

# DEPLOYING HDR FOR LIVE TV – THE BACK COMPATIBILITY QUESTION

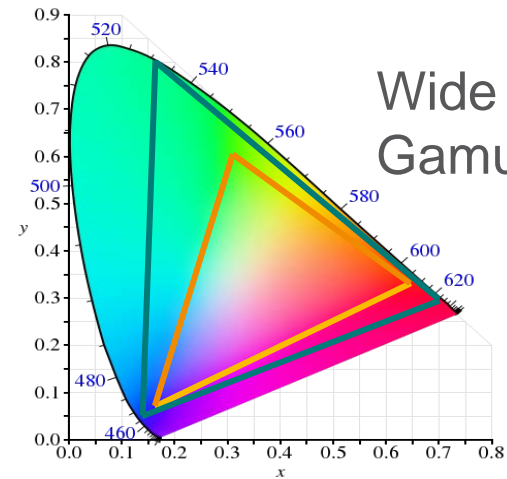
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# RECAP: 5 ULTRA-HD IMMERSIVE VIEWING IMAGE TECHNOLOGIES



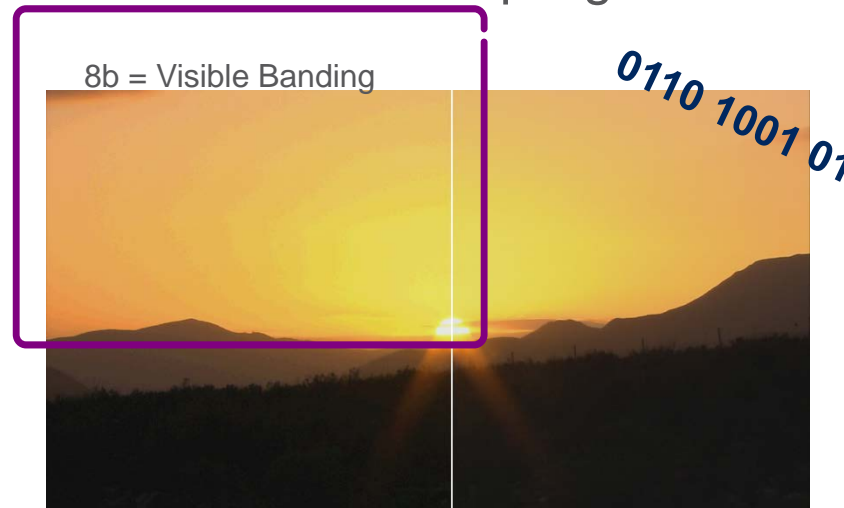
High Dynamic Range

Image Resolution



Wide Color Gamut

10-bit Sampling

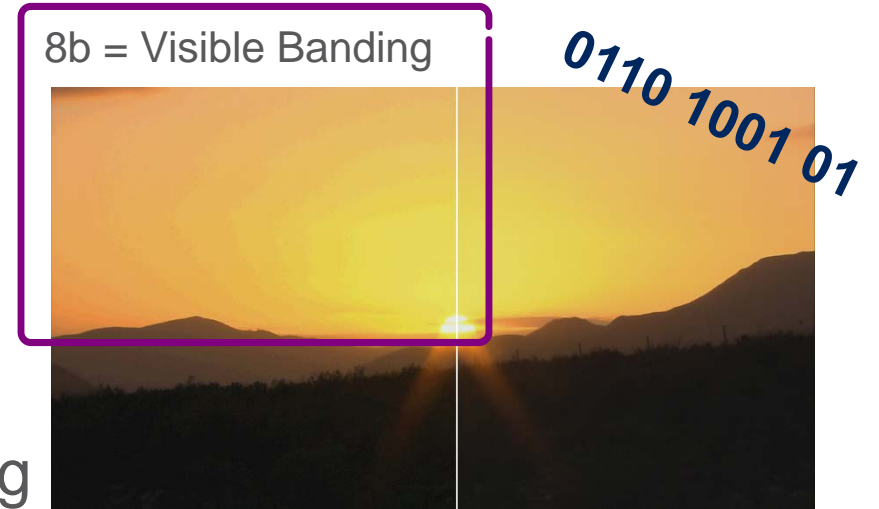


High Frame Rate

# "HDR+" ... FOR ANY IMAGE RESOLUTION

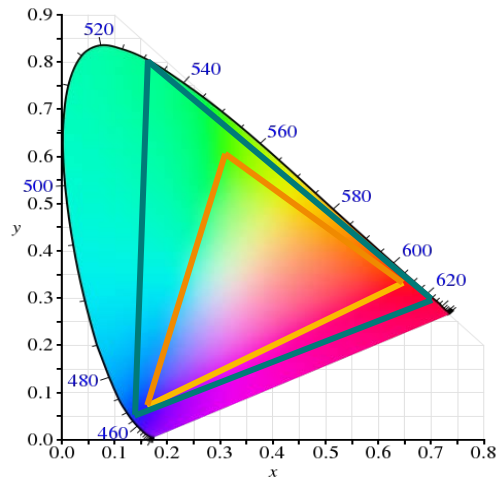


High Dynamic Range



10-bit Sampling

*The combination of HDR, WCG and higher sample precision technologies – acts as a single feature!*



Wide Color Gamut

Whether



or



# HDR+ “BACKWARD COMPATIBILITY”



- › Q1: Are we trying to make an HDR signal that also can be viewed on **any** conventional SDR TV/display?  
(**stream backward compatibility**)



Or

- › Q2: Are we trying to make a signal that can be **converted** by an intermediate step to be shown on any conventional SDR TV/display?  
(**display backward compatibility**)



Or

- › Q3: Are we planning to **simulcast**, as we do today with HD/SD, and are planning to do with UHD/HD?



*Historical note: Prior to HD being launched, backward compatibility was a big concern – after in-depth review, not so much*

# BACKWARDS COMPATIBILITY CHECKLIST



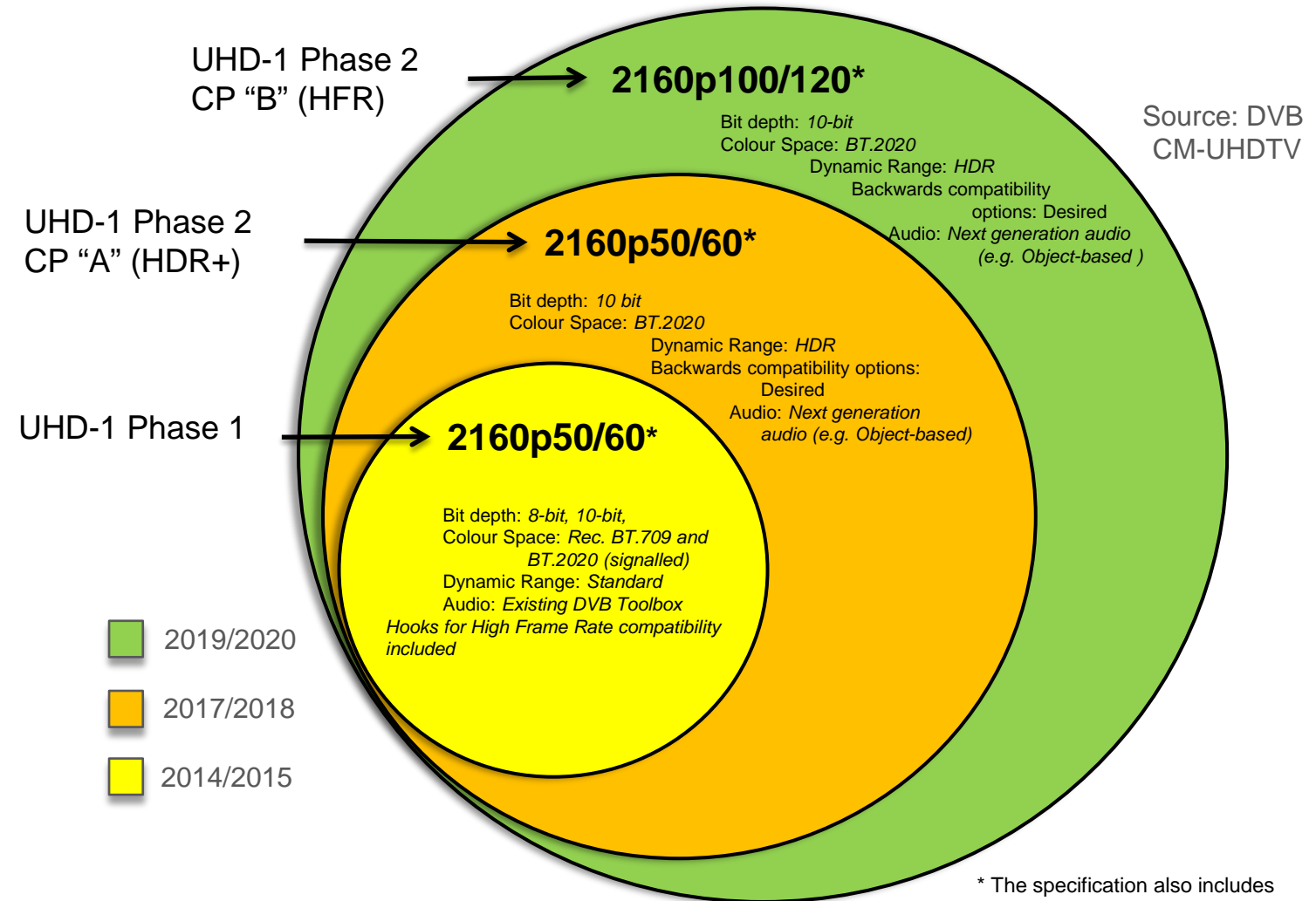
1. What exactly is meant by backwards compatibility?
2. Which technologies are we trying to address?
  1. Dynamic range
  2. Color gamut / Color space
  3. Sample bit depth
  4. Spatial resolution
  5. Temporal resolution
  6. Video coding standard for delivery-to-consumer (DTH)
3. What is “good enough” picture quality?
  1. For legacy, conventional HD service
  2. For new Ultra HD service (1080p or 2160p HDR+)
4. What new costs will backward compatibility create?
  1. In production
  2. In post-production
  3. In distribution
  4. In delivery to consumer

# DVB UHD ROADMAP & "BC"



## > HDR backwards compatibility defined as:

- UHD-1 Phase 2 to UHD-1 Phase 1
  - > **HDR to SDR change only!**
- **Not** UHD-1 Phase 2 to legacy conventional HD



\* The specification also includes fractional variants of the 60fps family (1/1.001)



# “BC” TO LEGACY HD



- › Dynamic range: ITU-R BT.2100 (PQ or HLG) → BT.709/BT.1886 (Gamma)
- › Color space: ITU-R BT.2020 → BT.709
- › Sample bit depth: 10b → 8b (for delivery-to-consumers)
- › Spatial resolution: 3840x2160 → 1920x1080 or 1280x720 (as applicable)
- › Temporal resolution: 50-60 fps progressive → 25-30 fps interlaced
- › Video coding standard: HEVC → to AVC or MPEG-2 (for delivery-to-consumers)
- › With “broadcast quality” images in both HDR and SDR formats
  - For legacy conventional HD service
  - For new Ultra HD service (1080p or 2160p HDR+)

***Simulcast needed if all of these conditions are not meant***

*And we have not even discussed audio BC!*

# HDR+ APPROACHES: "PQ10"-BASED



- › SMPTE ST 2084 PQ HDR + Rec. ITU-R BT.2020 color
  - One of two HDR+ formats defined in new [Rec. ITU-R BT.2100 Image parameter values for high dynamic range television for use in production and international programme exchange](#)
- › Single layer baseline is **non backwards compatible**
- › **HDR10 = PQ10 + reference display metadata**
  - Metadata = SMPTE ST 2086 HDR static metadata + MaxCLL + MaxFALL
  - Specified by Blu-ray® Disc Association, DECE, CTA, UHD Alliance for pre-produced content
  - Uses HEVC Color Remapping Information SEI message



# SO CALLED "HDR10" MEDIA PROFILE

## BDA: ULTRA HD BLU-RAY® VIDEO CHARACTERISTICS



Video Codec	HEVC <sup>(1)</sup>		AVC
Spatial Resolution	3840x2160	1920x1080	1920x1080
Picture Format Aspect Ratio	16:9		
Bit Depth – SDR	10		8 <sup>(2)</sup>
Color Space Primaries	BT.2020 <sup>(3)</sup> BT.709 (SDR only)		BT.709 (SDR only)
Color Sub sampling	4:2:0		
Frame Rates	23.976p, 24p, 25p <sup>(4)</sup> , 50p <sup>(4)</sup> , 59.94p, 60p		23.976p, 24p
Peak Video Bit rate <sup>(5)</sup>	100Mbps		40Mbps
Bit Depth - HDR	10		N/A
HDR EOTF	SMPTE ST 2084		
Static Metadata	SMPTE ST2086, MaxFALL (HDR only) <sup>(6)</sup> , MaxCLL (HDR only) <sup>(6)</sup>		

<sup>(1)</sup>Main 10 High Tier Level 5.1. NOTE: in the mandatory part, HDR content is transmitted using a single layer codec with metadata in SEI messages.

<sup>(2)</sup>AVC 8-bit BT.709 SDR is allowed only for 1080/23.976p and 1080/24p frame rates and with a peak bit rate that is within existing BD specification

<sup>(3)</sup> BT.2020 uses the YCbCr non-constant luminance format

<sup>(4)</sup>Decoding 25Hz and 50Hz video is BD-ROM Player mandatory if a 50Hz TV system is used

<sup>(5)</sup>Peak Video Bitrate is constrained by the relevant ISO/IEC HRD conformance and by the MPEG-TS T-STD decoder buffer input rate

# HDR+ APPROACHES: “PQ10”-BASED (2)

- › **Backwards compatibility** possible by using proprietary add-on schemes involving dual layers or single layer + “HDR enhancement” metadata
- › Some examples
  - Dolby Vision: Dual layer, HDR baseline + “SDR reconstruction” enhancement layer
  - Dolby Vision Live: Single layer, HDR baseline + optional “Display Adaptation” metadata (SMPTE ST 2094-1 & 2094-10 HDR dynamic metadata)
    - › Also optional ICtCp color space + optional closed-loop Re-shaper
  - Technicolor “SL-HDR1” (formerly “Prime”): Single layer, SDR baseline + “HDR Reconstruction” metadata (SMPTE ST 2094-1 & 2094-30)
  - Qualcomm: HDR10 + “Dynamic Range Adjustment” metadata

# HDR+ APPROACHES: "HLG10"-BASED



- › Hybrid-Log Gamma (HLG) HDR + Rec. ITU-R BT.2020 color
  - One of two HDR+ formats defined in new [Rec. ITU-R BT.2100 Image parameter values for high dynamic range television for use in production and international programme exchange](#)
- › Single layer with **no metadata**
- › **Backwards compatible** for Live TV (if BT.2020 color space container maintained)
- › Possibly backward compatible to HD (BT.709) color space with tone mapping algorithm
  - But some in industry do not believe doing BC this way is necessary for 4K (very limited in-field)
  - Instead, plan to simulcast conventional HD SDR with 4K HDR+

# DUAL-LAYER & "HDR ENHANCEMENT" METADATA OPERATIONAL PROBLEMS



Dual layer and single layer + "HDR enhancement" metadata are difficult to apply to Live TV workflows

*If there are dual-layers or enhancement metadata that need to be reconstituted into a single stream to be processed and re-encoded, then how do I do the following?:*

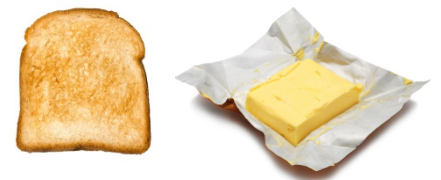
- Transition between two sources, for example in a live studio program?
- Apply effects (to which layer am I applying them?)
- Add graphics (to which layer am I applying them?)
- Format or standards convert (which layer am I converting and how?)
- Add logos or closed captions
- Cut between programs and adverts



# LIVE TV CHALLENGES

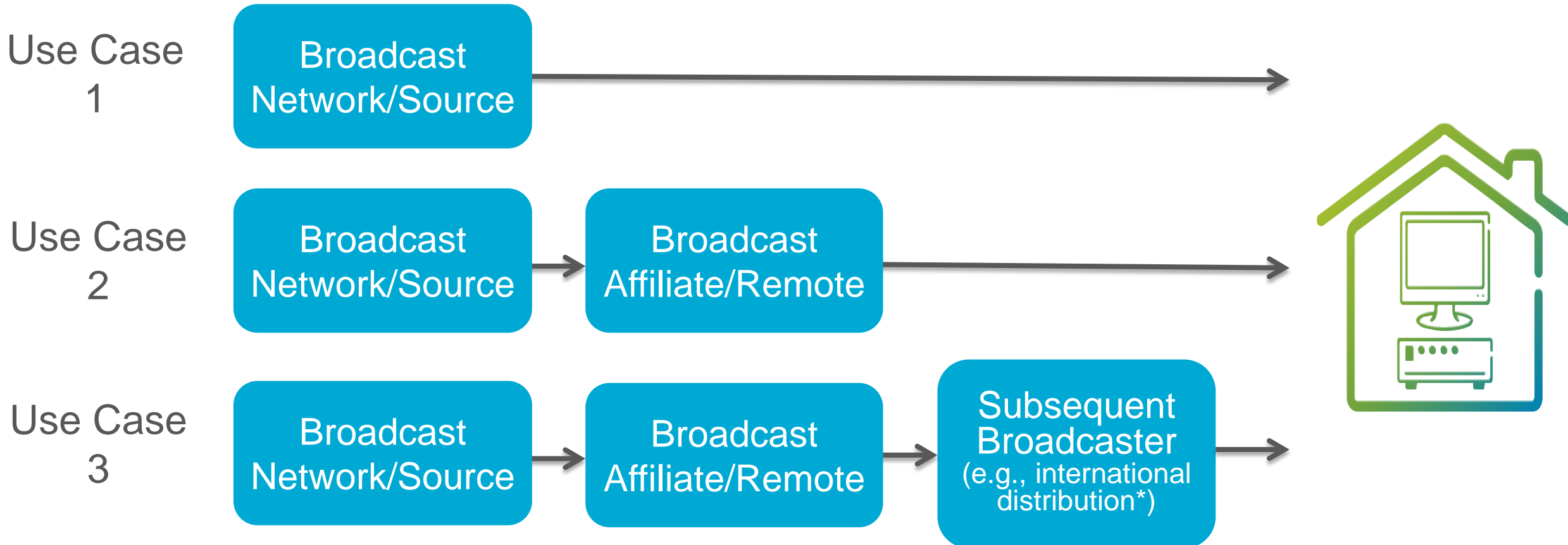


- › Live TV ecosystems have special needs
- › To get on-air in early adoption (2017-2019?), must keep the solution simple and “forgiving”, to work as best as possible with existing live workflows
- › Some proposed HDR schemes **require** metadata or dual layer streams
  - › This information may get dropped until the HDR Live TV ecosystem matures (islands of implementations always occur in technology displacements)
  - › For early **Live TV workflows**, use HDR schemes that **do not require** metadata or dual layers so that if lost/missing/not produced, renderer is still able to produce “broadcast quality” HDR images
- › “Bread & butter” will be conventional HD for a long time
  - Simulcast likely required in early deployments



# “JUST INSERT AT THE FINAL ENCODE”

*In Live TV, what/where is the “final encoder”?*



*\*or MVPD (Cable or Satellite Provider) in some regions*



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