End to end advocacy for next-generation A/V delivery

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Comcast  
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Akamai  
AMD  
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Envivio  
FOX  
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SKY PerfecTV!  
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DEUTSCHE TV-PLATTFORM  
Testronic  
Communication Digital

NABSHOW  
#NABShow  
unleash
Ultra HD Forum MasterClass

9:00: Welcome and Forum Update: David Price, Ericsson; Vice-Chair, Ultra HD Forum

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Quick Thoughts on UHD

Thomas Edwards
FOX Networks Engineering & Operations
20th Century Fox & UHD

- CTO Hanno Basse, President of UHD Alliance
- All new 20CF movies will be in UHD:
  - 4K, HDR, WCG
  - Ultra HD Blu-ray, or
  - Vidity Download (through mgo.com)
Fox on UHD For TV…

• Backwards “derivable” HDR/WCG needed
  – Single-thread production is required
• Excited about 1080p60 HDR/WCG especially for OTA broadcast
• 4K needed as well of course!
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Update on the SDO Perspective

Matthew Goldman
Ericsson
ITU-R WP6C

- **HDR TV**: Draft Proposed Rec. ITU-R BT.[HDR-TV] – *Parameter values for high dynamic range television systems for production & international program exchange*
  - 2 methods of representing HDR-TV signals
    - **Perceptual Quantization (PQ)**: Achieves a very wide range of brightness levels for a given bit depth using a non-linear transfer function that is finely tuned to match the human visual system
    - **Hybrid Log-Gamma (HLG)**: Offers a degree of compatibility with legacy displays by more closely matching the previously established television transfer curves

- **Report ITU-R BT.2390** – *High dynamic range television for production and international programme exchange* (companion report to BT.[HDR-TV])

SMPTE

• **Drafts ST 2094-x** – *Content-Dependent Metadata for Color Volume Transformation of High Luminance and Wide Color Gamut Images* (aka dynamic metadata)

• New project: *HDR and WCG Signaling on Streaming Interfaces* (e.g., over SDI, SVIP)
MPEG HEVC HDR “Fast Track”

• **Call for Evidence for HDR/WCG**
  – Input contributions showed that low bitrate applications did not perform as expected, including poor texture rendition, color shifts after compression, color boundary overflow & chroma sub-sampling issues
  – CfE issued February 2015, with test results reviewed in July 2015

• **January 2016:** Decision made not to add new HDR tools to HEVC due to lack of significant improvements of candidate proposals over improved encode-side only techniques (no changes to bitstream syntax or reference decoder)

• 3 techniques improved the “anchors” (source images used in evaluation)
  – Luma Adjustment (Ericsson)
    • Preprocessing before encoding
    • Removes subsampling artifacts
  – Chroma QP Offset (Ericsson)
    • Encoder optimization
    • Removes chrominance artifacts
  – Luma QP Offset (Ericsson & Sharp)
    • Encoder optimization
    • Increases detail
Other Current Standards Activities

• CTA
    • To add HDR dynamic metadata & HLG OETF to HDR support already in CTA-861.3

• UHD Alliance
  – **UltraHD Premium** specs and logo certification program
  – Broadcasting Sub-Group to consider the definition or recommendation of a reference display environment

• ATSC, DVB, SCTE, others …
  – Standardizing the use of HDR/WCG in direct-to-home/consumer systems
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2016 Sony Television

Transcend Reality
The HDR Industry Leader from Lens to Living Room
Picture Quality remains the #1 purchase decision criteria when choosing a new TV

4K & HDR are the natural choice for large screen TV customers
3 Keys Area of Picture Quality

Color

Contrast

Clarity
4K HDR - Why do we need HDR?

Creation → Distribution → Display

**Conventional**

- Brightness/Contrast
- Colour

**Compressed**

- Brightness/Contrast
- Colour

**Compressed**

Loss of colour information in bright areas

**HDR**

- Brightness/Contrast
- Colour

**Maintains full color/brightness**

Displays full color/brightness

Maintains color and brightness information

SONY

NABSHOW #NABShow

Unleash
4K HDR – Where will we get it from?

Internet Streaming

- Amazon Video
- Netflix
- Ultra 4K Movies & TV (Sony Pictures)

Packaged Media

- Ultra HD Blu-ray
## How Does a CE Company Differentiate & Compete?

<table>
<thead>
<tr>
<th>PQ Element</th>
<th>Old Standard</th>
<th>New Standard</th>
<th>Sony’s Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clarity</strong></td>
<td>Full HD 1080</td>
<td>4K</td>
<td>4K X-Reality PRO</td>
</tr>
<tr>
<td><strong>Color</strong></td>
<td>BT.709</td>
<td>BT.2020</td>
<td>TRILUMINOS</td>
</tr>
<tr>
<td><strong>Contrast</strong></td>
<td>SDR Standard Dynamic Range</td>
<td>HDR High Dynamic Range</td>
<td>X-tended Dynamic Range PRO</td>
</tr>
</tbody>
</table>

Powered by...

---

Sony
• Accurate Colors throughout the HDR brightness range
4K HDR – Slim Backlight Drive

The performance benefits of a local dimming Direct LED with the slim profile of an Edge Lit LED TV

Then how do we get with Edge-lit LEDs?
4K HDR - Slim Backlight Drive

Slim Backlight Drive with X-tended Dynamic Range PRO

Conventional Local Dimming

Sony’s Slim Backlight Drive with X-tended Dynamic Range PRO
4K HDR - Slim Backlight Drive

X-tended Dynamic Range Pro
Slim Backlight Drive

X-tended Dynamic Range Pro
Full Array Backlight
The 75X940D - Beautifully designed for brilliant pictures

75” | 65X940D

Key Features
- 4K HDR
- 4K Processor X1
- 4K X-Reality PRO
- TRILUMINOS Display
- X-tended Dynamic Range PRO
- **Full Array Local Dimming**
- Floating Style
- Android TV
- New Voice Remote
- Cable management

Full Array LED

Cable Management
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U.S. Broadcasters’ Perspective

Lynn Claudy
Senior Vice President, Technology
Ultra HD is a very attractive service to broadcasters…

…but it’s at the end of a long, unpaved, unpopulated and difficult road
The DTV transition was straightforward.
Television Spectrum Reallocation in the DTV Transition

Ch. 2 - 69

Ch. 2 - 51 (All DTV)

108 MHz Auction
The broadcast path to Ultra HD is ATSC 3.0

- MPEG-2 → HEVC
- AC-3 5.1 audio → AC-4 immersive audio

But ATSC 3.0 is not backward compatible with ATSC 1.0
A very hypothetical case for a transition to ATSC 3.0
A very hypothetical case for a transition to ATSC 3.0
<table>
<thead>
<tr>
<th>Today ATSC 1.0</th>
<th>Next-Gen Transition Period ATSC 3.0 Flash Cut</th>
</tr>
</thead>
<tbody>
<tr>
<td>abc</td>
<td>abc, CBSO, FOX, NBC, Univision, Ion</td>
</tr>
<tr>
<td>CBSO</td>
<td></td>
</tr>
<tr>
<td>FOX</td>
<td></td>
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<tr>
<td>Univision</td>
<td></td>
</tr>
<tr>
<td>Ion</td>
<td></td>
</tr>
<tr>
<td>ATSC 1.0 Simulcast</td>
<td>CBSO, FOX, Univision, Ion, NBC, abc</td>
</tr>
<tr>
<td>ATSC 1.0</td>
<td></td>
</tr>
</tbody>
</table>
Today ATSC 1.0

Next-Gen Transition Period
ATSC 3.0 Flash Cut

Move to ATSC 3.0

Cleared & Repacked
3 stations sold with 1 station electing to shut down and 2 channel sharing.

Next-Gen ATSC 3.0
Widespread broadcast of 4K/HDR/HFR/WCG may be elusive during the ATSC 3.0 transition period

• There aren’t likely to be enough broadcast bits available to cover the coding rates needed for 4K/HDR/HFR/WCG and maintain service to legacy receivers
• Which features have the most “bang for the bit?”
• 1080P60 with HDR/WCG may be the “sweet spot” for some broadcasters
• What are the optimum code rates? 6Mbps? 8Mbps? 10Mbps?
Broadcasters are facing a number of challenges:

- Participation in FCC Reverse Auction
- Channel repacking post-auction
- ATSC 3.0 transitional configuration
- Final ATSC 3.0 Services
- More to come, but...

work is important!
U.S. Broadcasters’ Perspective on Ultra HD

We have been here before...

“...[Y]ou will have a higher audience because it’s going to be more dramatic, you’re going to be more involved in it, the sound’s going to be better, the picture’s going to be better -- it’s going to be better. And better is better.”

James Goodman, CEO, Capitol Broadcasting
Interview in Broadcasting and Cable, September 29, 1997
U.S. Broadcasters’ Perspective on Ultra HD

Better is Better
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Phase A Guidelines Contents

- Phases, Timeframes, Use Cases
- Real-time Linear Services
  - End-to-end Workflow
- HDR/WCG Technologies
  - PQ, HLG
  - BT.709, BT.2020
  - Peak Brightness
  - SDR<>HDR Conversions
- Security Recommendations

- Production & Post Production
  - Pre-recorded Content
  - Live Content
- Distribution Supply Chain
  - Contribution
  - Primary Distribution
  - Final Distribution
  - Ad Insertions, Crawl Overlays
- Decoding & Rendering
- Backward Compatibility
# UHD Phase A Definition

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial Resolution</td>
<td>1080p* or 2160p</td>
</tr>
<tr>
<td>Color Gamut</td>
<td>BT.709, BT.2020</td>
</tr>
<tr>
<td>Bit Depth</td>
<td>10-bit</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>SDR, PQ, HLG</td>
</tr>
<tr>
<td>Frame Rate**</td>
<td>24, 25, 30, 50, 60</td>
</tr>
<tr>
<td>Video Codec</td>
<td>HEVC, Main 10, Level 5.1 (single lyr)</td>
</tr>
<tr>
<td>Audio Channels</td>
<td>Stereo or 5.1 multi-channel audio</td>
</tr>
<tr>
<td>Audio Codec</td>
<td>AC-3, EAC-3, HE-ACC, AAC-LC</td>
</tr>
<tr>
<td>Captions/Subs Coding (in/out formats)</td>
<td>CTA-608/708, ETSI 300 743, ETSI 300 472, SCTE-27, IMSC1</td>
</tr>
</tbody>
</table>

*1080p together with WCG and HDR fulfills certain use cases for UHD Phase A services and is therefore considered to be an Ultra HD format for the purposes of these guidelines. 1080p without WCG or HDR is considered to be an HD format. The possibility of 1080i or 720p plus HDR and WCG are not considered here. HDR and WCG for multiscreen resolutions may be considered in the future.

**Fractional frame rates for 24, 30 and 60 fps are included, but not preferred. Lower frame rates may be best applied to cinematic content.
Production
UHD Phase A HDR and WCG

- HDR10  CTA definition
- PQ    SMPTE ST 2084 definition
- PQ10  Ultra HD Forum definition
  PQ EOTF, BT.2020 color gamut, 10-bit depth
- HLG   Draft New Rec. BT.[HDR-TV] definition
- HLG10 Ultra HD Forum definition
  HLG OETF, BT.2020 color gamut, 10-bit depth
SDR<>HDR and PQ<>HLG

• Mechanisms used to convert or map
  – between SDR and HDR
  – between HDR technologies
• Use cases to illustrate
  – where in the distribution chain to convert
  – which conversion method to choose
  – peak brightness considerations
Mixing HDR with SDR
Signaling and Metadata Carriage

• HDR10 metadata carriage
  – work-a-rounds where standards do not yet exist in the workflow
  – e.g. compensate for lack of HDR metadata carriage over SDI

• Signaling
  – transfer function
  – color container
“Glass to glass” Distribution Chain

- End-to-end workflow for real-time linear service
  - live and/or pre-recorded content
- Production > Broadcast Center > Service Provider > Consumer
- At each point in the chain describe:
  - compression technologies and bitrate ranges
  - metadata carriage options
  - audio
  - captions and subtitles
  - content manipulation: ad insertion, graphic overlays, etc.
Security

- Security requirements are evolving and solutions need to stay ahead of piracy techniques.
- The Guidelines contain recommendations for a secure system in 2016, including:
  - key size
  - encryption technologies
Decoding and Rendering

- Consumer decoding and rendering devices
- Key parameters to process UHD Phase A content
- Displays, STBs and Interfaces
  - identify UHD parameters not carried over HDMI 2.0a
  - timeline of standards development, equipment upgrade possibilities
- Rendering closed captions or graphic overlays
Backward Compatibility

• Address UHD displays that are SDR only
  • Some process BT.2020, others only BT.709
• Various backward compatibility options explained
  • Simulcast, Unicast, Down-conversions
• Options described in context depending on, e.g.:
  • PQ or HLG
  • Type of service provider
  • Quality requirements
  • STB footprint
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Ultra HD Forum
Plugfest #1 Overview

By Eric Grab
Ultra HD Forum Board Member and Interoperability Working Group Chair
Plugfest #1 Overview

• The Ultra HD Forum held an in-person event, Plugfest #1, in Washington D.C. on March 29-30, 2016.

• Doing events such as this are part of the mission of the Ultra HD Forum and its Interoperability Working Group.

• Plugging together real Ultra HD products and seeing how they work, or not work, together. This helps accelerate adoption of Ultra HD.
Plugfest #1 Participants and Scope

• It included 9 member companies, each bringing various equipment to test Ultra High Definition technology from professional capture to consumer display.

• It included HDR via HLG and PQ, live capture from camera, and various devices and displays.
Plugfest #1 Focused on Action

• A confidential event for members. It was not a demo, it was about finding issues as well as confirming success.

• Due to Plugfest #1 some real products got updates.
Plugfest #1 General Workflow

Goal: Glass to glass, end-to-end.

Often many options between each box.
Plugfest #1 Points to Share

- Former video constants are now variables with Ultra HD; and they ripple through the end-to-end workflow. It is more than a resolution increase.
  - 8 bit to 10 bit depth.
  - 709 to 2020 color space.
  - HDR signalling.
- If you can see the picture, it does not mean it is correct.
  - Important to understand your content.
  - Recognize meaningful areas.
  - Test signal usage.
Plugfest #1 More to Share

- TV processing and modes have significant impact on the final picture.
  - Some dramatic changes, even more so then turning on HDR processing.
  - See sidebar on different quality gaps over time. It makes sense for this modes to exist, but now more complex, hence signaling is important.
- A broad content repository is important for testing.
  - The combinations have to be organized.
  - We came up with 12 content variations and 12 display variations to test. Still more to do.

![Diagram of Different Quality Created Gaps]

Pressure to fill the gap, it does make the picture look better.

Now variable gaps, and we need to handle the complexity.
Plugfest #1 Learning Together

• In addition to testing there were plenty of great discussions.
• In many ways it was also a workshop, and the event fostered more expertise in Ultra HD technology.
• Real world testing is invaluable at this stage to understand all the dynamics of Ultra HD technologies.
Plugfest #1 What is next?

- Plugfest #2, #3, …, #n.
- A more formal testing framework and more complete clip repository.
  - Tracking the profiles/settings through the workflow.
  - Report cards / results statistics.
- Continued integration with the end-to-end Ultra HD Forum Guidelines for Phase A, B, and beyond.
- Find patterns of Ultra HD trouble spots, and help members get through them.
- Work with industry liaisons to share the broader issues.

- Overall contribute to acceleration of Ultra HD products and services.
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