Ultra HD Forum
State of the UHD Union

Benjamin Schwarz
Ultra HD Forum Communications Chair
November 2017
Agenda

Status of UHD
Specifications
Ultra HD Forum
Telco Deployments
What is coming next?
Conclusion
The pillars of UHD

- **4K Resolution**: Clearer, crisper and more detail-rich picture than HD
- **WCG (Wide Color Gamut)**: More vibrant colors
- **HDR (High Dynamic Range)**: Greater range contrast
- **HFR (High Frame Rate)**: Motion rendering closest to real
- **NGA (Next Generation Audio)**: Sounds are perceived as coming from infinite points around
Key UHD Forum Definitions

4K Resolution
- UHD-1 Phase 1: 3840 x 2160 x 60 (Level 5.1)
- UHD-1 Phase 2: 3840 x 2160 x 120 (Level 5.2)

WCG Wide Color Gamut
- BT 2020 color space

HDR High Dynamic Range
- Non Backward Compatible: HDR10/PQ10 (BDA-CTA/DVB)
- Backward Compatible (BT 2020): HLG (ITU-R/DVB)
- Backward Compatible (BT 709): Technicolor
- Backward Compatible (PQ10): Dolby Vision

HFR High Frame Rate
- 100 / 120 fps for any resolution:
  - 1920 x 1080 x 100 / 2560 x 1440 x 100 (level 5.1)
  - 3840 x 2160 x 100 (Level 5.2)

NGA Next Generation Audio
- Object based coding
- Immersive audio
- Interactive audio
Survey: What’s Important in UHD?

- 4K Resolution
- Next Gen Audio
- WCG
- HDR
- New EOTF
- HFR > 60 fps
- Screen Size

n=52

* Source: Ultra HD Forum members survey (Aug’16)

Top Quality Video: The Emergence of 4K (and 8K)
© 2014 Parks Associates

UHD timing is now
HDR Penetration

Difference between HDR ready & PREMIUM HDR

SDR large installed base decreasing

Need proper market communication

Need backward compatible scheme with SDR UHD TVs

UHD Quality & BC are key
UHD Deployments World Wide*

58
UHD channels on air

By Infrastructure

- Satellite: 5
- OTT: 4
- Cable: 4
- IPTV: 4

By Type

- Commercial: 58
- Test: 17
- VOD: 10

By Region

- Europe: 23
- Asia: 17
- NAM: 4
- LAM: 14

By Sat Operator

- SES: 45
- Eutelsat: 19
- JCSAT: 6
- KoreaSat: 4
- Others: 3

* Updated list on https://ultrahdforum.org/resources/list-of-commercial-uhd-or-4k-services-that-are-live/

UHD (HDR) content still lacking

Courtesy SES Astra
Specifications
High Dynamic Range (HDR)

- Extends the luminance range:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SDR</td>
<td>100 nits (Cd/m²)</td>
</tr>
<tr>
<td>Film</td>
<td>48</td>
</tr>
<tr>
<td>Digital Cinema (DCI) (laser projector)</td>
<td>108</td>
</tr>
<tr>
<td>HDR (CES16)</td>
<td>~1,000 to 1,800</td>
</tr>
<tr>
<td>Grading Suite</td>
<td>~4,000</td>
</tr>
<tr>
<td>Maximum Specified</td>
<td>10,000</td>
</tr>
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</table>

- Immersive “real life” video
  - Deeper darks and shadows
  - Brighter speculars and highlights

- Creates the **WOW** effect, especially when compared to HD

- HDR needs to be implemented along with WCG to gain full benefit
## Where Are We At With HDR?

<table>
<thead>
<tr>
<th></th>
<th>PQ10</th>
<th>HLG10</th>
<th>Dolby Vision</th>
<th>HDR10+</th>
<th>Technicolor</th>
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</thead>
<tbody>
<tr>
<td><strong>Standard</strong></td>
<td>CTA/ITU-R/DVB</td>
<td>CTA/ITU-R/DVB</td>
<td>Dolby</td>
<td>In progress</td>
<td>Technicolor</td>
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<tr>
<td><strong>Application</strong></td>
<td>VoD/Live</td>
<td>Live</td>
<td>VoD/Live</td>
<td>VoD</td>
<td>Live</td>
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<tr>
<td><strong>HDMI</strong></td>
<td>2.0a</td>
<td>2.0b</td>
<td>1.4 and above</td>
<td>2.1 ?</td>
<td>2.0</td>
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<tr>
<td><strong>Color space</strong></td>
<td>BT 2020</td>
<td>BT 2020</td>
<td>BT 2020</td>
<td>BT 2020</td>
<td>BT 2020</td>
</tr>
<tr>
<td><strong>EOTF</strong></td>
<td>ST 2084/ST 2086</td>
<td>Hybrid Log Gamma</td>
<td>ST 2084</td>
<td>ST 2084</td>
<td>ST 2084</td>
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<tr>
<td><strong>Meta data</strong></td>
<td>Static</td>
<td>NA</td>
<td>Dynamic</td>
<td>Dynamic</td>
<td>Static/Dynamic</td>
</tr>
<tr>
<td><strong>Backward compatible</strong></td>
<td>No</td>
<td>SDR (BT 2020)</td>
<td>HDR10</td>
<td>HDR10</td>
<td>SDR (BT 709)</td>
</tr>
</tbody>
</table>

*(Too) many HDR options*
# Live HDR Summary

<table>
<thead>
<tr>
<th>HDR</th>
<th>Standard</th>
<th>Legacy STB</th>
<th>TVs</th>
<th>VOD</th>
<th>Live</th>
</tr>
</thead>
<tbody>
<tr>
<td>PQ10 / HDR10</td>
<td>✔ ✔ ✔ ✔ ✔</td>
<td>UHD1 – Phase 1</td>
<td>2015</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>HLG10</td>
<td>✔ ✔ ✔ ✔ ✔</td>
<td>UHD1 – Phase 1</td>
<td>2016</td>
<td>X</td>
<td>✔</td>
</tr>
<tr>
<td>Dolby Vision</td>
<td>✔ ✔ ✔</td>
<td>Not supported</td>
<td>2015</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Technicolor</td>
<td>✔ ✔ ✔</td>
<td>Not supported</td>
<td>2017</td>
<td>X</td>
<td>✔</td>
</tr>
</tbody>
</table>

Phased HDR approach for Live

- **Phase A**: PQ10 / HDR10, HLG10
- **Phase B**: Dolby Vision, Technicolor
Global Advocacy for Next-Gen A/V Delivery

CHARTER (17)

CONTRIBUTOR (13)

ASSOCIATE (23)

53 Direct members / 300+ indirect members
Ultra HD Forum Roadmap

Phase A

Creation

2015

Guidelines 1.0

2016

2017

Guidelines 2.0

2018

2019

Public interop #1

Public interop #2

5 years project

Phase B

2020
### Operators Members Live Deployment

<table>
<thead>
<tr>
<th>Date</th>
<th>Operator</th>
<th>HDR</th>
<th>Audio</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>May’16</td>
<td>DIRECTV</td>
<td>SDR</td>
<td>5.1</td>
<td>Commercial</td>
</tr>
<tr>
<td>June’16</td>
<td>NeuLion</td>
<td>SDR</td>
<td>5.1</td>
<td>Commercial</td>
</tr>
<tr>
<td>June’16</td>
<td>kpn</td>
<td>SDR</td>
<td>5.1</td>
<td>Friendly</td>
</tr>
<tr>
<td>Aug’16</td>
<td>comcast</td>
<td>SDR / HDR10</td>
<td>5.1 / Atmos</td>
<td>Commercial</td>
</tr>
<tr>
<td>Aug’16</td>
<td>sky</td>
<td>SDR</td>
<td>5.1 / Atmos</td>
<td>Commercial</td>
</tr>
<tr>
<td>Rio’16</td>
<td>NBC</td>
<td>SDR / HDR10</td>
<td>5.1 / Atmos</td>
<td>Commercial</td>
</tr>
<tr>
<td>Oct’16</td>
<td>SKY PerfecTV!</td>
<td>HLG</td>
<td>5.1</td>
<td>Commercial</td>
</tr>
<tr>
<td>April’17</td>
<td>DIRECTV</td>
<td>HLG</td>
<td>5.1</td>
<td>Trial/Demo</td>
</tr>
<tr>
<td>May’17</td>
<td>travelxp</td>
<td>HLG</td>
<td>5.1</td>
<td>Commercial</td>
</tr>
</tbody>
</table>
What are barriers to launching UHD services?*

**Additional comments:**
- Market demand in OTA
- Cost of delivery in OTT
- Availability of IP-based infrastructure
- Lack of single HDR solution (x2)
- MVPD customers and advertisers not willing to pay more for UHD
- Quality of UHD content (sometimes not much better than HD)

Guidelines

Streamline WF (SDR/HDR)

Guidelines (watermarking)

Educate Market (B2B)

Lots of work to make UHD take off

* Source: Ultra HD Forum Operators’ Survey, IBC’17
Why Join the Forum?

- Network with all UHD industry players and learn from them
- Interact with other operators who have already deployed Live UHD service
- Participate to plug fest
- Influence Spanish regulators on UHD
- Help shape the future of UHD

Ultra HD Forum is here to help you deploy UHD!
Agenda
## Deployed UHD IPTV Services

<table>
<thead>
<tr>
<th>Delivered via</th>
<th>Transfer function</th>
<th>Frame rate</th>
<th>Bit depth</th>
<th>Color space</th>
<th>Audio codec(s)</th>
<th>Bitrate</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPTV</td>
<td>SDR</td>
<td>50fps</td>
<td>8 or 10-bit</td>
<td>BT.709</td>
<td>AC-3</td>
<td>24-30Mbps</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PQ</td>
<td>59.94fps</td>
<td>10-bit</td>
<td>BT.2020</td>
<td>AAC, AC-3</td>
<td>32Mbps</td>
<td></td>
</tr>
<tr>
<td>IPTV</td>
<td>PQ</td>
<td>50fps</td>
<td>10-bit</td>
<td>BT.2020</td>
<td>MPEG2, AC-3, DD</td>
<td>25Mbps</td>
<td>Sports content</td>
</tr>
</tbody>
</table>

UHD mainly on Fiber today
UHD IP delivered

May ways to deliver UHD over IP
What is coming next?
What’s covered in Phase B

- 4K Resolution
- Next Gen Audio
- WCG
- HDR
- New EOTF
- HFR > 60 fps
- Screen Size

n=52

* Source: Ultra HD Forum members survey (Aug’16)
<table>
<thead>
<tr>
<th>Topics</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGA</td>
<td>Object based</td>
</tr>
<tr>
<td>New HDRs</td>
<td>Dolby, Technicolor, HDR10+, ST 2094- X, China,...</td>
</tr>
<tr>
<td>HDR Dual Layer Technology</td>
<td>Backward compatibility</td>
</tr>
<tr>
<td>HFR</td>
<td>P100 &amp; 120</td>
</tr>
<tr>
<td>HDR Conversion Tools</td>
<td>HDR10 &lt;&gt; HLG</td>
</tr>
<tr>
<td>HDR “Brightness” Control</td>
<td>Regulatory impact</td>
</tr>
<tr>
<td>Applications : OTT</td>
<td>Live &amp; VoD</td>
</tr>
<tr>
<td>Applications : OTA</td>
<td>ATSC 3.0 / DVB-T2 / ISDB-T</td>
</tr>
<tr>
<td>Applications : MVPD</td>
<td>Broadcast / IP Unicast &amp; Multicast</td>
</tr>
</tbody>
</table>
Phase B Operator’s Survey

- Survey topics included:
  - UHD in general, including spatial resolution, color space and dynamic range
  - HDR, including transfer function (PQ/HLG) and metadata
  - Phase B technologies
  - Video codecs
  - Information about the respondent’s operation

- Results available online at: https://ultrahdforum.org/resources/ibc-2017-masterclass-slides-available-for-download-here/
## Survey Summary

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Timing</strong></td>
<td>Phase A still not deployed</td>
</tr>
<tr>
<td><strong>HDR</strong></td>
<td>Too many HDRs, meta data valued though, BC?</td>
</tr>
<tr>
<td><strong>HFR</strong></td>
<td>1080p120 preferred, need E/E workflow</td>
</tr>
<tr>
<td><strong>Needs</strong></td>
<td>Detailed production specification</td>
</tr>
<tr>
<td><strong>Gaps</strong></td>
<td>HDR over SDI/IP, HDR seamless switch on TV</td>
</tr>
</tbody>
</table>

Forum’s 12 months roadmap
Conclusions

- Ultra HD is a long journey: content, standards, devices, business model
- 2018 will be the year of HDR commercial deployments
- UHD: higher ARPU and gain market share in HE segment
- China #1 is UHD TV set production, last in UHD content production

Ultra HD Forum is here to help you deploy UHD!
4KSummit 3 Demonstrations

- Receiver HDR Adaptation
- Headend HDR Adaptation
- HFR 1080p100 Vs 1080p50
Thank You

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