Global UHD Conference
27-28 Mar. 2017

Madeleine Noland
Chair, Ultra HD Forum Guidelines Work Group

Agenda

1. **Ultra HD Forum Introduction**

2. **Guidelines Work Group and Ultra HD Forum Phase A Guidelines**

3. **Security Work Group**

4. **InterOp Work Group**

5. **Phase B Guidelines and Next Steps**

Ultra HD Forum History

- Initially conceived in 2012 with key concept: Ultra HD means 4K resolution and MORE

    - WCG

    - HDR

    - HFR

    - NGA

    - Etc.

- This all GOOD! …BUT…

    All these aspects of Ultra HD can lead to market confusion, fragmentation and issues of backward compatibility.

- The Ultra HD Forum was founded to collaborate to solve real-world hurdles and accelerate Ultra HD deployment
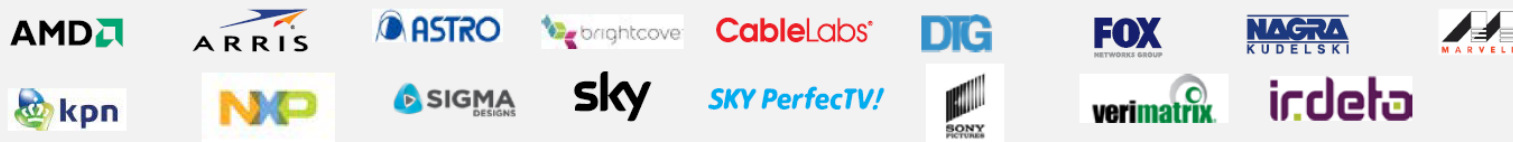
Global Advocacy for Ultra HD

UHD Alliance & Ultra HD Forum

- Ultra HD Forum and UHD Alliance are complementary

- UHD Alliance is B2C focused: guaranteeing a consumer experience quality level through a logo program

- UHD Forum is B2B focused: working on interoperability and best practices for the end to end ecosystem

Ultra HD Forum Work Groups

Guidelines	InterOp	Security	Comms	Liaison
Chair	Madeleine Noland, LGE	William Frantz Neulion	Laurent Piron Nagra	Benjamin Schwarz CTO IC	Pat Griffis Dolby
Co-Chair	Don Eklund Sony	Renard Jenkins PBS		Craig Knudsen Dolby	Nandhu Nandhakumar LG

Ultra HD Forum Phase A Guidelines

- Focus on end-to-end work flows for real-time program streams (aka "linear services")
  - Live and pre-recorded programming
  - "On-the-fly" assembly of the service
  - Interstitial insertion and graphic overlays at multiple points in the supply chain
- Phase A = 2016
  - Technologies and procedures that were deployed as early as 2016
- Phase A linear services are likely to be delivered via MVPDs and OTT

We are very excited about UHD Terrestrial Services launch in Korea!
OTA UHD will be in Phase B Guidelines

UHD Phase A Definition

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

*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.

UHD Phase A: HDR and WCG

- HDR Transfer functions in Phase A :
  - PQ
  - HLG

- HDR "Packages" in Phase A:
  - PQ10   PQ EOTF, BT.2020 color gamut,10-bit depth
  - HLG10   HLG OETF, BT.2020 color gamut,10-bit depth
  - HDR10   PQ EOTF, BT.2020 color gamut,10-bit depth
              plus metadata: SMPTE ST 2086, MaxFALL, MaxCLL

UHD Phase A: Format Signaling

- Currently, Dynamic Range and Color Space cannot be signaled in SDI – SMPTE is working on this
- Encoders can be set up to insert Dynamic Range and Color Space in HEVC output
  - Changes in dynamic range and/or color space "on the fly" during a linear program service may not be feasible in Phase A
  - Encoders operating in real-time may not be able to receive and implement a format change instantly
- The transfer function and color space must reach the display to get a reasonable picture
- Care needs to be taken at each decode/ re-encode point in the chain since the signaling is "lost" at decode

© Johnny Sajem * www.ClipartOf.com/42370

UHD Phase A: Format Conversion

- Normalizing content in a linear service to one "house format" is recommended in Phase A
  - All program segments, interstitials, and graphic overlays comprising the linear service inserted at all points in the chain
- 3D LUTs are currently the most common tools
  - Information about "reference white" levels in conversions are emerging, e.g., 75IRE for HLG
- Other methods are emerging and new standards are in development for HDR<>SDR and HLG<>PQ conversions

Key Challenge: Mixing HDR & SDR
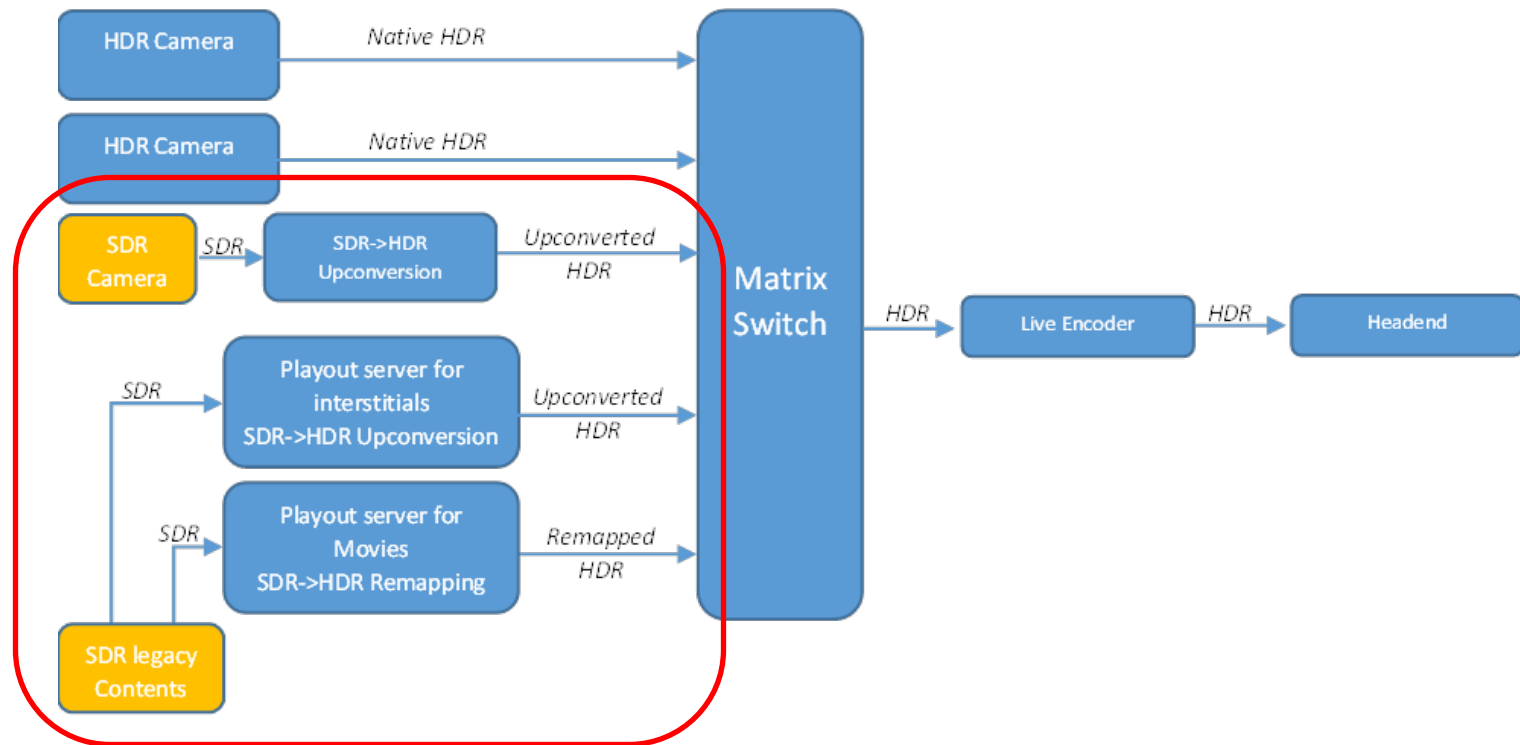
UHD Phase A: Audio

- Multi-channel workflows
  - Stereo (not recommended for UHD content)
  - 5.1 surround
  - Immersive (Dolby Atmos, channel-based only)
- Immersive audio workflow described in detail
- Codecs: AC-3, E-AC-3, HE-AAC, AAC-LC
- Backward compatibility for Immersive audio

UHD Phase A: Distribution Chain

| Capture | Production | Playout | Encoding | Distribution | Decoding | Display |

At each point in the chain the Phase A Guidelines describes:
- Compression technologies and bitrate ranges
- Metadata carriage options
- Audio
- Captions and subtitles
- Linear service assembly: ad insertion, graphic overlays, etc.

UHD Phase A: Decoding, Rendering

- Early UHD displays handle 2160p resolutions, but may not be capable of HDR or WCG
  - UHD SDR/BT.709
  - UHD HDR/BT.709
- Integrated architecture: decoder and display in one unit (TV)
  - Phase A: OTT use case
  - HDMI is not a factor
  - Different streams for different devices, so backward compatibility is easier
- Separated architecture: decoder separate from display (STB+TV)
  - Phase A: MVPD use case
  - Not all Ultra HD parameters are carried over HDMI 2.0a
  - STBs may provide some conversion capabilities for backward compatibility

UHD Phase A: Backward Compatibility

- Options include
  - Down-conversion at Production
  - Down-conversion at the Service Provider
    - Simulcast or unicast
  - Down-conversion at the STB
    - HDMI "hand-shake" to discover display capabilities
  - Spatial up-conversion of HD/SDR/BT.709 content in the UHD device
- Interoperability of channel-based immersive audio
  - Atmos using E-AC-3 includes a 5.1 feed for legacy devices

Ultra HD Forum Security Work Group

- Contributed Security section to Phase A Guidelines
- Security requirements are evolving and solutions need to stay ahead of piracy techniques
- The Phase A Guidelines contain recommendations for a secure linear service in 2016, including
  - key size
  - encryption technologies

Ultra HD Forum InterOp Work Group

- Organizes interop events to test end-to-end systems

- Coordinates demos to promote progress on end-to-end system advancements

Ultra HD Forum InterOp WG Plug Fest #1

- 9 members involved
- HDR via HLG and PQ
- Live capture from camera
- Various devices and displays
- Bit depth, transfer function and color space used to be constants; in UHD they are variables
- Just because you can see the picture, it does not mean it is correct
  - Know your content well, use test patterns
 - Check signaling and metadata at multiple points

Learnings from Plug Fest #1 resulted in valuable product updates
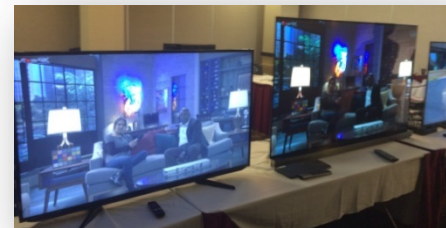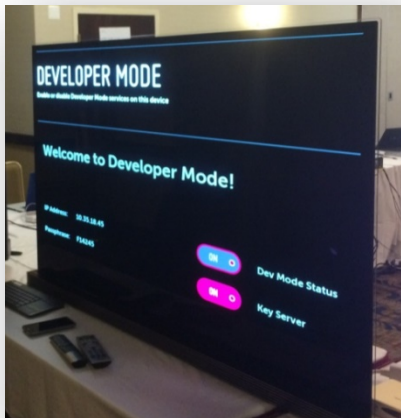
Ultra HD Forum InterOp WG Plug Fest #2 & 3

- 11 member and 6 guest companies participated in #2 and several in the follow-up #3
- Goal 1: Demonstrate HLG10 backward compatibility alongside HDR10, PQ10 and SDR
- Goal 2: Learn more about "pain points"
- Goal 3: Plugfest #3 added ABR scenarios
- Emulated E2E – focus on displays and STBs
  - Encoded content prepared offline
  - Playout via UDP/Linear, USB and VoD
- Content included SDR, HDR10, PQ10, and HLG10 – test cards used for validation
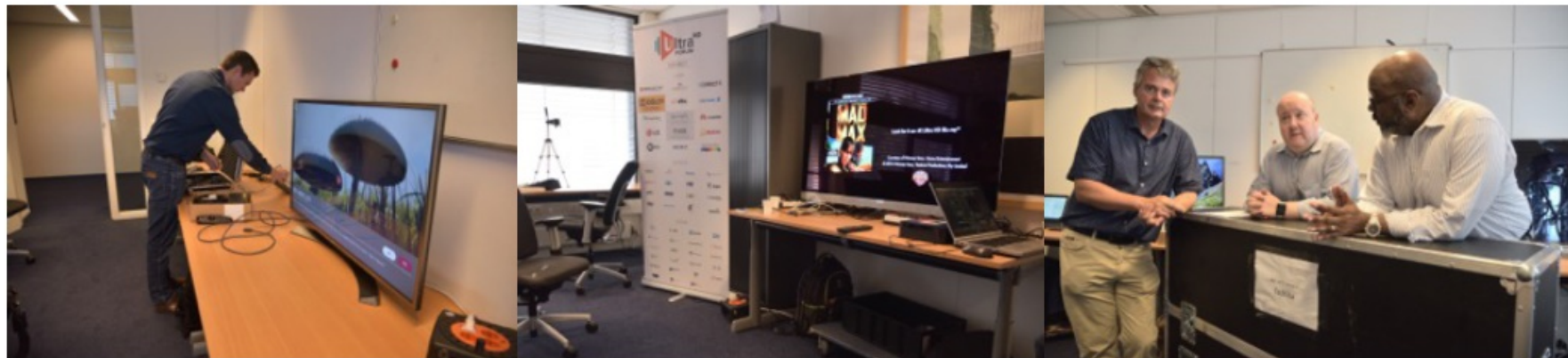
Ultra HD Forum InterOp WG DTG/DTVP joint Plug Fest

- Goal 1: Utilize growing UHDF InterOp WG content repository (SDR, HLG10, HDR10)
- Goal 1: Validate display performance using the above content
- Some findings:
  - There is a lot of variation between displays, including how highlights, dark areas and colors appeared
  - Auto-detection of HLG and of HDR is still not common, but it is improving
  - Different built-in display modes make significant changes to how the content looks; some improve the picture, some do not
  - You need at least 500 nits to experience the HDR "wow" factor

3.6. Direct Sun Image
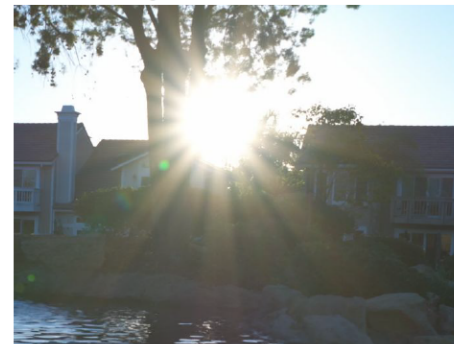
3.8. House Fronts and Boat Water Reflections

Ultra HD Forum: Phase B Guidelines

- Focus on cutting edge UHD parameters in the end-to-end ecosystem
- Additional HDR features
  - Explore HDR "loudness" issues
  - Dynamic metadata
- Additional NGA features
  - object-based workflows
  - personalized audio
- High Frame Rate
  - SHVC for temporal scalability
  - 1080p HFR feasible in the near term? Challenges for 2160p HFR?
- Add terrestrial broadcast as a delivery mechanism
- Add forensic watermarking security techniques

Guidelines WG will collaborate closely with InterOp WG to prove new technologies can work in end-to-end workflows

Ultra HD Forum: NAB Show 2017

- Ultra HD Forum Futures Park
- Adjacent to Korea On Air and NHK 8K booths
- 12 demos planned: 9 Phase A and 3 Phase B
- 9+ companies involved
- Demos include:
    - HLG backward compatibility
    - ABR
    - Format conversions – SDR<>HDR, PQ<>HLG
        - At the head-end
        - At the consumer device
        - Various methods
    - Effects of metadata
    - High Frame Rate
    - Viewer experience related to various peak luminances
    - Compression effects
    - Effects of mixing SDR and HDR in a service

Summary

- **Focus is on the challenges of linear services**

- **Guidelines, Security and InterOp Work Groups collaborate closely**

- **Ultra HD Forum Plugfests are key activities**

- **Phase A Guidelines: UHD technologies "ready to go" as early as 2016**

- **Phase B Guidelines: next generation UHD technologies**

- **New members are welcome – worldwide expertise is essential!**

The Ultra HD Forum works to solve real-world hurdles and accelerate Ultra HD deployment.

감사합니다