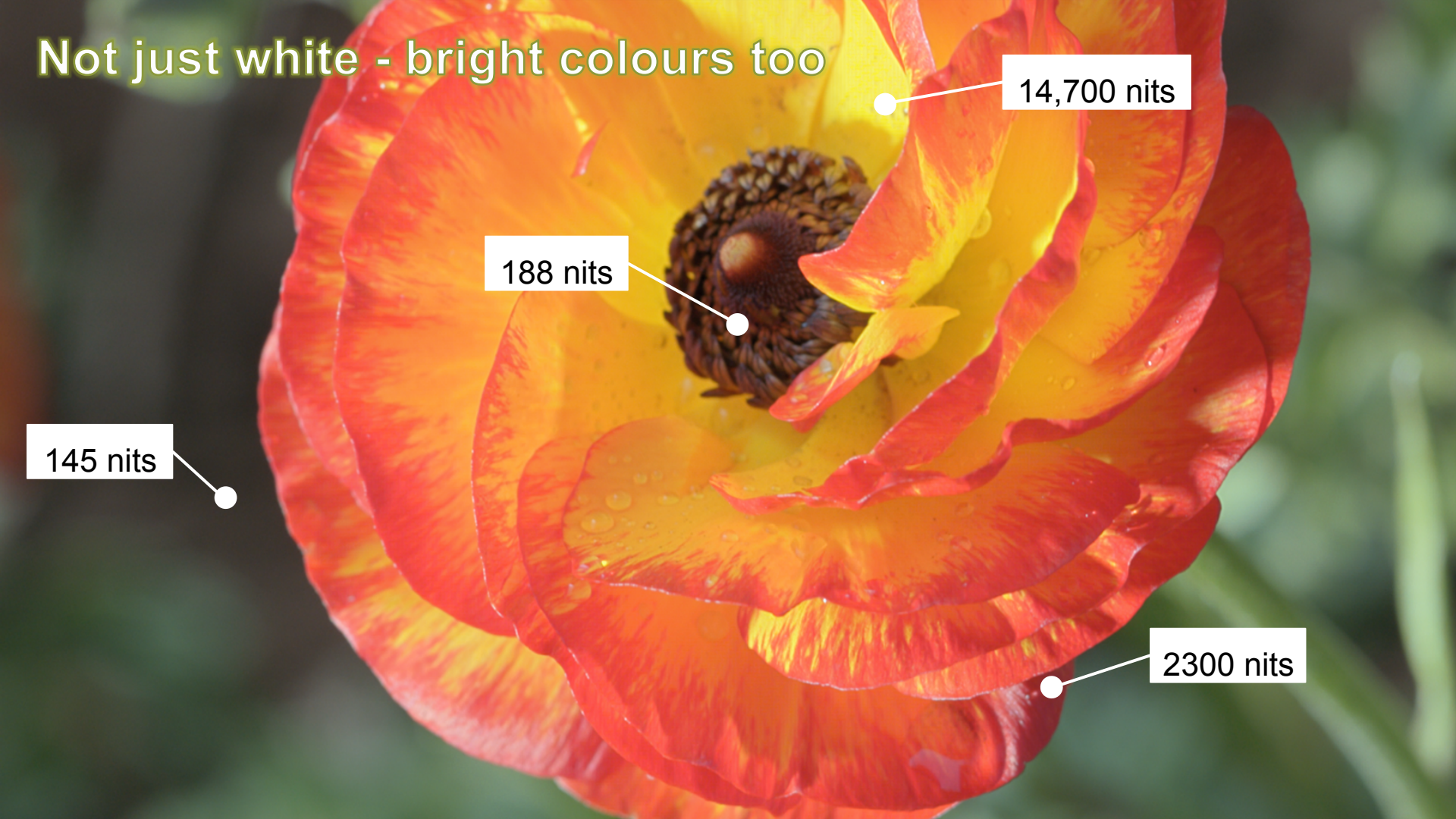
We see an incredible range of brightness in the world





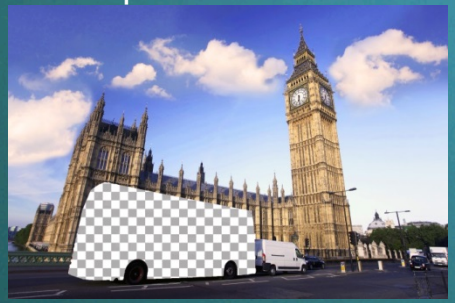
Light units are in candela/m², or **“nits”**

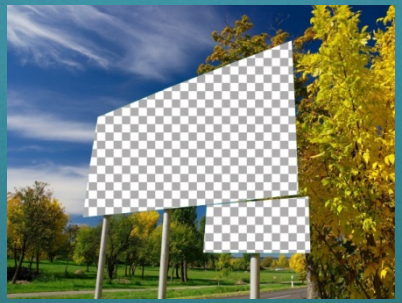

Not just white - bright colours too
14,700 nits
188 nits
145 nits
2300 nits

Showcasing new colours

Can now reproduce the true to life colors (Pointer's colors) like the iconic **RED** of a London bus, the **GREEN** of a California highway sign, the **CYAN** of the Pacific ocean, or a goal keeper **YELLOW** strip

TODAY





HDR/WCG

Enabling HDR

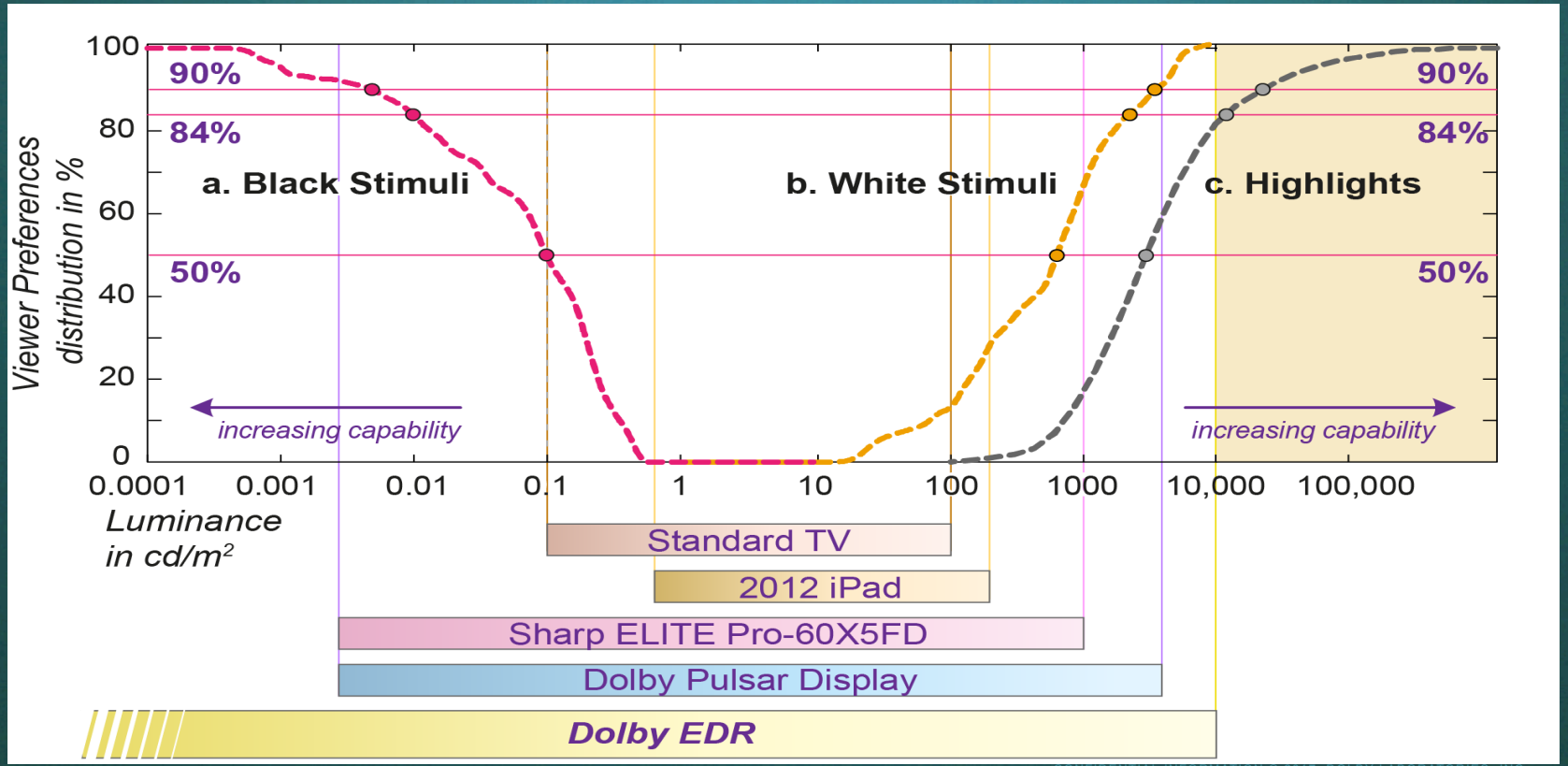
- How to represent a higher fidelity image?
- How to display faithfully on diverse displays in diverse environments?
- How to ensure a great user experience?

Enabling HDR #1: representing a higher fidelity image

What range for HDR?

- How to decide the range for systems and content with a multi-decade lifetime?
- Dolby built a prototype HDR P3 display which could create high brightness (20 000 nits) with high contrast
- 3 preference studies were conducted to determine the preferences for
  - Black level
  - Diffuse White maximum
  - Highlights

Support for 0.01-10,000 nits is preferable to viewers



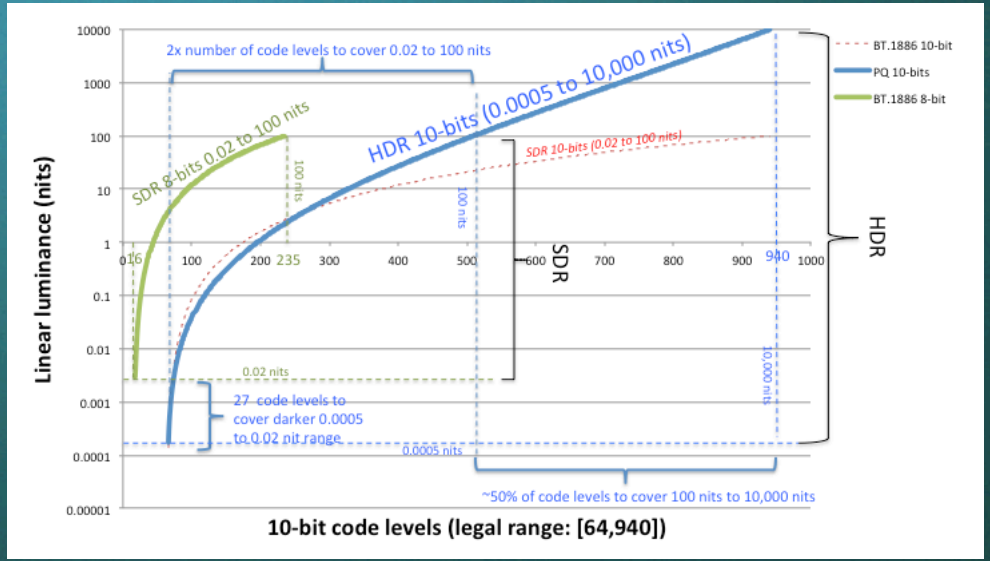
Requirements for an HDR signal representation

- Supports 0.01-10,000 nits
- Supports full ITU Rec.2020 colour space
- Effectively lossless for broadcast content at 10 bits; visually lossless at 12 bits where available
- Display independent – support a range of professional and consumer monitors
- Solve backward compatibility at the system level

PQ: a 10,000 nit capable representation for HDR signals

Perceptual Quantizer (PQ) transfer function developed based on psycho-visual characteristics

- Enables HDR to be carried in 10 and 12 bit workflows with no visible contouring
- Absolute scale, rather than normalised
- Standardised as SMPTE 2084, with no Dolby royalty



PQ is in use today for the first HDR content & services

- Basis for HDR10 and Dolby Vision delivery formats
- Adopted by all Hollywood Studios for HDR Distribution (IMF)
- Adopted for HDR Blu-Ray and by Vudu, Netflix and Amazon Instant Video
- Present in all HDR enabled TV's
- Included in ITU Recommendation for HDR broadcast program exchange and appearing in professional broadcast products

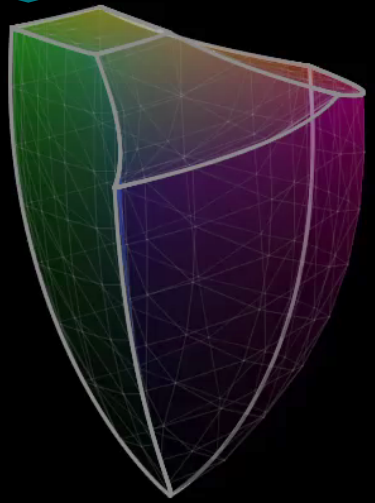
HDR live production in PQ – test conclusions

- Key PQ-capable HDR tools (cameras, displays, etc) are becoming available
- PQ can flow through conventional 10-bit infrastructure
- No HDR metadata is needed at production
- Prototype solutions exist for deriving 709 SDR from 2020 HDR
- More work to do to develop production tools and practice

Enabling HDR #2: mapping for different displays

Display Color Volume

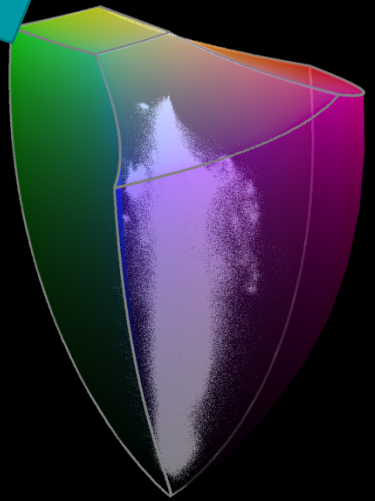
The 3D palette of all colors that can be reproduced at all allowable intensities



Content courtesy of the EBU

Image Color Volume

The pixels that comprise the HDR image change location on a frame by frame basis

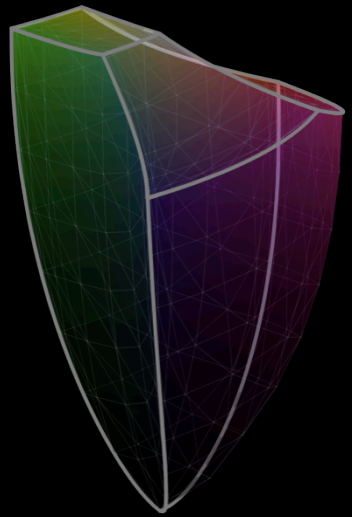


An HDR Image

Content courtesy of the EBU

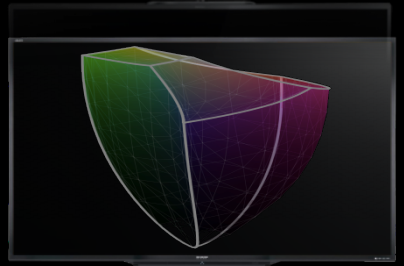
Optimising for diverse displays

- Each target display has a different color volume
- Use Color Volume Mapping to correctly place pixels into the target display color volume preserving relationships
  - Both Tone Mapping (intensity) and Gamut Mapping (color)



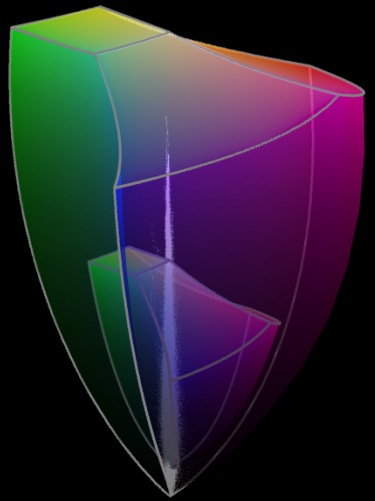
High end HDR Display e.g. OLED/LCD

Legacy SDR 709 Display

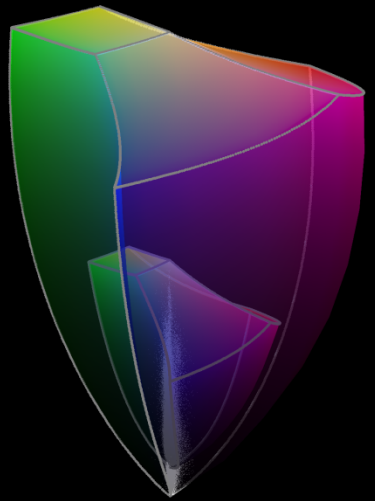


Future HDR Display

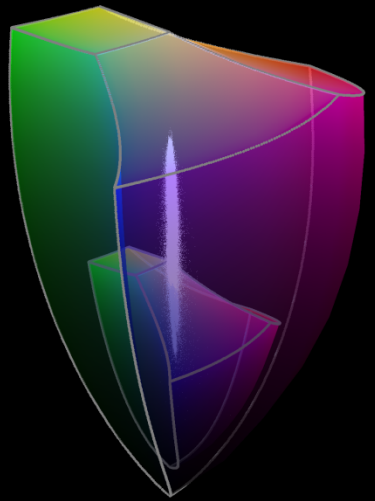
White Feathers – contains both bright & dark colors



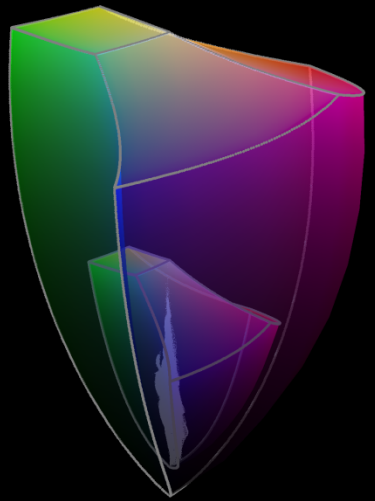
Dark Feathers – contains only dark colors



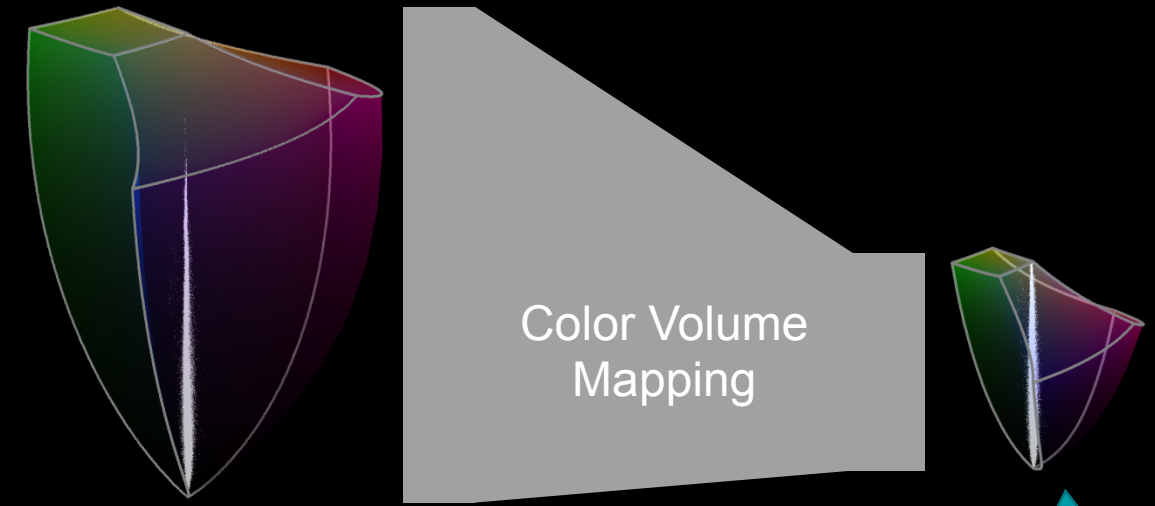
Glacier – contains only bright colors



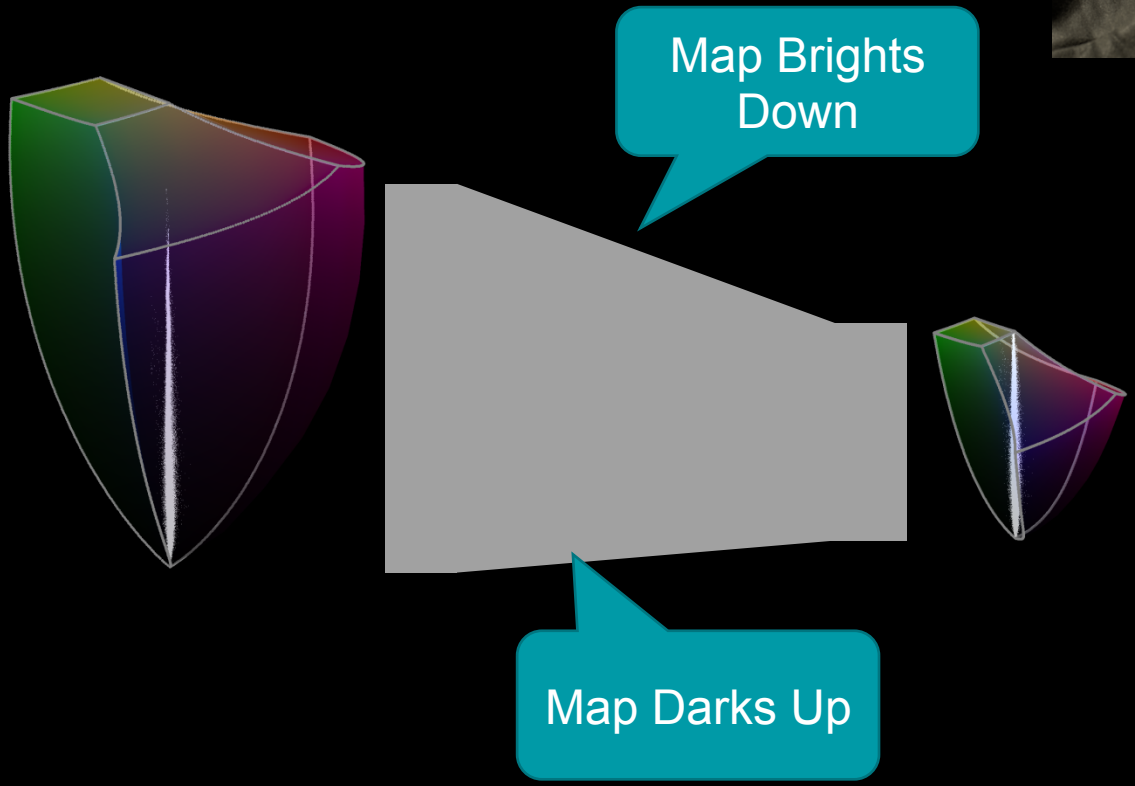
Sugar and Beans – contains no bright or dark colors



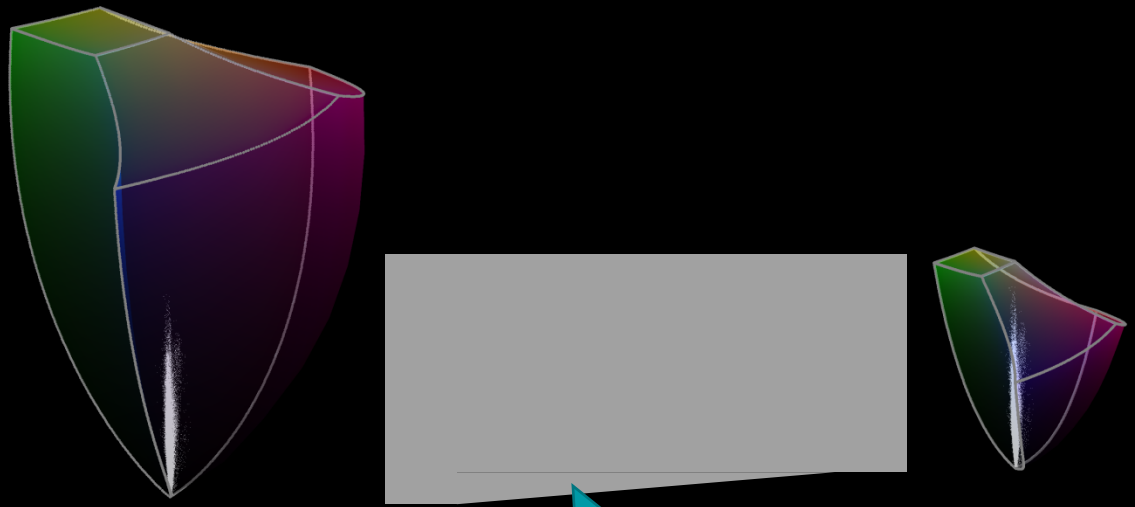
Static Mapping of HDR to SDR



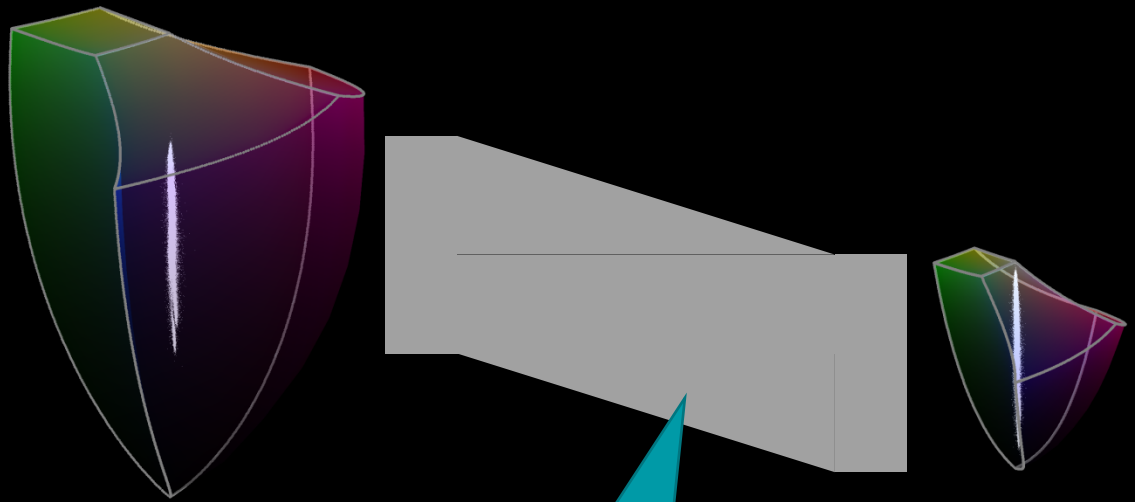
Dynamic Mapping



Dynamic Mapping



Dynamic Mapping



Dynamic Mapping

No Mapping Needed!

Mapping HDR to SDR: White Feathers

Static Metadata

Dynamic Metadata

Same mapping in this case

Mapping HDR to SDR: Black Feathers

Static Metadata

Dynamic Metadata

Less compression of dark detail

Mapping HDR to SDR: Glaciers

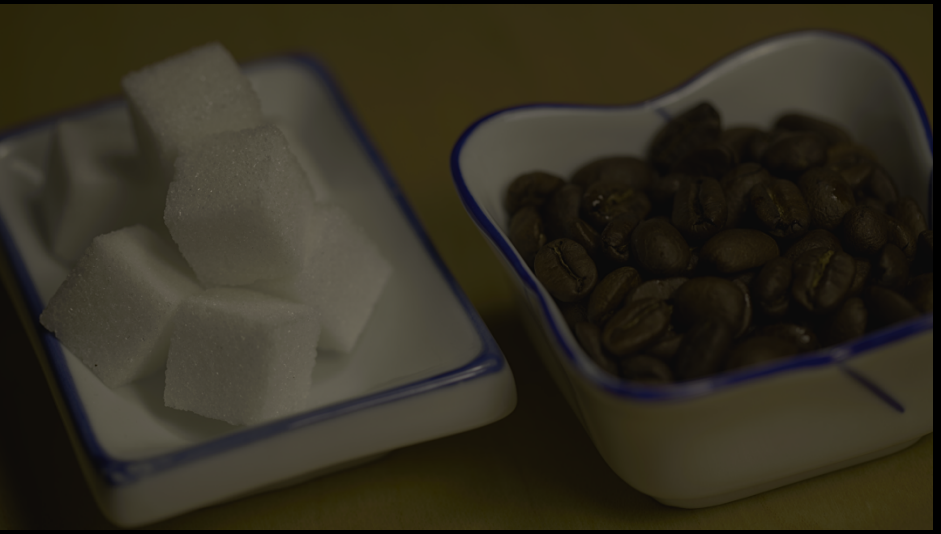
Static Metadata

Dynamic Metadata

Less compression of highlight detail

Mapping HDR to SDR: Sugar and Beans

Static Metadata



Dynamic Metadata

Less mapping of image since already in range

Dynamic display mapping in practice

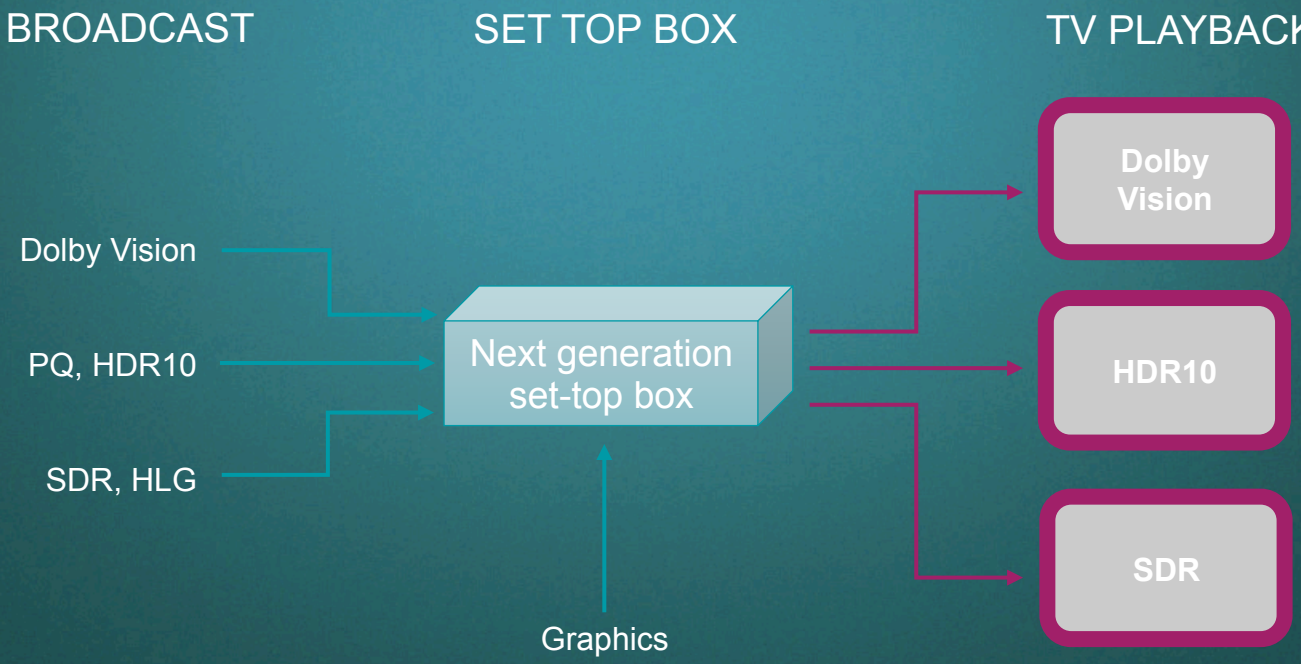
- Dynamic display metadata standardised as SMPTE 2094-10
- Supported in Dolby Vision TVs from several major brands including LG and Sony
- Metadata created during grading for premium post produced content
- 100+ Dolby Vision movie titles mastered so far and available on OTT platforms
- For broadcast, metadata can be created automatically at point of transmission encoding
- Content can be backward compatible with non-Dolby HDR10 TVs

Enabling HDR #3: ensuring a fantastic user experience

User experience considerations

- Deployed UHD TVs have very mixed capabilities
  - SDR vs HDR, 709 vs 2020, supported HDR formats
- Some issues with dynamic format switching
  - desirable to hold input format constant
- Early UHD set top box silicon has limited HDR processing capabilities
  - Passthrough may be supported
  - Limitations for conversion, blending, graphics, etc

Universal playback, consistent output



Enabling HDR broadcast

Summary

- PQ is a high quality universal HDR format that is commercially deployed for content, services and TVs
- With Dolby Vision, the display experience is optimised by the addition of dynamic metadata in post or at transmission
- Important to consider the overall user experience – handling of mixed content, mixed displays will be key

jason.power@dolby.com

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