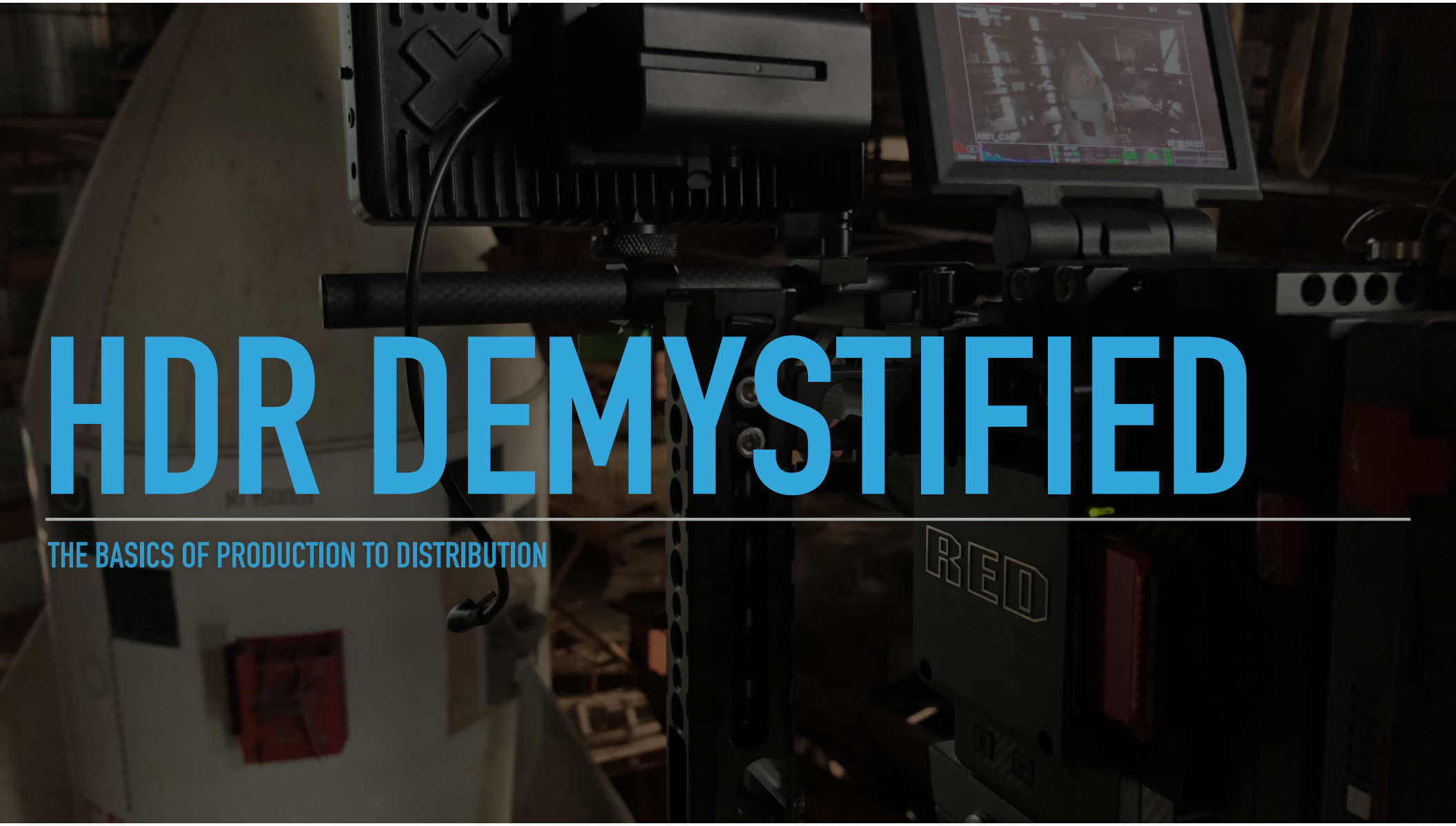


HDR DEMYSTIFIED

THE BASICS OF PRODUCTION TO DISTRIBUTION

PHILIP GROSSMAN

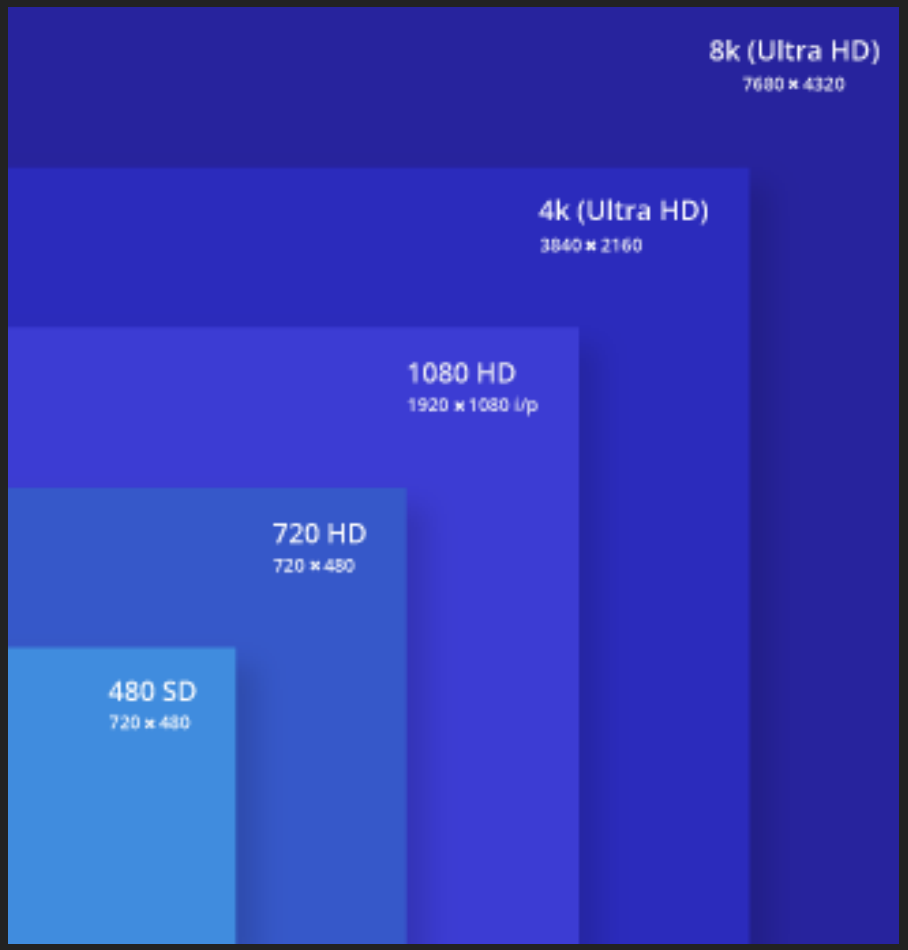
- Vice President Imagine Advisory Services
- 20 plus years in media technology
- Produced and hosted “Mysteries of the Abandoned: Chernobyl’s Deadly Secrets”
- RED Digital Cinema Adjunct Instructor

WHAT WE WILL COVER

- What HDR is NOT
- What HDR is
- How do we produce and deliver it

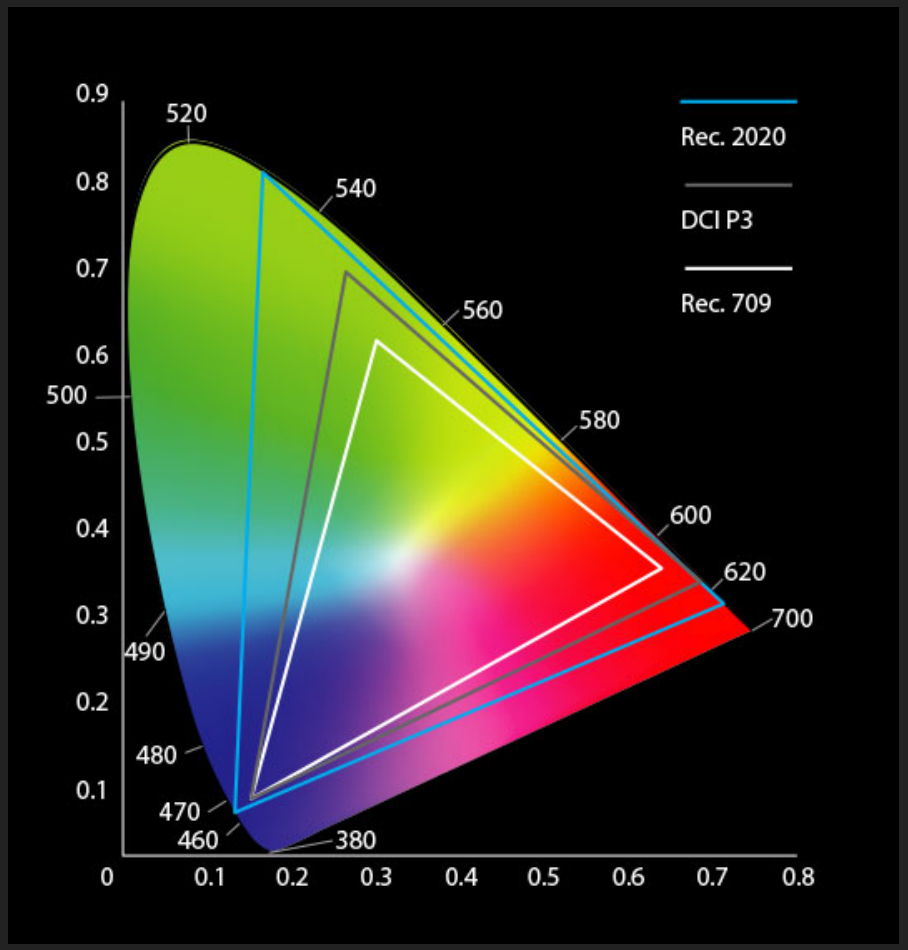
HDR IS NOT. . . . . .

- It is not RESOLUTION



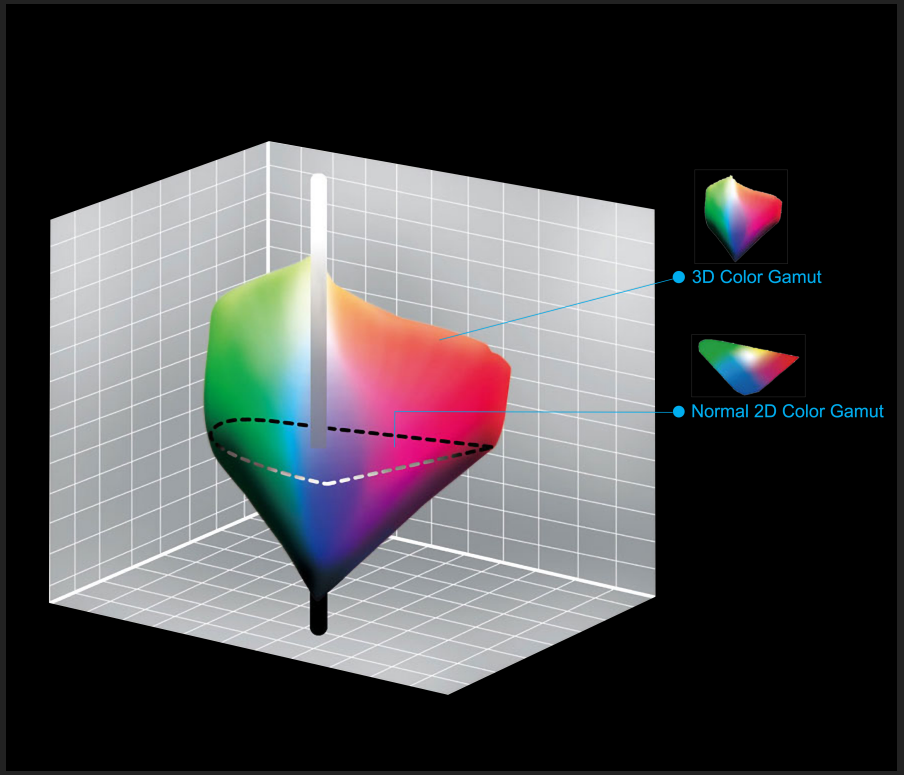
HDR IS NOT. . . . . .

- It is not RESOLUTION
- It is not COLOR



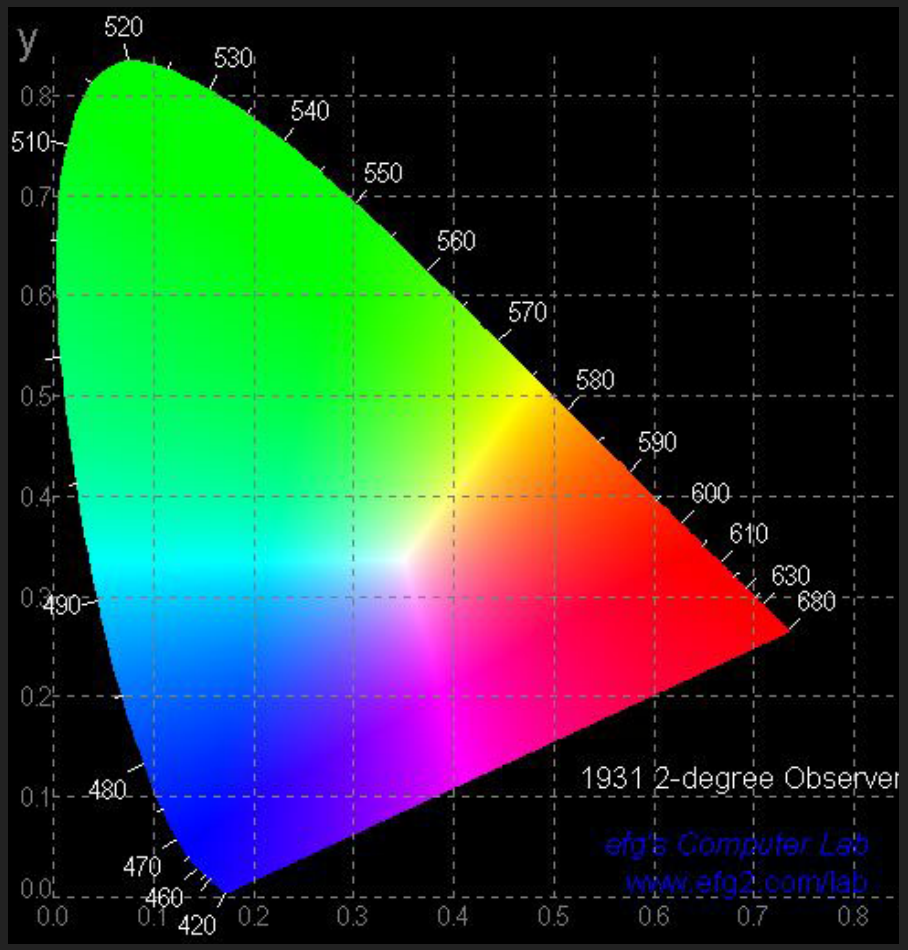
HDR IS NOT. . . . . .

- It is not RESOLUTION
- It is not COLOR
  - CIE 1931 RGB color space - Perceived Color



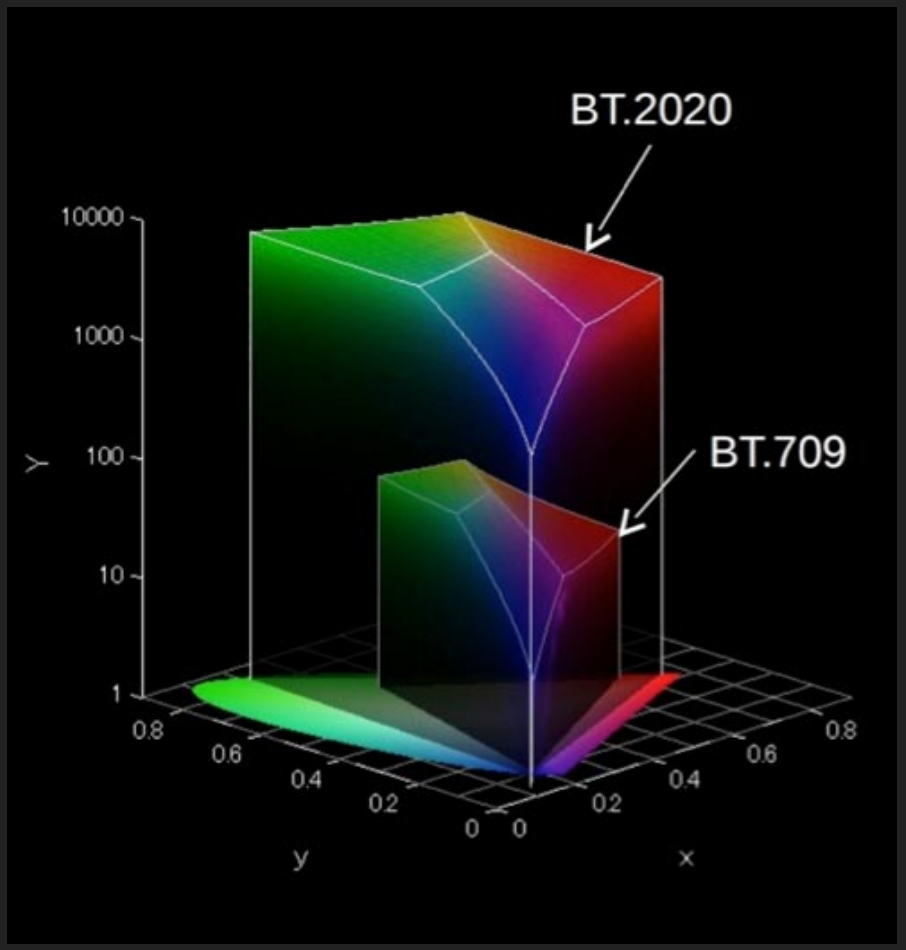
HDR IS NOT. . . . . .

- It is not RESOLUTION
- It is not COLOR
  - CIE 1931 RGB color space - Perceived Color
    - Encompasses total spectrum visible to a human being (corrected for standard colorimetric observer)
    - Eye's have three (3) types of cones sensitive to specific wave lengths
      - •S (short): Around blue (~ 445 nm, (2 %, but most sensitive)
      - •M (middle): Around green (~ 535 nm, (33 %)
      - •L (long): Around red (~ 575 nm, (65 %)



HDR IS NOT. . . . . .

- It is not RESOLUTION
- It is not COLOR
  - CIE 1931 RGB color space - Perceived
- REC 709 and REC 2020 Color Volume



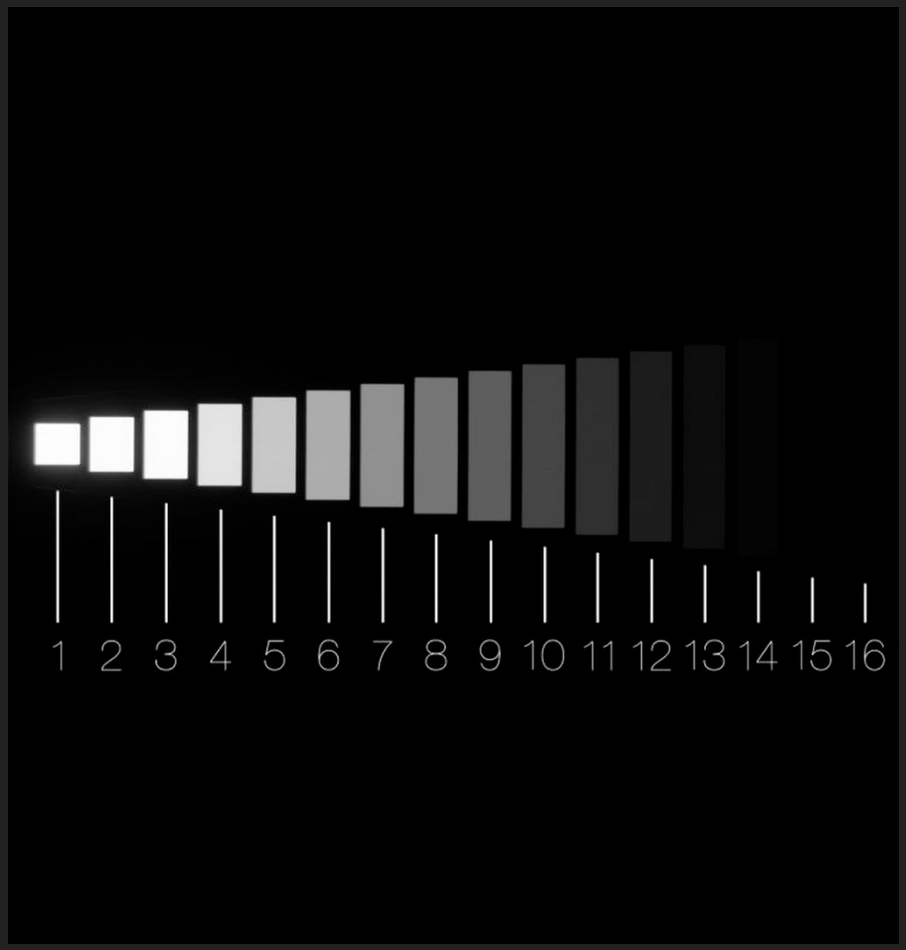
WHAT IS HDR?

THE BASICS

- Dynamic Range describes the measurement between the maximum and minimum values in a system
- Measurement between the “whitest” whites and the “blackest” blacks or simply put, the luminance range, measure in Nits
- As mentioned before, Dynamic Range and Color Space are not the same thing, but are related.

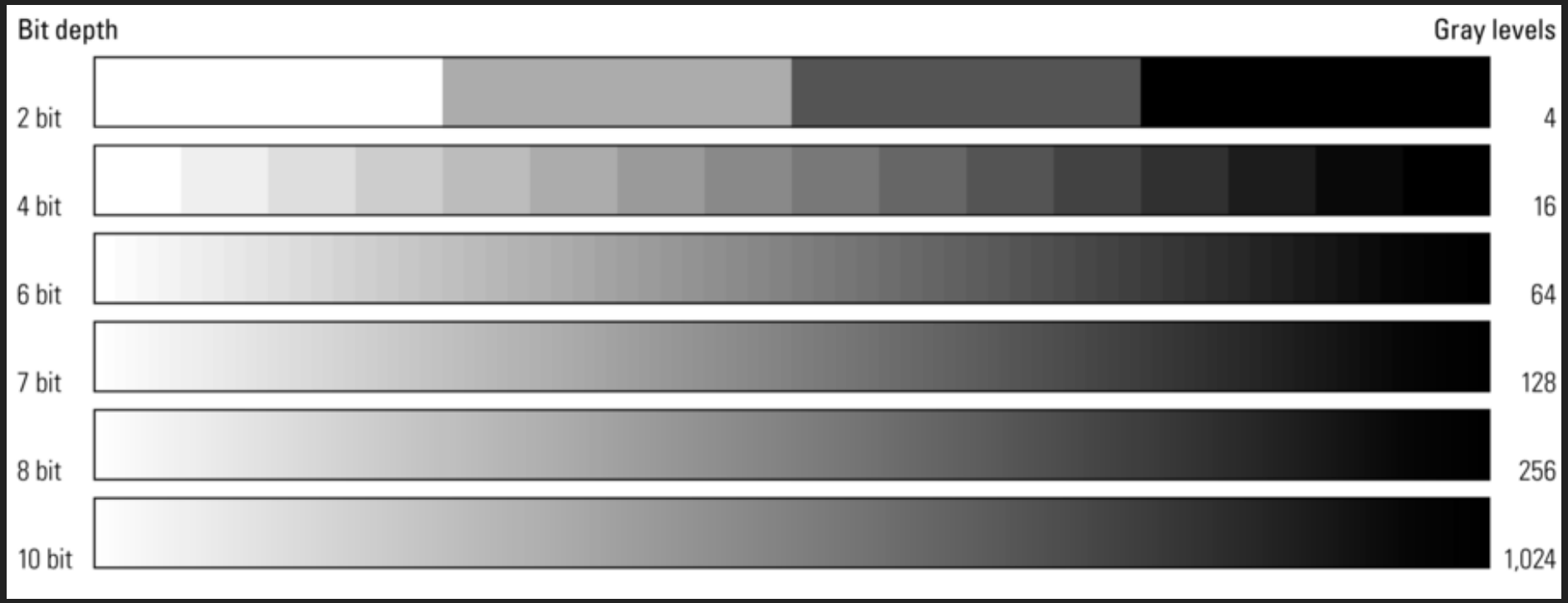
THE BASICS

- Dynamic Range is Measured in STOPS
- A STOP is the doubling fo the value of Luminance
  - A stope loosely equates to “bits” in luminance values
    - 8 bits is approximately 8 stops
    - 10 bits is approximately 10 stops
- Follows the Stephans’ Power Law - greater sensitivity between darker tones than between light ones



THE BASICS

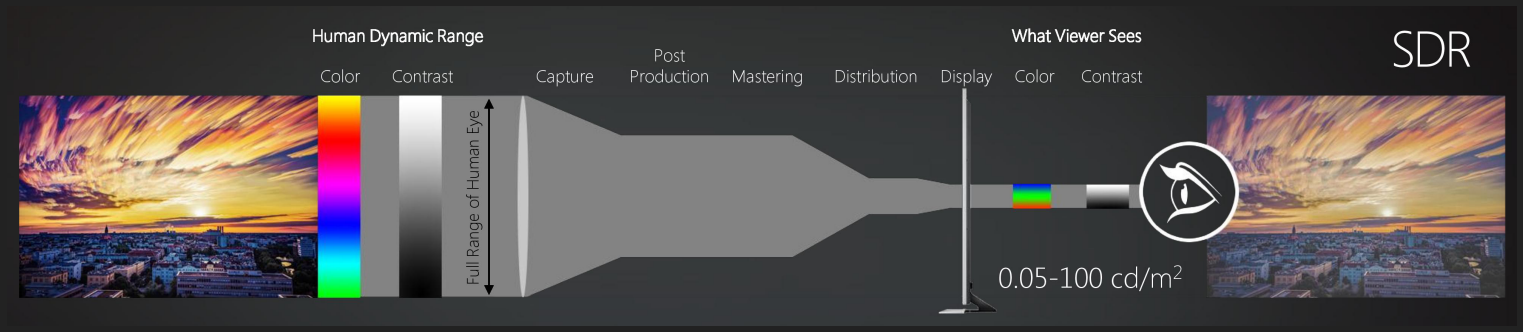
DYNAMIC RANGE – BITS/NITS/GRAY LEVELS



THE BASICS

LET'S TAKE A STEP BACK ….WHAT IS SDR?

- Standard Dynamic Range
  - Utilizes a Gamma Curve to encode and decode luminance values
  - SDR sets have a brightness between 80 and 100 Nits
  - Utilizes 8 Bit Color
- Roughly 6 to 7 Stops of Dynamic Range



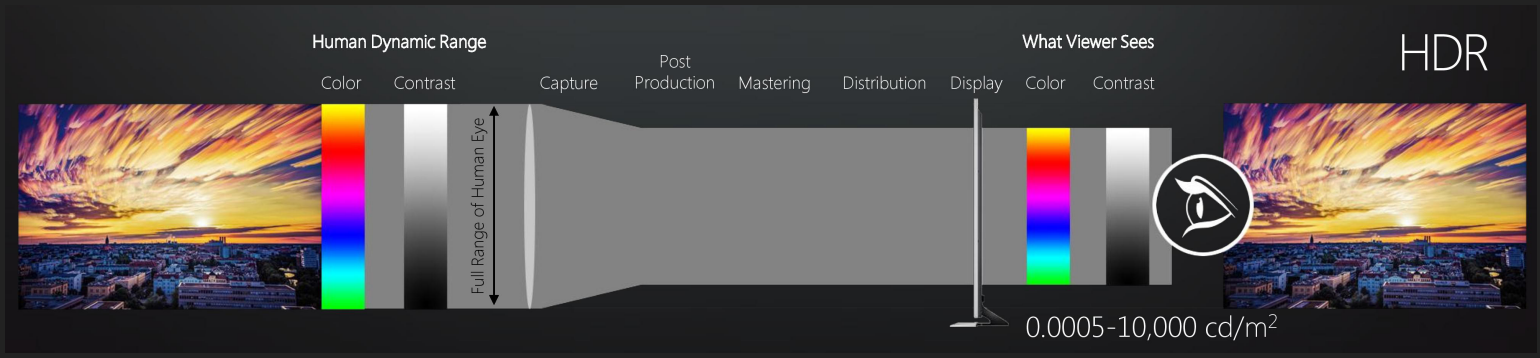
THE BASICS

HDR STANDARDS

- EOTF vs Gamma Curves
  - SDR utilizes standard Gamma Curves based on CRT response (BT 1886 – 2011)
  - HDR utilizes new Electro-Optical Transfer Functions (EOTF)
- HDR EOTF's
  - SMPTE ST - 2084 (Perceptual Quantization - PQ)
  - BBC/NHK - Hybrid-Log Gamma

DOLBY VISION

HDR 10 HLG



HDR – PQ & HLG

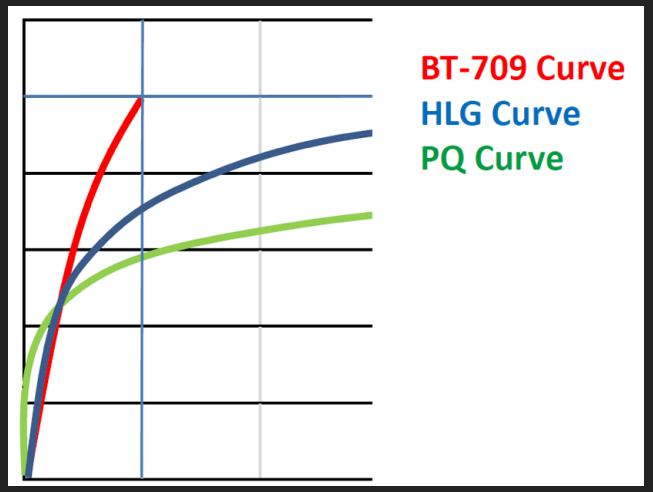
HDR STANDARDS

- Perceptual Quantization (PQ) - A quantizing function that mimics human perception. Developed by Dolby, a key part of HDR10, Dolby Vision and Ultra HD Alliance Standards.
  - Standardized by SMPTE in ST 2084 (1,000 to 10,000 Nits)
  - Utilizes Meta Data to ensure “absolute” reference in its EOTF
  - Not backwards compatible
- Hybrid-Log Gamma - Developed by the BBC and NHK as a backward compatible way of delivering HDR to the home
  - No meta data required
  - Backwards compatible
  - Best suited for Live Production
  - Standardized in BT 2100

HDR – PQ & HLG

HDR PRODUCTION

- PQ "requires" meta data to be calculated
  - MaxFALL - Maximum Frame Average Light Level
  - MaxCLL - Maximum Content Light Level
- HLG does not require meta data
  - Nonlinear transfer function - lower half of the signal values use a gamma curve and the upper half of the signal values use a logarithmic curve
  - Not "absolute" values, so whites could look grey



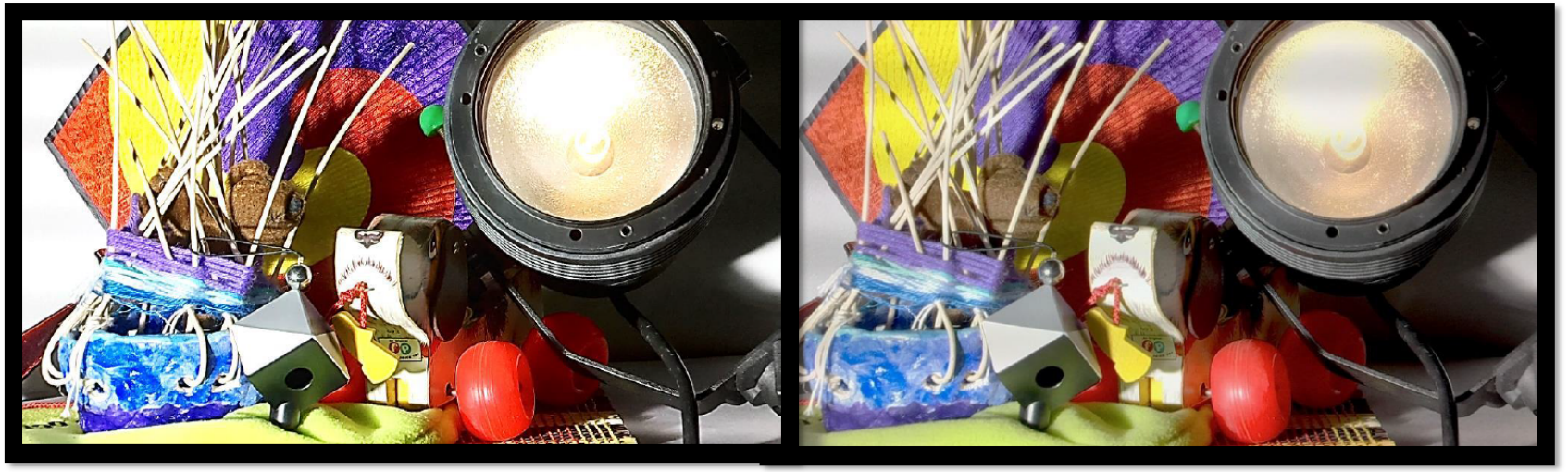
HDR – PQ & HLG

HDR LIVE PRODUCTION CONSIDERATIONS

- Are all elements in the signal path HDR?
  - Anything that touches “color” will affect the signal
  - Need to “up-convert” signals to same color space
- Do graphics need to be HDR?
  - Graphics typical are very “specific” colors
  - HDR “Colors” will not translate to SDR exactly
- Should you produce in 10 or 12 Bits?
  - Are you recording for historical playback?
- How bright is too bright?

HDR – COMPATIBILITY

HLG TO SDR



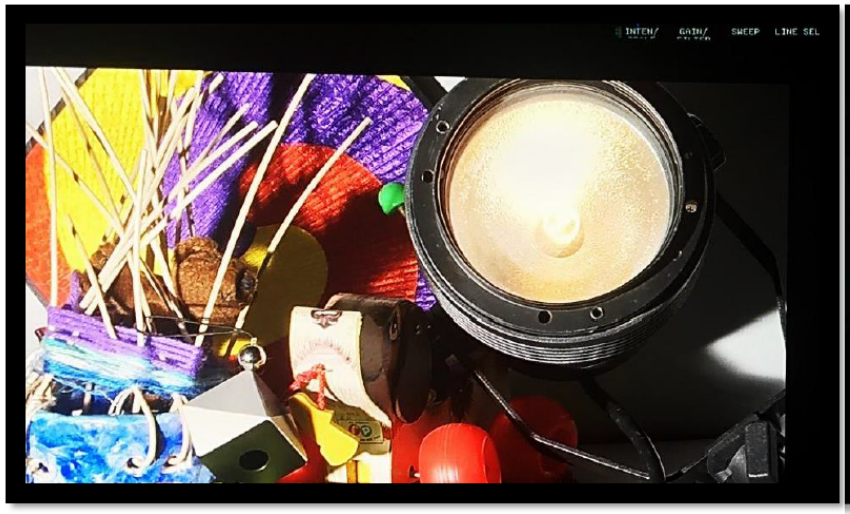
4K HDR monitor (HLG)

HD SDR monitor (HLG)

HLG "Hybrid" Log-Gamma Curve is more compatible with SDR displays.

HDR – COMPATIBILITY

PQ TO SDR



4K HDR monitor (PQ)

HD SDR monitor (PQ)

The PQ curve will appear grey, muddy & washed out a SDR display.

HDR – HOW IMPORTANT IS META DATA?

imagine COMMUNICATIONS

PQ TO SDR

displaycalibrations.com

HDR10 UltraHD Movies Static Metadata InfoFrame

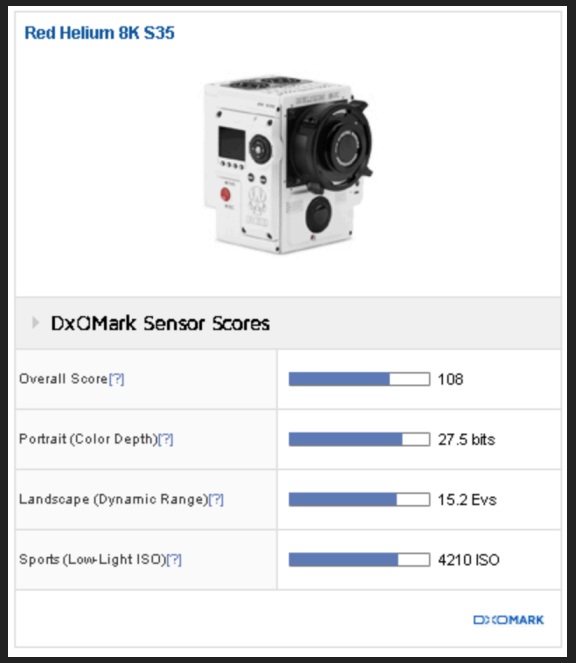
Mastering Display Color Volume & Content Metadata Database

Release Details			Mastering Display Color Volume Metadata				Content Metadata	
Title	Studio	Region	Display Primaries	White Point	Maximum	Minimum	MaxCLL	MaxFALL
Blade Runner 2049	Warner Bros		REC.2020	D65	10000 nits	0.005 nits	181 nits	73 nits
Blade Runner 2049	Sony/Columbia Pictures		DCI-P3	D65	4000 nits	0.005 nits	457 nits	179 nits
Dunkirk	Warner Bros		DCI-P3	D65	4000 nits	0.005 nits	323 nits	144 nits
Dunkirk	Warner Bros		0	0	0 nits	0 nits	0 nits	0 nits
Life of Pi	20th Century Fox		0	0	0 nits	0 nits	0 nits	0 nits
Life of Pi	20th Century Fox		DCI-P3	D65	1100 nits	0.000 nits	0 nits	0 nits
Valerian and the City of a Thousand Planets	LionsGate Films		DCI-P3	D65	4000 nits	0.005 nits	0 nits	0 nits
Valerian and the City of a Thousand Planets	LionsGate Films		DCI-P3	D65	1000 nits	0.005 nits	632 nits	298 nits

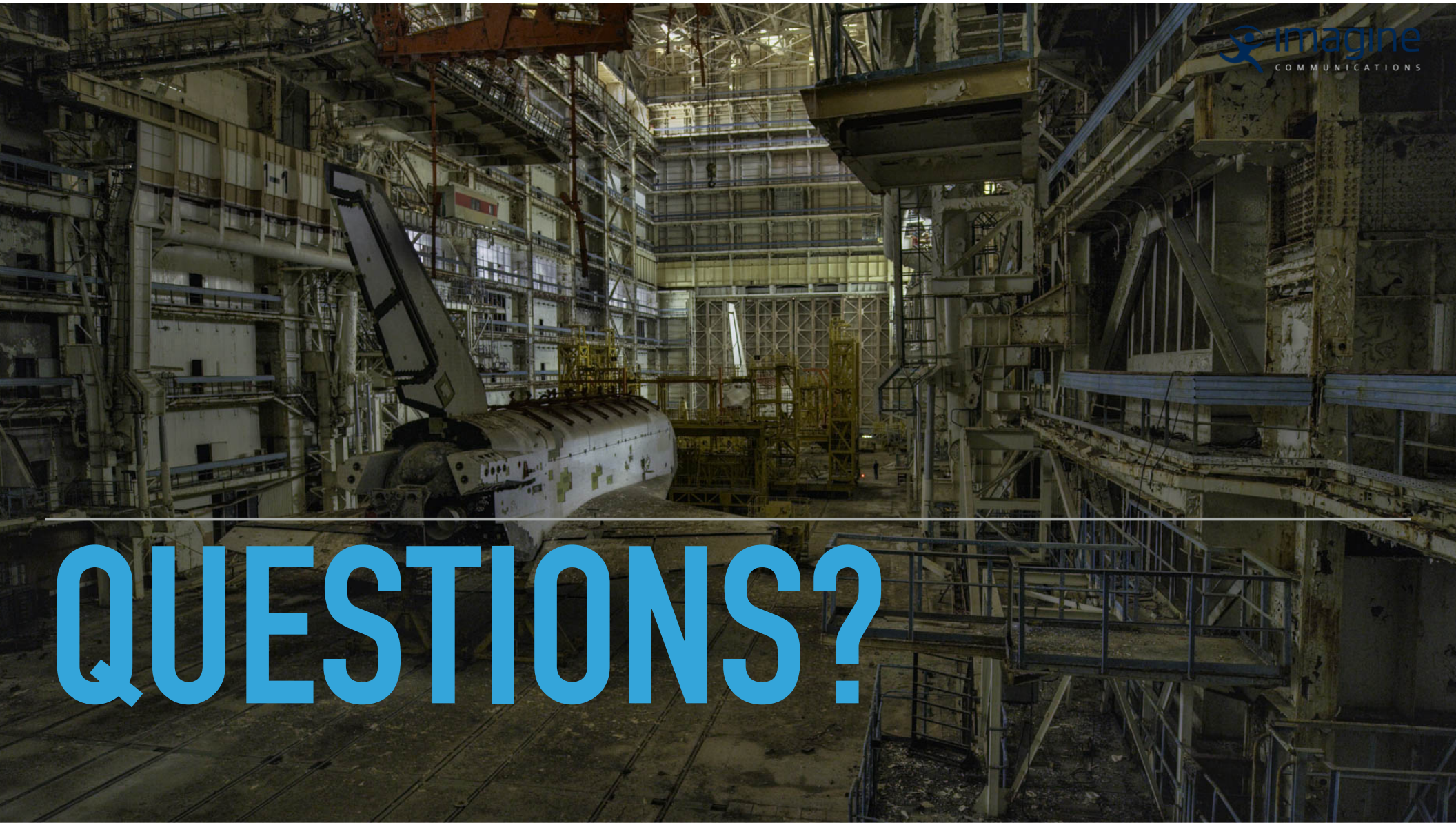
HDR

WHAT DO YOU NEED TO CREATE IT

- Camera Cable of Capturing at least 10 Stops of Dynamic Range
  - Typically will shoot in Log or RAW formats
  - 10 Bit Color or better
- Production Pipe Line
  - All components must pass through or support Color Space/HDR format
  - HDR capable monitors to view material




REC709
PQ
HLG


imagine
COMMUNICATIONS
QUESTIONS?