



UHD Phase 2: Status and next steps



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File Transcoding Product Marketing Manager

One Step Closer to the Real Thing

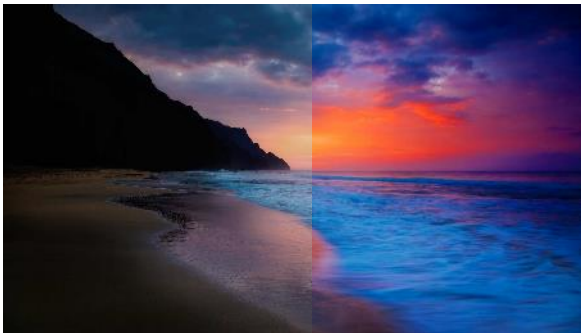
Higher resolution



High Dynamic Range (HDR)



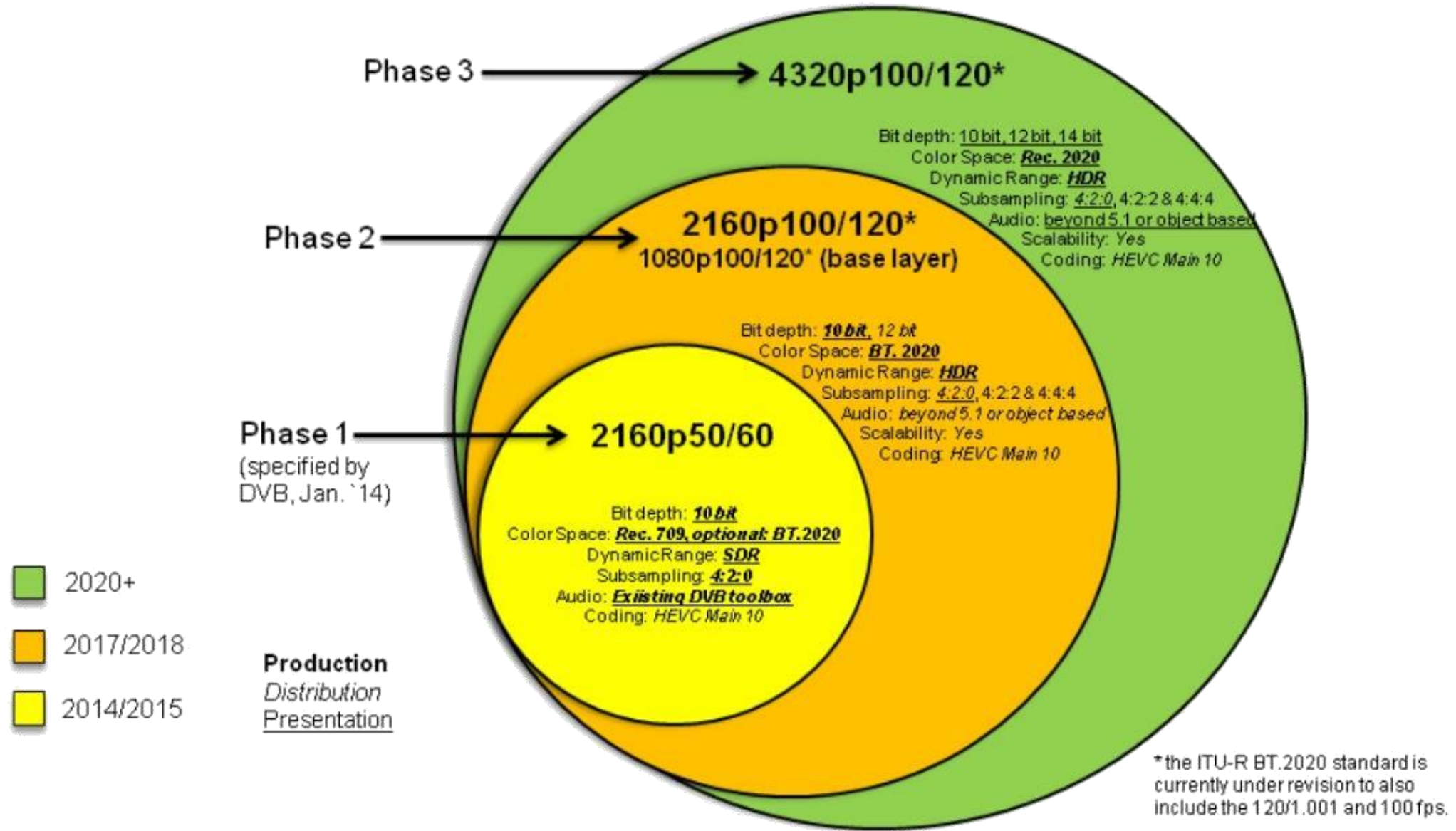
Wide Color Gamut (WCG)



High Frame Rate (HFR)



UHD phases as defined by DVB



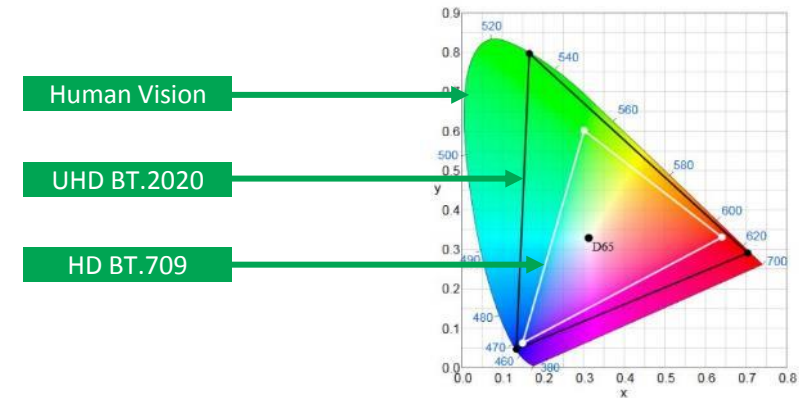
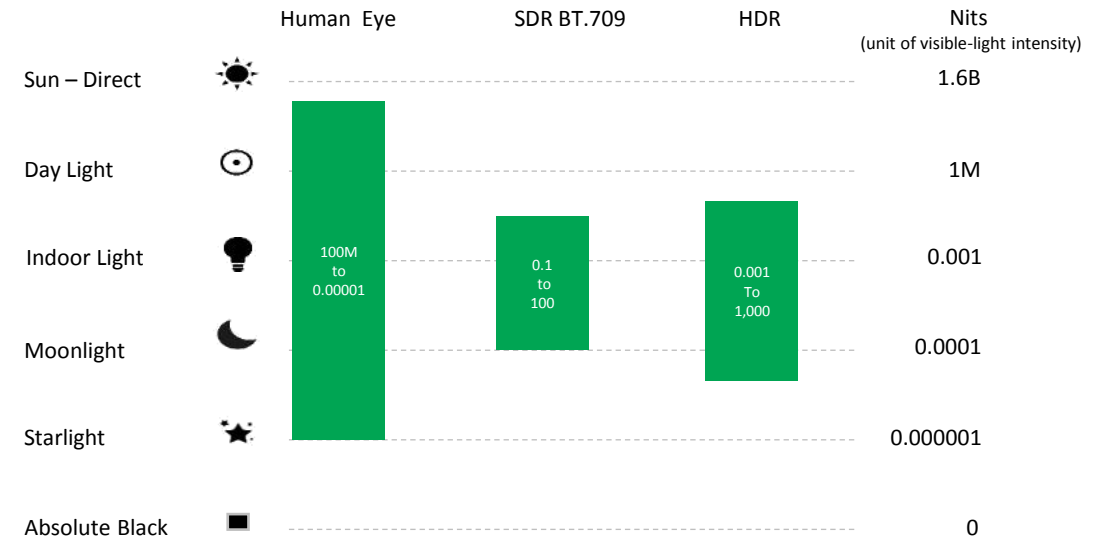
HDR Content now Available to End-Users

- 4 Fox titles, more on the way
 - On Samsung SUHD TV like JS9500
 - From M-Go VOD platform
 - Using SCSA/Vidity DRM
 - Stored on Samsung Video Pack HDD
 - Encoded with ATEME TITAN File
 - Press [here](#)
-
- Next step: Ultra HD Blu-ray by Q4



Higher Luminance Level & More Color Shades

- High Dynamic Range (HDR)
 - Represent a greater range of luminance levels, closer to the human eye range of luminance
- Wide Color Gamut (WCG)
 - BT.2020: pure spectral primary colors
 - This wide color gamut encompasses 75.8% of the visible colors, vs. the current color space BT.709 with 35.9%

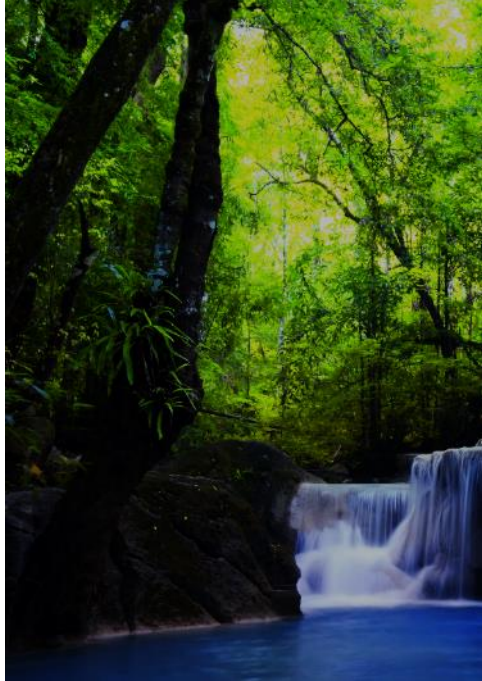


HDR Luminance

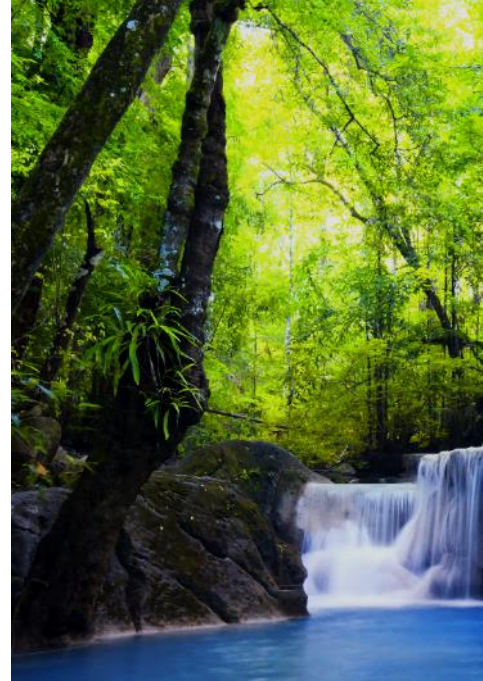
Units:

- Candelas per square meter - “nit”
- 1 nit = 1 candela/m²

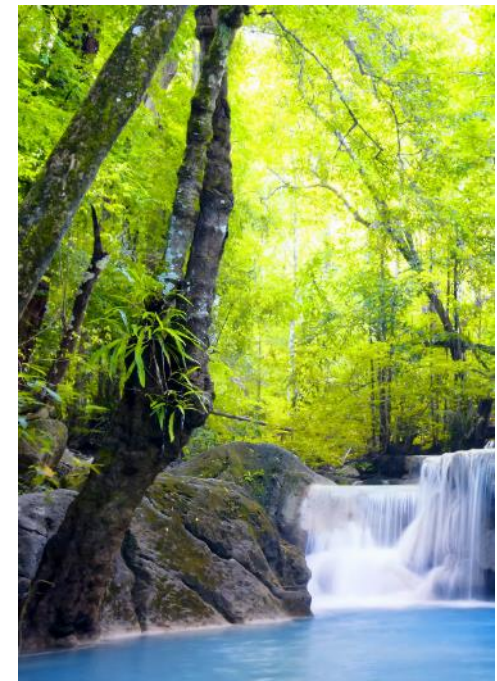
Cinema Theatre
48



LCD TVs
~300-400



HDR TVs
>1000



SDR vs. HDR

Standard Dynamic Range



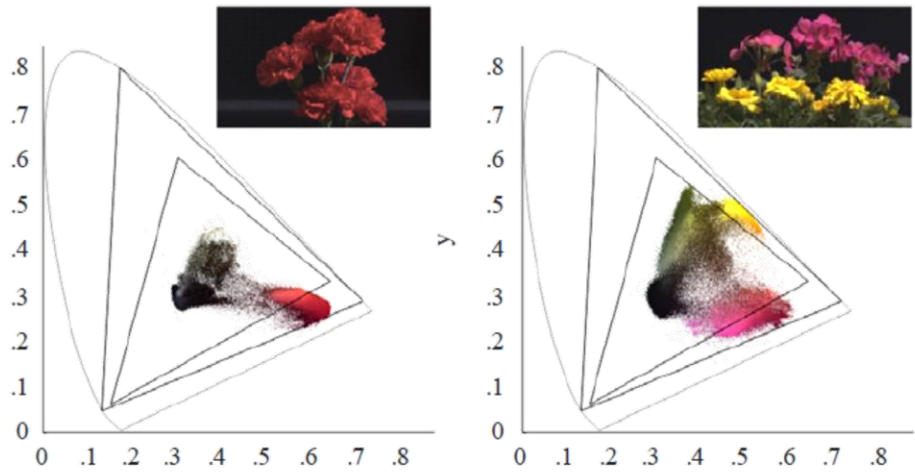
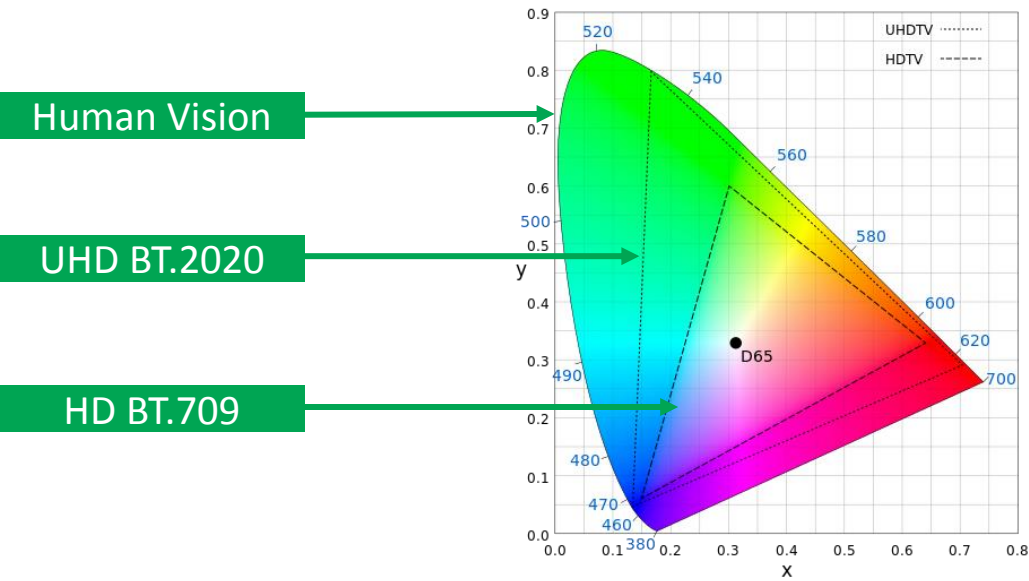
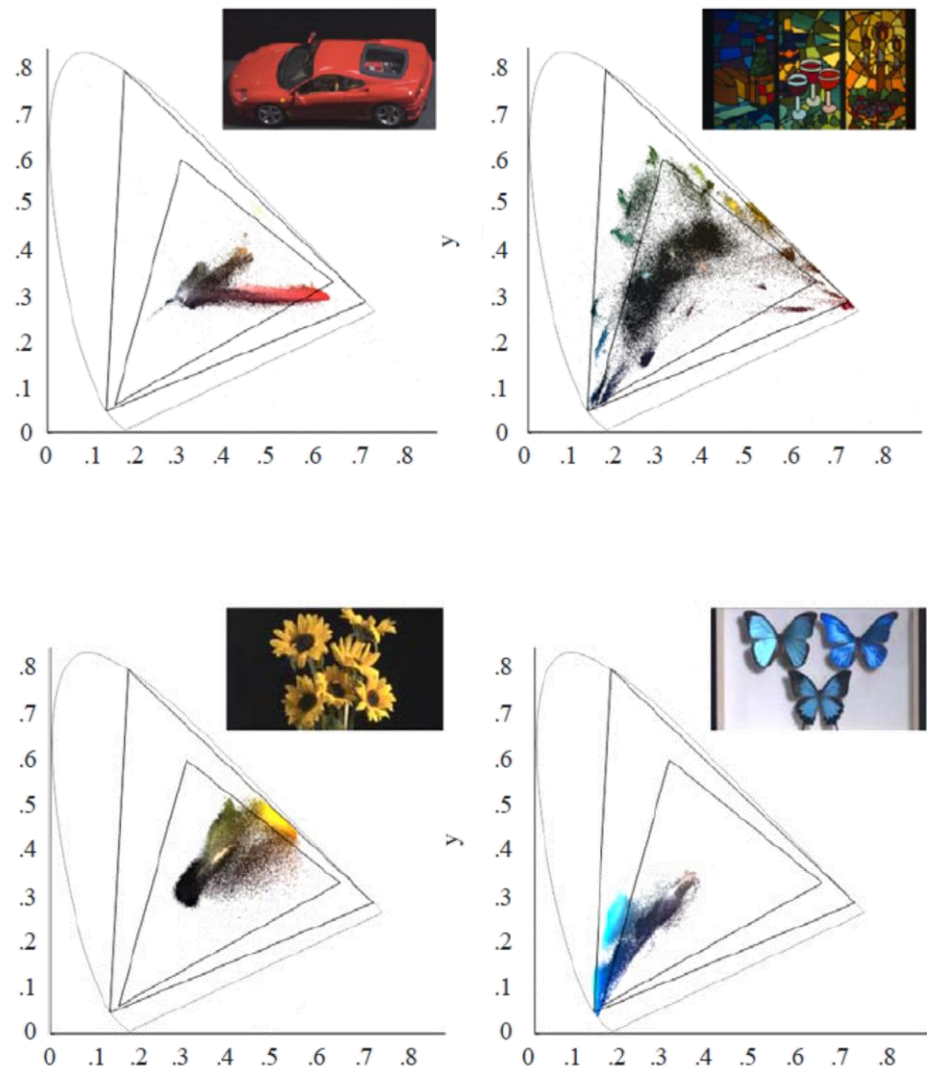
High Dynamic Range



- Increased contrast
 - Bright areas (e.g. > 1000 nits) , Dark areas (e.g. < 0.005 nits)
- Luminance range rendering closer to the real world luminance range
- HDR vs SDR higher gain than UHD vs HD
 - Perceived video quality increases with peak luminance level, optimal range 750 to 1500 nits

Wide Color Gamut (WCG)

Source: Report ITU-R BT.2246-3



BT.709 vs. BT.2020

BT.709



BT.2020

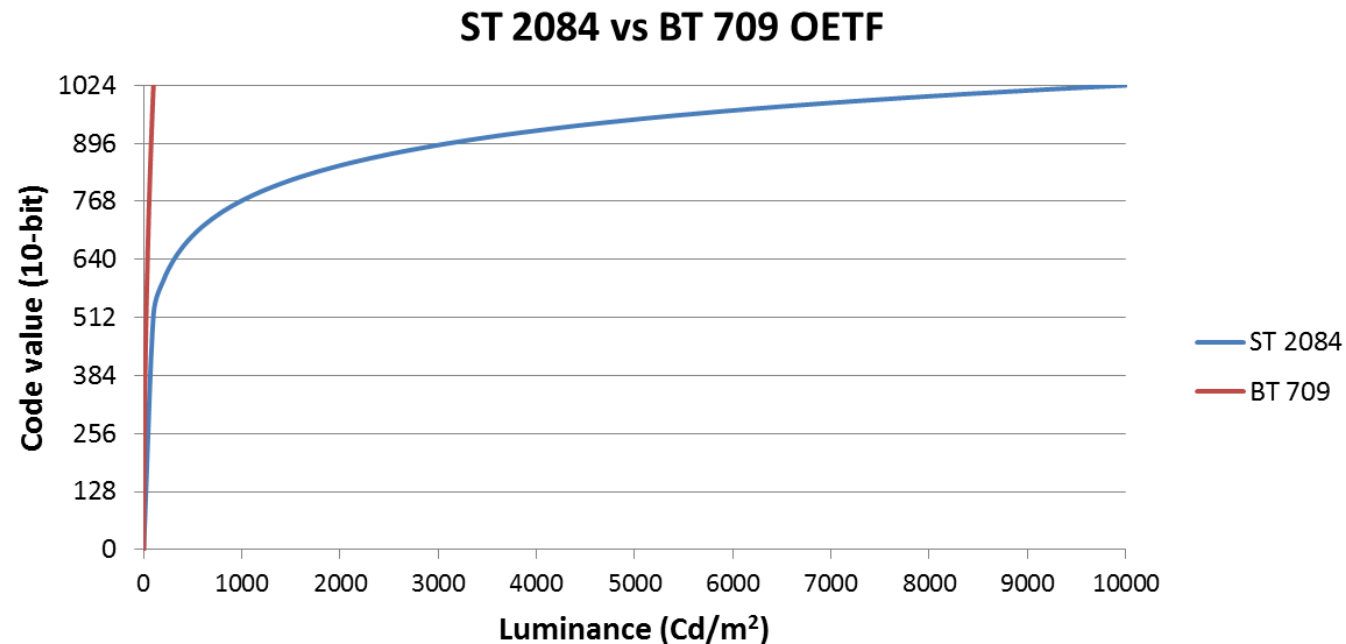


Simulation

- Richer and more vibrant colors

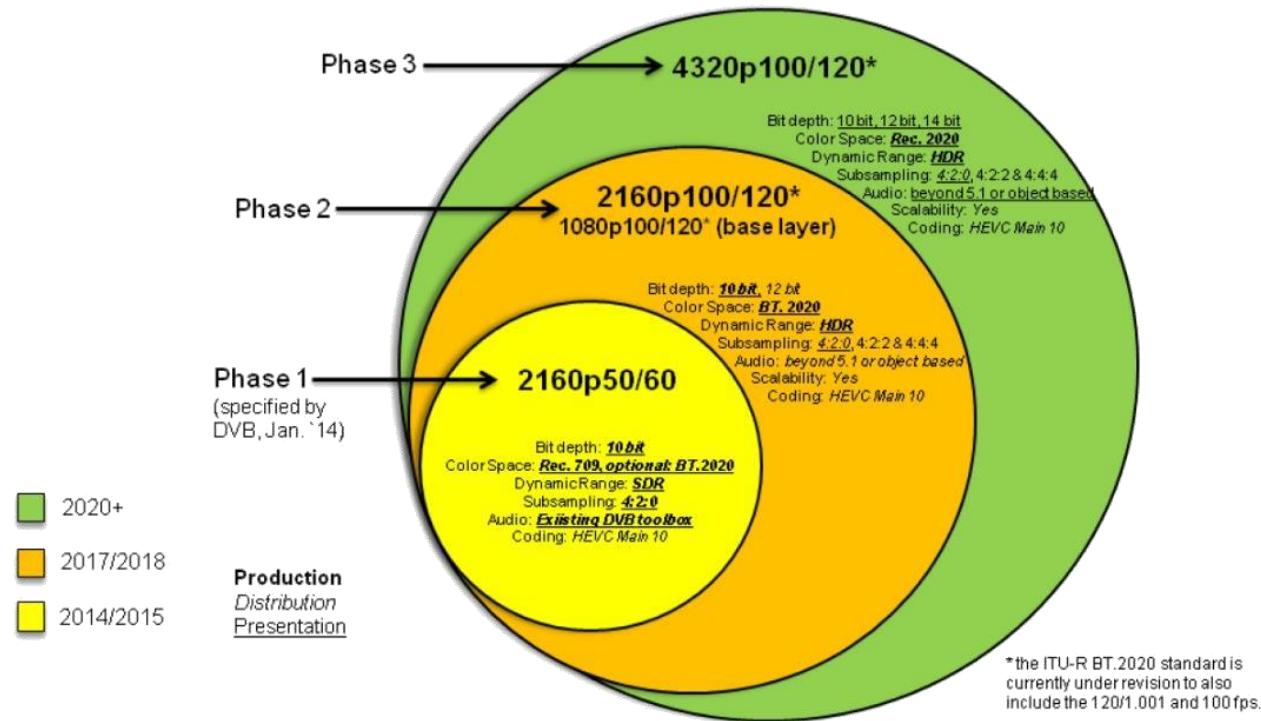
Opto Electronic Transfer Function (OETF)

- PQ (Perceptual Quantizer - SMPTE ST-2084) is the most efficient use of bits throughout entire range
- HDR, being closer for the human visual system, does not rely on gamma correction curve like SDR



UHD: Spec Completed, Next: HDR & WCG

		Phase-1 (now)	Phase-2	Phase-3
1	Dynamic range	SDR	HDR	
2	Color gamut	BT.709	BT.2020	
3	Resolution	3840x2160p		8K
4	Sample & bit depth	4:2:0, 8–10 bits	4:2:2 , 4:4:4 10-12bit	14bit
5	Frame rate	50/60	100/120	



UHD Eco-System Standardization Status

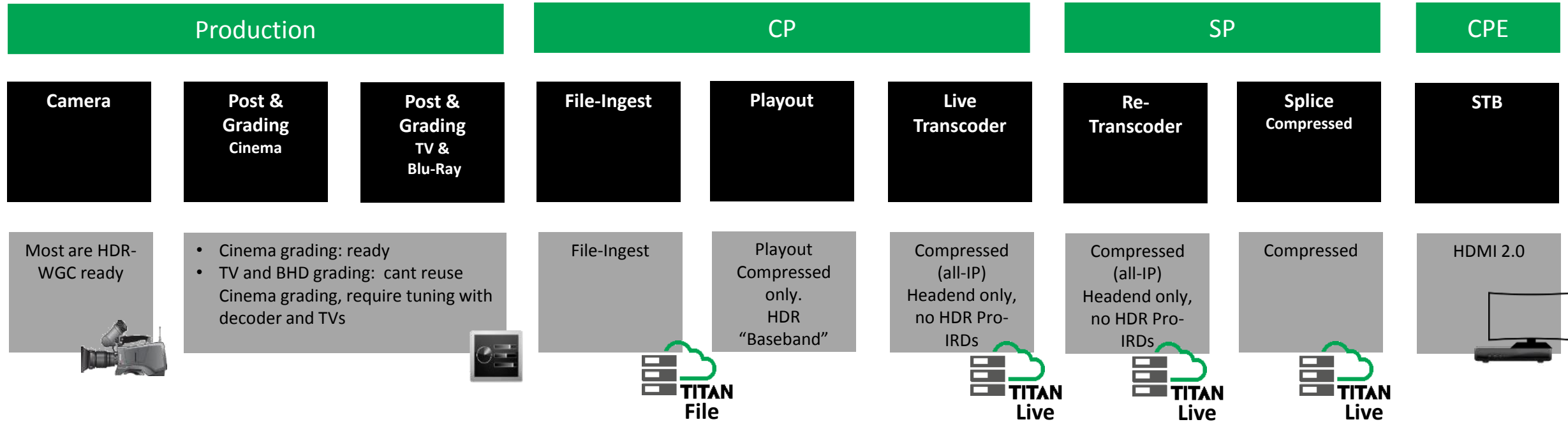
- HDR OETF/EOTF:
 - SMPTE ST 2084 (PQ) is the only standard transfer function
- HDR Metadata
 - SMPTE ST 2086: define standard color grading display metadata
 - HEVC SEI messages to convey HDR information (ST-2086+ remapping)
- HDMI 2.0a
 - Support standard ST 2084 + metadata ST 2086
- Blu-Ray Disc Association (BDA):
 - HEVC main 10-bits + ST-2084 + Metadata
 - Optional: Proprietary metadata: Dolby, Philips, Technicolor
- HDR standardization:
 - ITU, MPEG, DVB and SMPTE: standardization work in progress, may follow BDA format
- WCG:
 - Standardization completed BT.2020

Alternative HDR Solutions

- In addition to the MPEG solution described in this presentation, Dolby, Philips, Technicolor, SMPTE, NHK, BBC suggesting alternative solutions
- OETF: New transfer functions proposals
- Proprietary Metadata with Single or Dual layer
- Some supports SDR (Standard Dynamic Range) backward compatibility

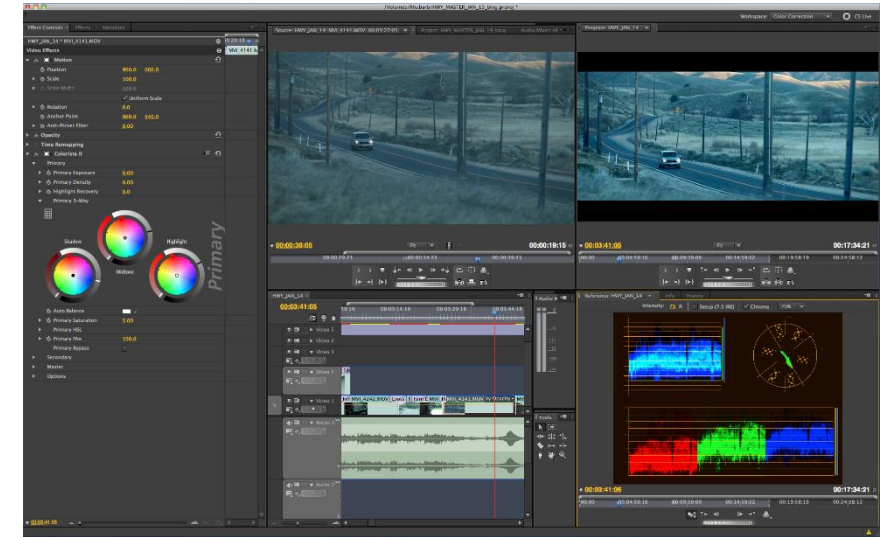
	Vendor	OETF/EOTF	Method	Metadata	Backward Compatible	Layers
1	BBC/NHK	Proprietary	OETF	Standard	Yes	Single
2	ST 2084/BDA	PQ	PQ	Standard	No	Single
3	Philips-1	PQ	PQ	Standard + Proprietary	No	Single
4	Philips-2	Proprietary	SDR	Proprietary	Yes	Single
5	Philips-3	Proprietary	HDR	Proprietary	Yes	Single
6	Technicolor	PQ or proprietary	Near SDR	Standard + proprietary	Yes	Single
7	Dolby Vision	PQ or proprietary	1 layer	Proprietary	Yes & No	Dual

HDR and WCG: The Broadcast Chain

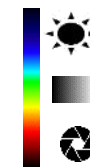


HDR Grading

- Color grading
 - Tuning the RGB level, Hue, Brightness, Saturation, and Contrast
- HDR color grading relies on a set of parameters
 - OETF ST-2084 or proprietary Transfer Function
 - Color gamut or primaries BT.709, P3, BT.2020
 - White primaries C, D65 etc
 - Min and max brightness value
 - Grading monitor characteristics
- Metadata
 - The grading metadata is part of the HDR asset
 - Data is per Sequence, Scene or Image
 - Metadata is used by the display device to ensure proper presentation of brightness and colors
- HDR grading for TV and Cinema is different

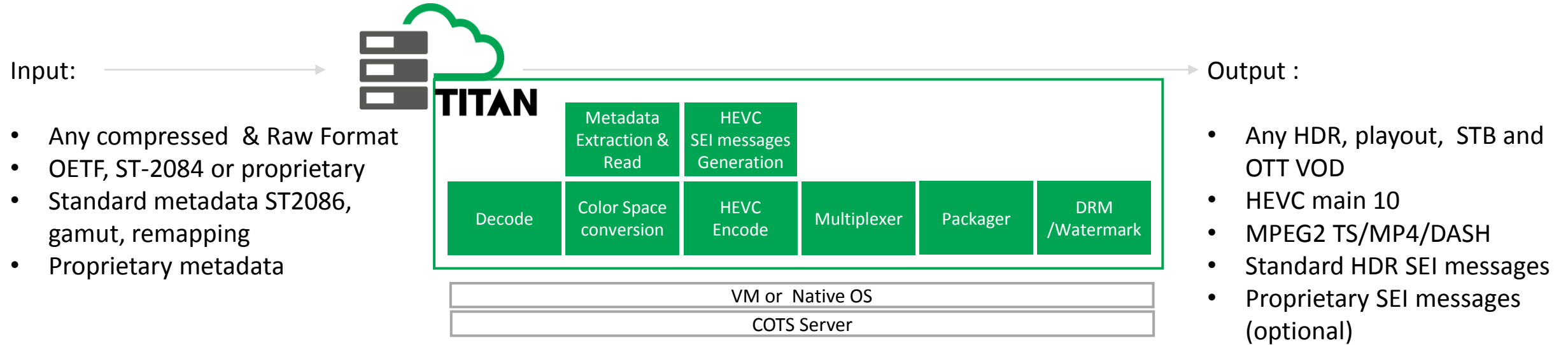


Adobe Color grading tool



	Cinema	TV
Brightness	48 nits	1000 nits
Darkness	0.02 nits	0.001 nits
S.Stops	11 stops	19 stops

TITAN: HDR Now

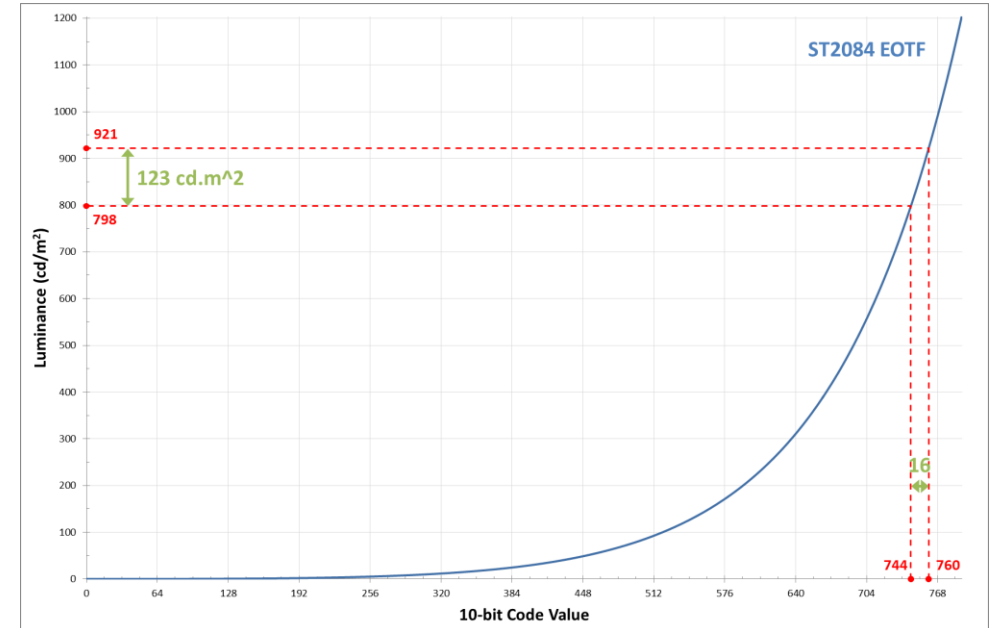


TITAN HDR – High Level Spec

- HDR : standard OETF & standard metadata
- Bit depth: 10, 12 bits
- Any color space conversion: BT.709, P3, BT 2020
- OETF: SMPTE ST-2084 (PQ)
- HEVC SEI messages:
 - Mastering Display Color Volume (ST 2086)
 - Chroma resampling filter hint
 - Knee function information
 - Color Remapping Information
 - Content Light Level Information
- HDR metadata agnostic
 - Any “proprietary” metadata
 - Any proprietary OETF support
 - Static and Dynamic metadata support: per Sequence, Scene or Image
- Standard & proprietary metadata configuration
 - Admin settings
 - XML Files
 - REST API

TITAN HDR Optimization

- Opto Electronic Transfer Function (OETF) is nonlinear
 - May generate chroma shifts and halos on bright area edges due to steep curve at high luminance
 - E.g. an error of 16 in code value (1.5% of the full scale) will generate a luminance error of 123 nits (10% of the full scale)
- TITAN overcome this challenge with nonlinear algorithms
 - HDR adapted content processing
 - Down-sampling & Down-scaling
 - Color conversion



Summary

- HDR Roll-out Started
 - Even though standardization isn't completed
 - Several SPs starting VOD service - using TITAN
 - Studios releasing HDR titles - using TITAN
 - Some SPs looking at a linear movie channel – likely H1/2016
- Eco-System Readiness
 - Incomplete standardization require grading-file-display calibration
- ATEME Leadership
 - Working with standardization bodies, studios, SPs and display manufactures