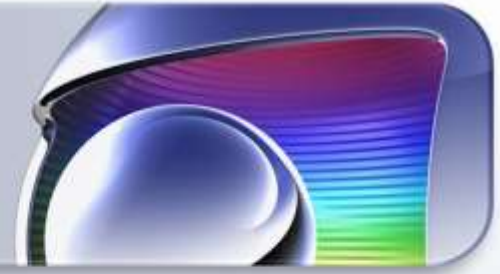




**UHDTV**  
**Challenges**  
**WBU ISOG FORUM**  
**2013**  
**Rio de Janeiro**

2 weeks ago in Hollywood, CA



## SMPTE 2013 Symposium



### **SMPTE 2013 Annual Technical Conference & Exhibition**

22-24 October 2013

Pre-Conference Symposium 21 October

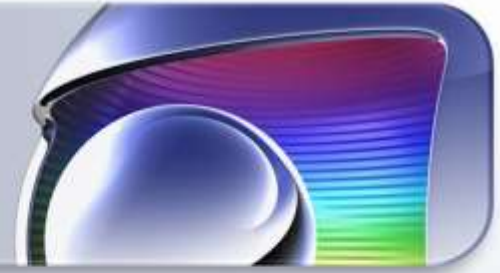
Hollywood, California

SMPTE 2013 Symposium

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*Next Generation Imaging Formats; More, Faster, and Better Pixels*

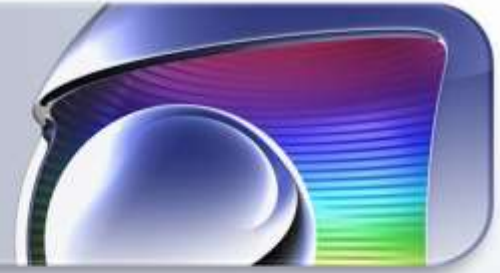
In 2 week in Geneva



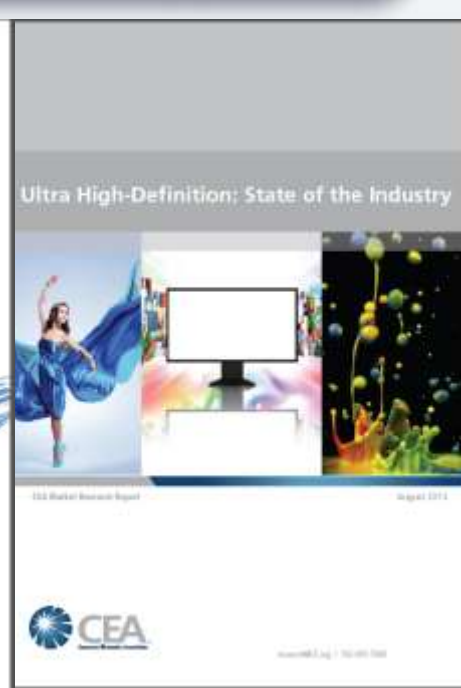
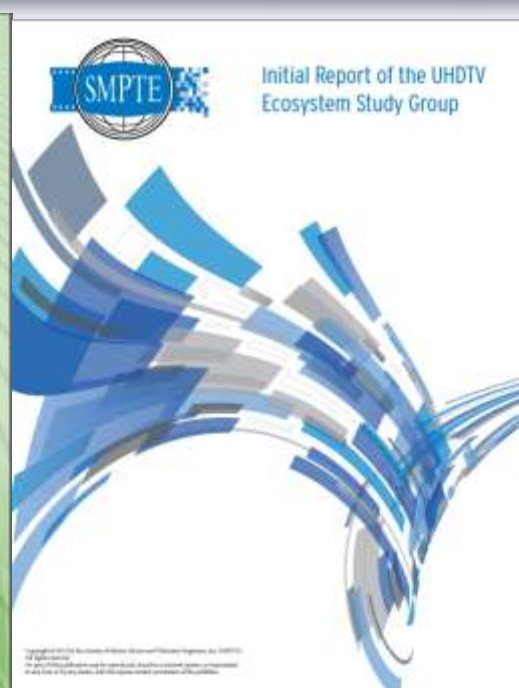
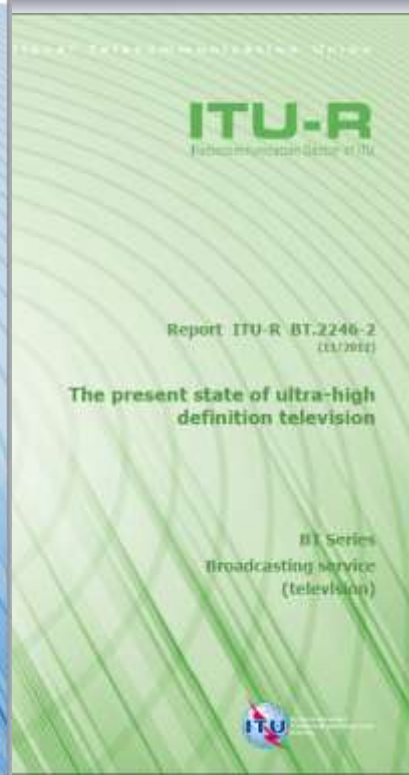
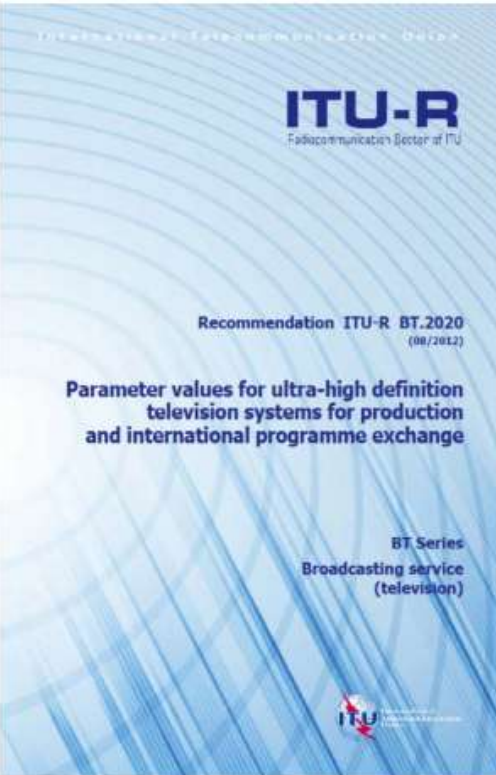
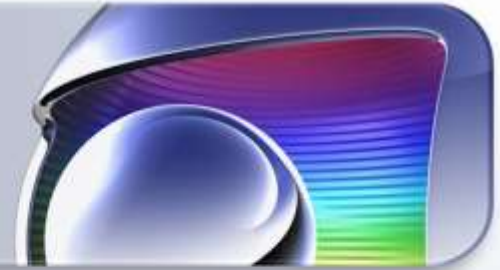
## **UHDTV: VOICES & CHOICES**

25-26 November 2013 / EBU, Geneva

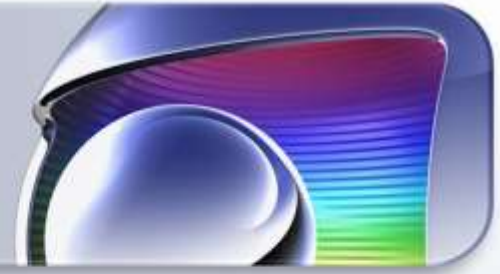
# This week in Rio



# Starting with References



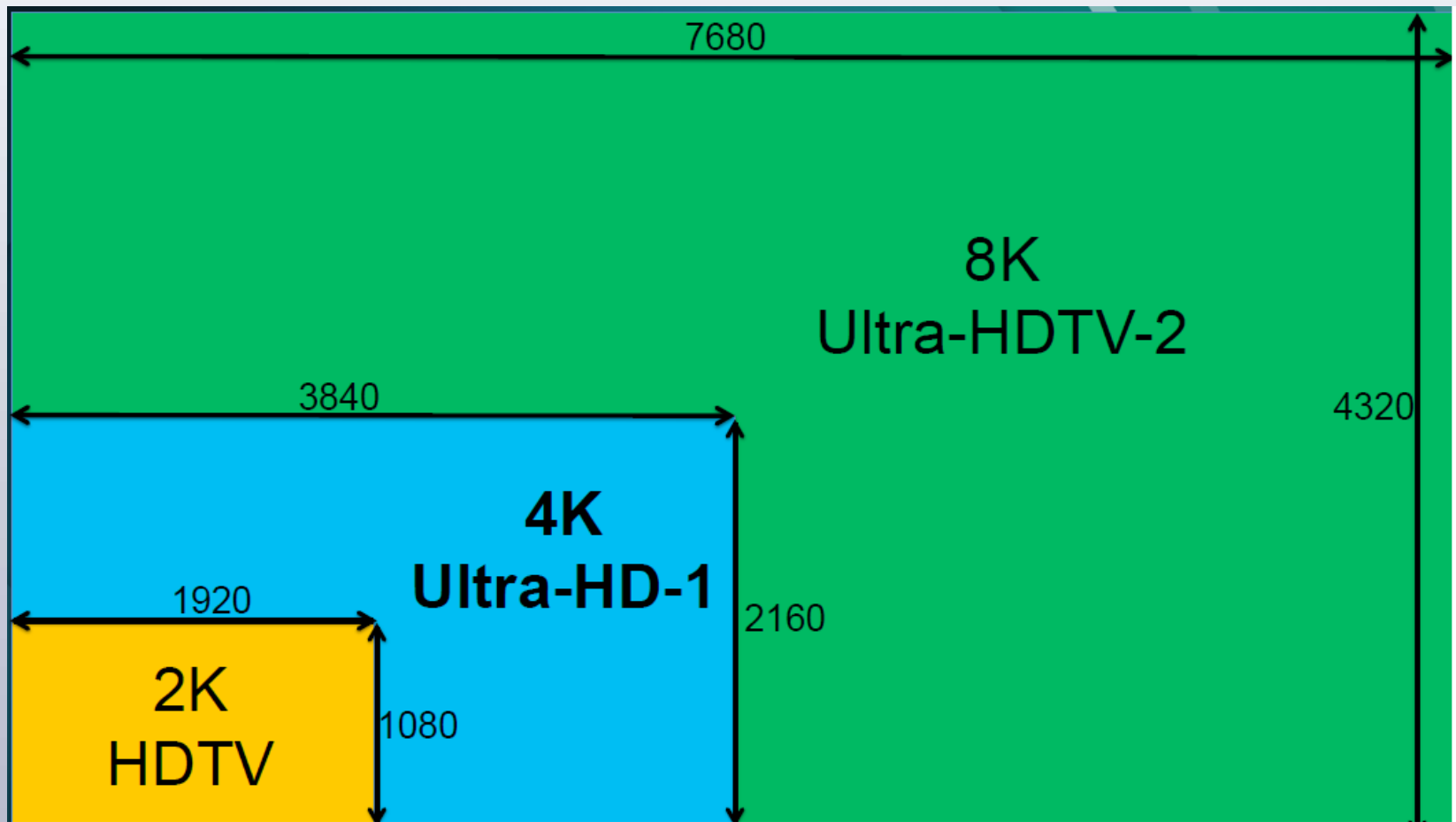
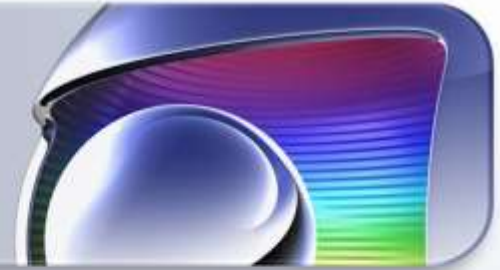
- Rec ITU-R BT2020 (08/2012)
- Report ITU-R BT.2246-2 (11/2012)
- CEA - Ultra High-Definition: State of the Industry (08/2013)
- SMPTE - Initial Report of the UHDTV - Ecosystem Study Group (09/2013)



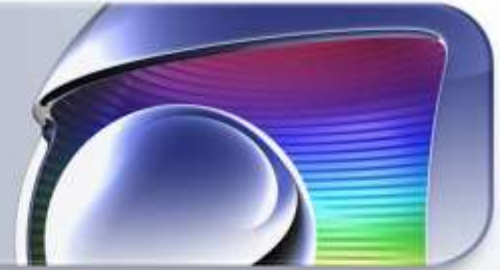
## ■ Next Generation

- Higher Spatial Resolution
  - UHD-1 = 4k ~ 3840 x 2160
  - UHD-2 – 8-K – 7680 x 4320 - Super Hi-Vision
- Higher Temporal Resolution
  - High Frame Rate (HFR)
- Extended Dynamic Range
  - More Bit Depth
- Wider Color Gamut
- Immersive Sound
  - 3-D Audio

# Spatial Resolution



# Temporal Resolution



- 60, 120, 240, 300(??)
- Motion Blur

24 frames per second



Frame 1, 1/24 sec.



Frame 2, 1/24 sec.



Frame 3, 1/24 sec.



Frame 1, 1/60 sec.

Frame 2, 1/60 sec.

Frame 3, 1/60 sec.

Frame 4, 1/60 sec.

Frame 5, 1/60 sec.

Frame 6, 1/60 sec.

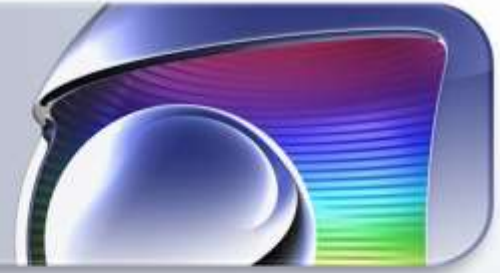


60 frames per second





# Bit Depth – 16 bits



- All in the same image – Details on the Brighter and on the Darker areas



Original

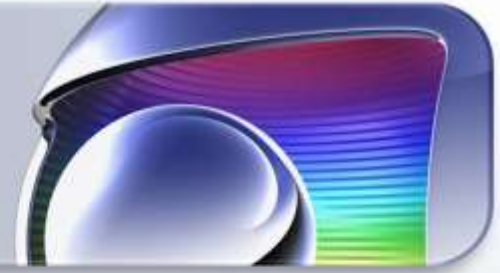


+ 3 Stops

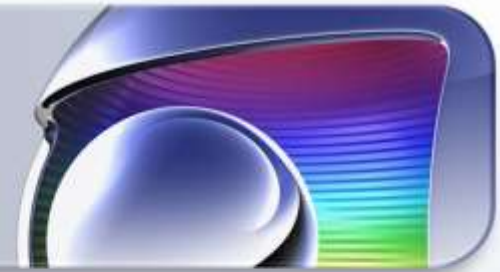


+5 Stops

# After Processing



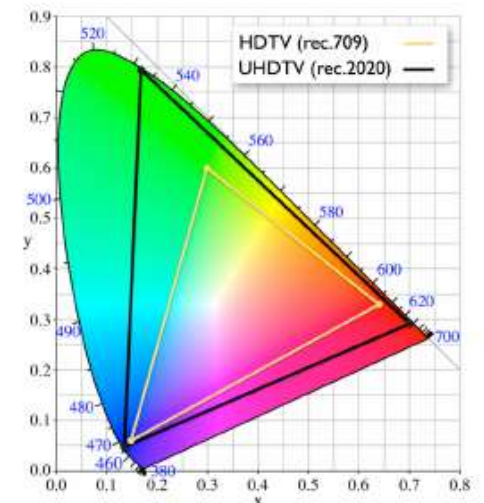
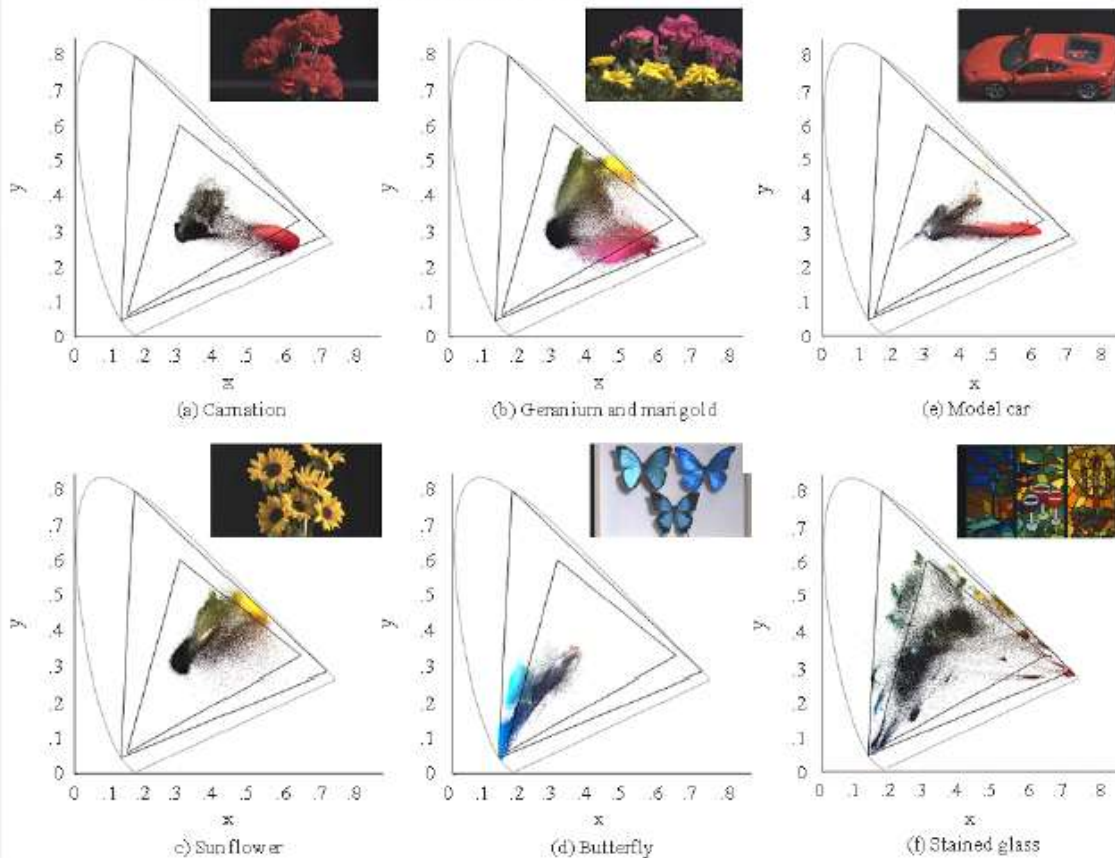
# Wide Color Gamut



## Colour distribution of objects on the x-y chromaticity coordinates

(Inner triangle: HDTV primaries, Outer triangle: UHDTV primaries)

Report BT.2246-24

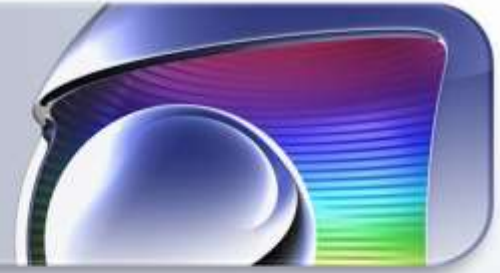


Surface color of real objects often lie outside HDTV gamut (Rec 709)

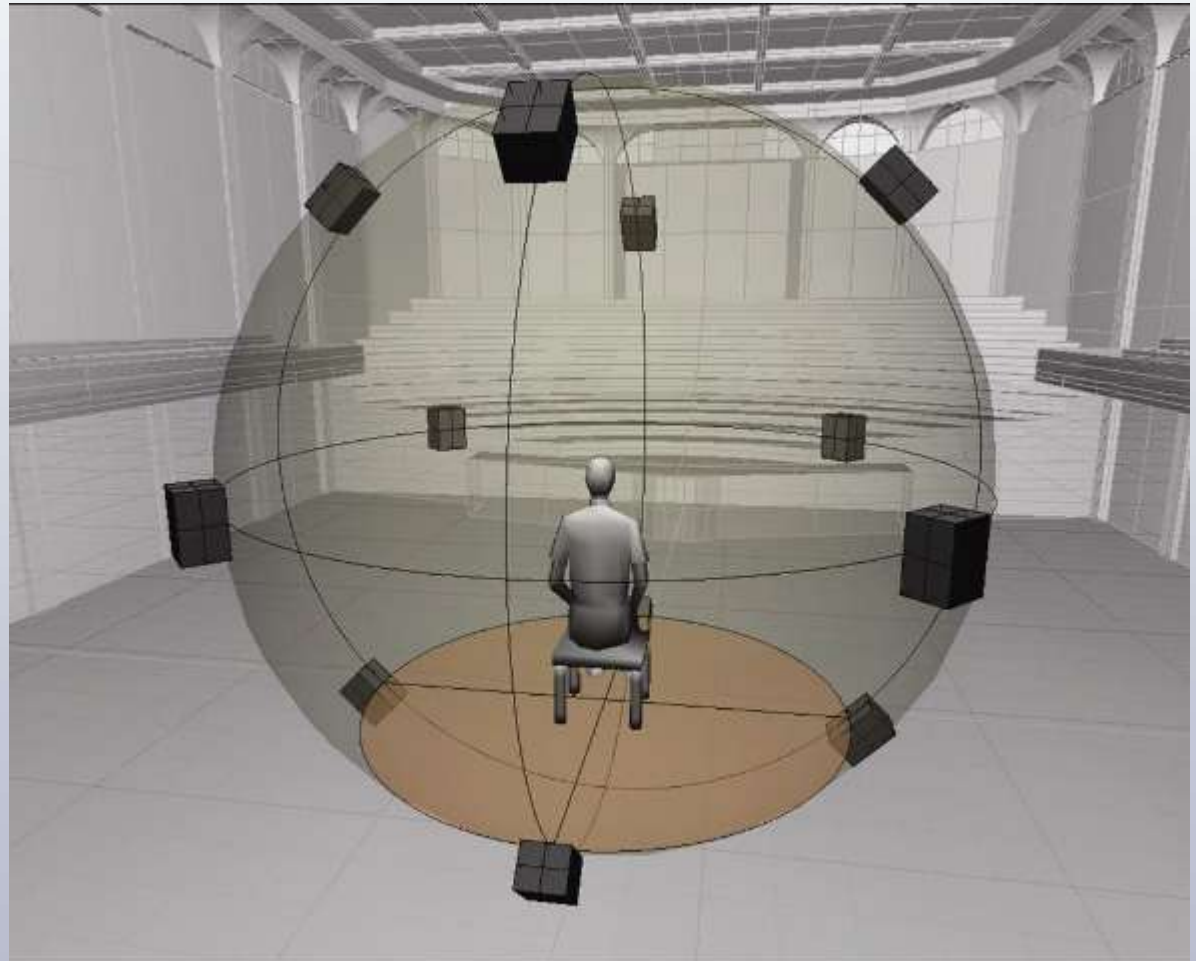
... but mostly within the UHDTV gamut (ITU-R Rec. BT.2020)

From Report ITU-R BT.2246-1 (2012)

# Immersive Audio



- X,Y,Z planes



# Production Quality

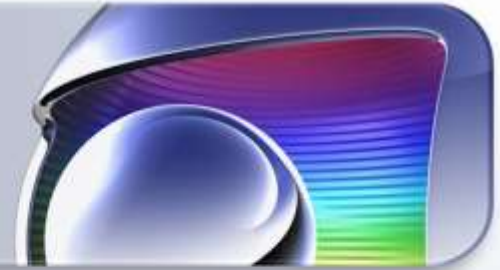
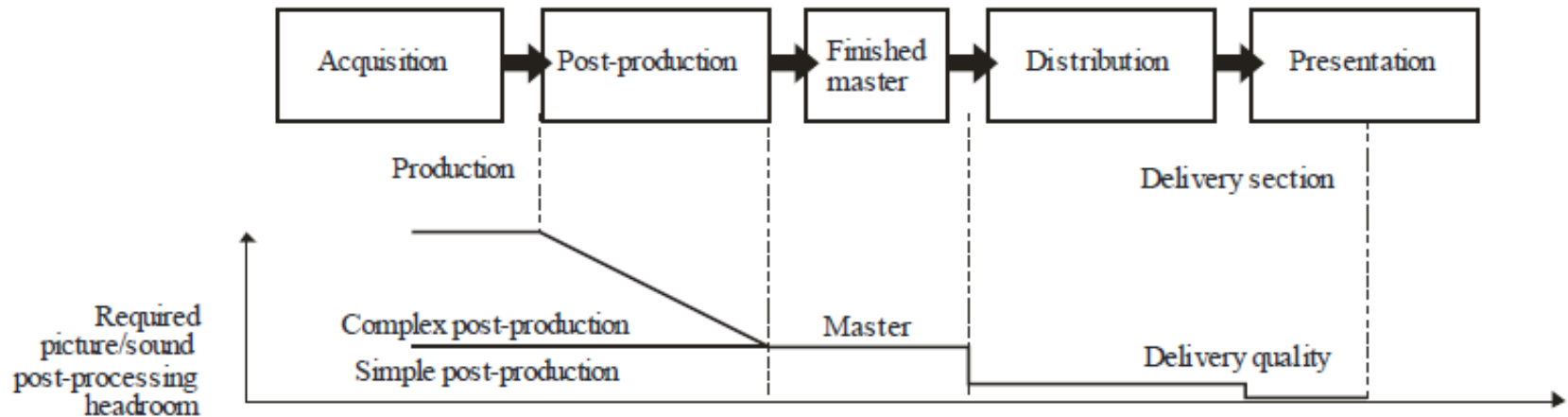


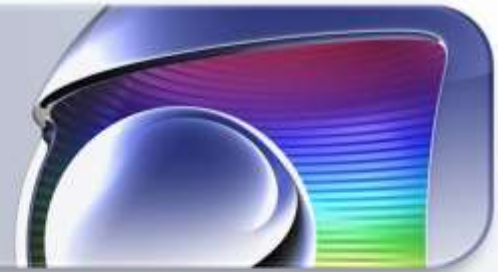
FIGURE 4

Reference chain for typical LSDI applications and cognitive evolution of picture/sound post-processing headroom along the chain



Report BT.2246-04

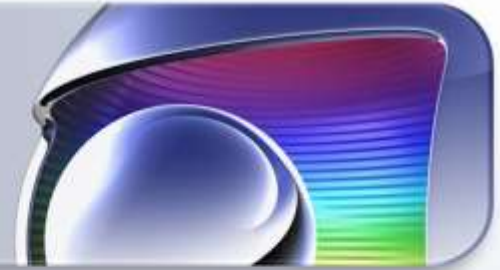
# Data Rate Challenge



## ■ Data Rate Chart Example

DATA RATE Gb/s		1.920 & 2.048 x 1.080 Lines		3.840 & 4.096 x 2.160 Lines		7.680 x 4.320 Lines	
		Mono 2D	Stereo 3D	Mono 2D	Stereo 3D	Mono 2D	Stereo 3D
High frame rate 60-120 fps	4:4:4 12-bits	12	24	48	96	192	384
	4:2:2 10-bits	6	12	24	48	96	192
Mid frame rate 30-60 fps	4:4:4 12-bits	2 x 3	4 x 3	24	48	96	192
	4:2:2 10-bits	3	2 x 3	4 x 3	24	48	96
Low Frame rate ≤ 30 fps	4:4:4 12-bits	3	2 x 3	4 x 3	24	48	96
	4:2:2 10-bits	1,5	3	4 x 3	4x3	24	48

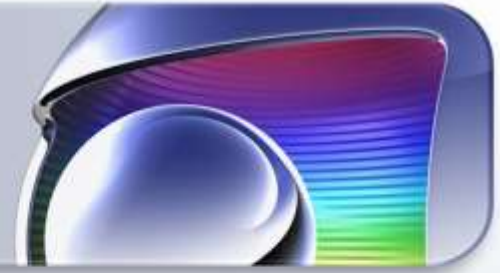
# Storage and Network Bandwidth



STORAGE		
1080p	10 bits dpx	8.102 KB
	16 bits dpx	12.152 KB
	16 bits EXR	16.218 KB
	32 bits EXR	32.418 KB
4K	10 bits dpx	34.562 KB
	16 bits dpx	51.842 KB
	16 bits EXR	69.155 KB
	32 bits EXR	138.275 KB
1080p (24p)	1 min - 16 bits EXR	23.354 GB
4K (24p)	1 min - 16 bits EXR	99.583 GB

# Tool For Production Today

## VFX Example

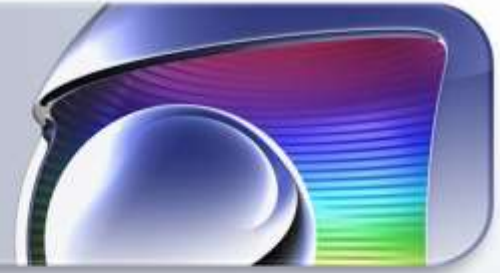


- Video



# Production Example

## 4K Sticking for Digital Backlot



- Video



# Thank you

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[phcastro@ieee.org](mailto:phcastro@ieee.org)