FUTURE OF TV:
4K, HDR, IMMERSIVE AUDIO
TV 2020 CONFERENCE

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RECAP: 5 ULTRA-HD IMMERSIVE VIEWING IMAGE TECHNOLOGIES

Image Resolution

- SD 1920x1080
- HD 1920x1080
- 4K UHD 3840x2160
- 8K UHD 7680x4320

Wide Color Gamut

- High Dynamic Range
- Wide Color Gamut
- 10-bit Sampling

Visible Banding

- 8b = Visible Banding

High Frame Rate
The combination of HDR, WCG and higher sample precision technologies ("HDR+") – acts as a single feature!
BANDWIDTH IMPACTS

<table>
<thead>
<tr>
<th></th>
<th>Uncompressed</th>
<th>Compressed (consumer-grade)</th>
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</thead>
<tbody>
<tr>
<td>4K (2160p) vs. 1080i HD</td>
<td>400%</td>
<td>circa 250%</td>
</tr>
<tr>
<td>“HDR+” (HDR+WCG+10bit)</td>
<td>25-30%</td>
<td>circa 0-20%</td>
</tr>
<tr>
<td>HFR (50-60fps → 100-120fps)</td>
<td>200%</td>
<td>circa 30%</td>
</tr>
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In some cases, bandwidth also required to simulcast legacy HD bitstreams in addition to new UHD HDR+ bitstreams
WHY NOT 1080P HDR+?

› If bandwidth constraints prevent a broadcaster from offering all of the new technologies, then focus on the “best bang for the bit”
  - 1080p50/60 HDR+

› Take advantage of all modern displays’ ability to up-convert 1080p to 4K (2160p)
  - Of course, HDR+ support required to render HDR+
4K & HDR STANDARDS STATUS

› 4K foundation standards for imaging and interfaces are complete

› HDR foundation standards are “mostly” complete
  – Perceptual Quantization (SMPTE ST 2084) transfer function
  – Hybrid Log-Gamma transfer function
  – Mastering Display Color Volume Metadata (static)
  – Content-Dependent Metadata for Color Volume Transformation (dynamic)
  – Signaling of dynamic range (SDR, PQ, HLG) being added to interfaces
    › SDI, Studio Video over IP, HDMI
However, there are still many practical issues to consider:

- Mixing of different HDR/SDR material in the live workflow
- Video loudness (aka the "Dim Act")
- Backward compatibility (hint: no one truly has it!)
MIXING HDR & SDR IN PRODUCTION

These all need to have matched levels ..... or you can never create the SDR version
This content often needs further downstream image manipulation (mixing, wipes, fades, keying, graphics) …
VIDEO “LOUDNESS”!

› Remember audio loudness issues?
VIDEO “LOUDNESS”!

› Advertisers may use the opportunity to grab attention by introducing huge steps in light levels
BACKWARD COMPATIBILITY TO LEGACY HD

- Dynamic range: ITU-R BT.2100 (PQ or HLG) $\rightarrow$ BT.709/BT.1886 (Gamma)
- Color space: ITU-R BT.2020 $\rightarrow$ BT.709
- Sample bit depth: 10b $\rightarrow$ 8b (for delivery-to-consumers)
- Spatial resolution: 3840x2160 $\rightarrow$ 1920x1080 or 1280x720 (as applicable)
- Temporal resolution: 50-60 fps progressive $\rightarrow$ 25-30 fps interlaced
- Video coding standard: HEVC $\rightarrow$ 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 required unless all of these conditions are met*

*Note: the above still excludes modulation, transport, and audio BC!*