UHD Masterclass Agenda

1. Welcome, Thierry Fautier, Ultra HD Forum President, Harmonic

2. Guidelines & standards in the field
   Madeleine Noland, UHDF Guidelines Chair, LG, Skip Pizzi, NAB

3. TECH PANEL: learnings from the FIFA World Cup & other sports in 2018
   Madeleine Noland (Chair)
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   María Rua Aguete, IHS Markit (Chair)
   Yoeri Geutskens, @UHD4K
   Thierry Fautier
   Mike Zink, Warner Bros
   Adina Gorita, Insight TV
   Michel Chabrol, Eutelsat
IBC 2018 Activities

- Operators' yearly survey*
- IBC Masterclass
- Future zone booth
- Phase A refinements
- FIFA 2018 debrief

* [https://www.surveymonkey.com/r/UHDFSurvey2018](https://www.surveymonkey.com/r/UHDFSurvey2018)
**Demo @ IBC**

* Future Zone

<table>
<thead>
<tr>
<th>The Consumer Experience</th>
<th>HFR</th>
<th>CAE</th>
<th>Dynamic HDR</th>
<th>Scalable</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPN TV</td>
<td>Interop</td>
<td>VOD</td>
<td>Phase A</td>
<td>UHD/HD</td>
</tr>
<tr>
<td>NASA TV</td>
<td>BC</td>
<td>Live</td>
<td>Phase B</td>
<td></td>
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<tr>
<td></td>
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<td>Comparison w/BBC Live</td>
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</tr>
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- **HFR**
  - Interop
  - BC
- **CAE**
  - VOD
  - Live
  - Comparison w/BBC Live
- **Dynamic HDR**
  - Phase A
  - Phase B
- **Scalable**
  - UHD/HD
Importance of Technologies*

*Source: UHD Forum internal members

![Importance Chart](chart.png)
FIFA’18 Outcome for the Forum’s members

Large Success of UHD Forum members

CHARTER (15)

CONTRIBUTOR (12)

ASSOCIATE (21)
Why did you join the Ultra HD Forum?

- Develop best practices to deploy UHD,
- Networking with industry peers
- Pursue business development...
- Collaborate with members on important...
- Central point of information on UHD,...
- Develop joint activities: interop with...
- Promote UHD and UHD Forum's work,...
- Other

Other: 4
Comments: Contribute on content security requirements and constraints, Charter member company of the Forum, Alignment with other International standards.

*Source: UHD Forum internal members*
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Korean UHD with ATSC 3.0 PyeongChang Winter Olympics

Madeleine Noland, LG Electronics
Chair, Ultra HD Forum Guidelines Work Group
ATSC 3.0

Digital Terrestrial Television system

Robust physical layer similar to DVB-T2

All IP-based transport

Hybrid broadcast/broadband

Includes all UHDF Phase A and B technologies for broadcast

4K resolution
HFR (100/120 fps with temporal scalability)
HDR/WCG (PQ and HLG with static and dynamic metadata)
Next Gen Audio (AC-4 and MPEG-H, one per region)
ATSC 3.0 Video

**Resolutions up to 3840 × 2160**

**Spatial scalability (SHVC)**

**High Frame Rate**
Up to 100, 120, 120/1.001 (plus lower frame rates)
Temporal sub-layering enables backward compatibility
Plus temporal filtering for optimizing both the SFR and HFR pictures

**High Dynamic Range**
PQ & HLG transfer functions (plus SDR)
Metadata for PQ

**Wide Color Gamut**
Wide Color Gamut BT.2100 (plus BT.709 for SDR)
Y’CBCR non-constant luminance
ICTCP constant luminance (for PQ)
Full Range coding (for PQ)
SL-HDR1 for delivering SDR/709 stream that SL-HDR1-capable decoders can render as HDR/2020
ATSC 3.0 Audio

- Dolby AC-4 in U.S.
- MPEG-H in South Korea

1 technology per country or region

MPEG-H AUDIO ALLIANCE
The Next-Generation System for Interactive and Immersive Sound

Immersive 3D sound
Works for various speaker positions and headphones
Enhanced dialog, alternate languages, consumer choices
Korean ATSC 3.0 Deployment

KBS, MBC and SBS launched ATSC 3.0 broadcasting in May 2017

LG and Samsung commercially launched ATSC 3.0 TVs in advance of the Pyeongchang Winter Games

Since fall of 2017, all new LG 4K UHD TVs and most new LG smart TVs sold in Korea have dual ATSC 3.0-ATSC 1.0 capability

KBS, MBC and SBS prepared 4K workflows and mobile units for the Olympics
Korean 2018 Winter Olympics
Example Korean Olympic Workflow

Studio

- HD content
- UP Scaler
- VMU + Keyer
- HEVC
- Scrambler
- MUX
- STL
- Switch

Station

- Exciter
- Transmitter

Flow:
- clean
- UHD Server
- Live
- SMPTE 292 HD-SDI
- SMPTE 2082 12G-SDI
- IP Stream
- IP Stream (STL)
Mobile TV
Korea’s Aggressive UHD Plan

<table>
<thead>
<tr>
<th>Year</th>
<th>UHD Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>10%</td>
</tr>
<tr>
<td>2019</td>
<td>15%</td>
</tr>
<tr>
<td>2020</td>
<td>25%</td>
</tr>
<tr>
<td>2023</td>
<td>50%</td>
</tr>
<tr>
<td><strong>2027</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Already more than 10 percent of broadcast programming is produced in 4K.

This includes dramas, documentaries, entertainment, sports, news, etc.
NBC’s UHD Presentation of PyeongChang Winter Olympics in U.S.

Skip Pizzi, NAB
(with thanks to NBC Sports And Olympics Engineering)
PyeongChang 4K UHD and 5.1 + 4 NGA Dolby Atmos

Opening and closing ceremonies on a 1-day delay along with select events from the following competition venues, time delayed, over the duration of the Games:
- Figure Skating, Short Track Speed Skating, Ski Jumping and Hockey

UHD Picture Specifics:
- NHK 8K downconverted to 3840 X 2160, 59.94P. Native HLG was convert to PQ for distribution.
- Transport stream bit rates set from as high as 80 mb/s down to 18 mb/s based on point in the signal path

NGA Dolby Atmos Audio Specifics:
- Derived from NHK 22.2.
  - The 22.2 downmixed 5.1 was provided from NHK. Discrete effects and crowd sources were added to the 5.1 mix for the +4 overheads, composed of venue live microphones, captured in sync to add immersive effects to the mix
  - Discrete channels were sent from Korea to NBC Sports HQ in Stamford CT. where the immersive 10-channel mix was created in a 4K-UHD Mobile Unit
  - The completed mix with picture was sent to NBCU’s Network Operation Center in Englewood Cliffs NJ where the PCM audio was encoded to Dolby Digital Plus with JOC, creating a Dolby Atmos 5.1+4 soundtrack for the UHD pictures for distribution to DBS and VOD

DBS provider DIRECTV carried a UHD 4k and Dolby Atmos 5.1+4 Linear Channel
DISH Network carried a UHD 4k and Dolby Digital 5.1 Linear channel
Comcast carried UHD 4k and Dolby Atmos 5.1+4 VOD

Lessons learned:
- UHD: use of 4K lenses was important. HLG to PQ translation at 1 knit normalized, was transparent using static LUTs
- NGA: ability to add downmix attenuation metadata to the overhead channels protected the 5.1 and stereo versions derived form the 10 channel mix. This allowed higher overhead channel amplitude for greater effect. Fine tuning was required to find the right settings for coder bandwidth, overhead amplitude and downmix attenuation while listening to both the immersive and derived 2 and 5.1 channel versions
Opening and closing ceremonies on a 1-day delay, along with select events from the following competition venues, time delayed, over the duration of the Games:

Figure Skating, Short Track Speed Skating, Ski Jumping and Hockey
Delivery Channels

DBS provider DIRECTV carried a UHD 4K/HDR and Dolby Atmos 5.1+4 Linear Channel

DBS provider DISH Network carried a UHD 4K/HDR and Dolby Digital 5.1 Linear channel

Cable provider Comcast carried UHD 4K/HDR and Dolby Atmos 5.1+4 VOD

WRAL experimental ATSC 3.0 transmission carried UHD 4K/HDR and Dolby Digital 5.1 Linear channel
UHD Video

NHK 8K video was down-converted to 3840x2160, 59.94p

Native HLG was converted to PQ for distribution

Transport stream bit rates ranged from 18 Mb/s to 80 Mb/s at various points along the signal path
UHD Audio

Derived from NHK 22.2 channel original mix

A 5.1-channel downmix was provided by NHK. Discrete effects and crowd sources from the 22.2 channel original were added to the 5.1 mix for the +4 overheads. From live venue microphones, captured in sync to add immersive effects to the mix.

Discrete channels were sent from Korea to NBC Sports HQ in Stamford, CT where the immersive 10-channel (5.1+4) mix was created in a 4K-UHD Mobile Unit.

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UHD Stamford Technical Operation Center
Audio Control, Stamford OB Unit
Lessons Learned

UHD Video
Use of 4K lenses was important
HLG to PQ translation normalized to 1 nit was transparent using static LUTs

NGA
Ability to add downmix-attenuation metadata to the overhead channels protected the 5.1 and stereo versions derived from the immersive (10 channel) mix. This allowed higher overhead-channel amplitude for greater effect.

Fine tuning was required to find the right settings for coder bandwidth, overhead amplitude and downmix attenuation while listening to both the immersive and derived 2 and 5.1 channel versions
Acknowledgements @ NBCU

Karl Malone, Sound designer, NBC Sports and Olympics

Chris Seeger, Director of Advanced Content Production Technology

Jim Starzynski, Director and Principal Audio Engineer
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   Michel Chabrol, Eutelsat
UHD Take-up in the Field: FIFA and Roland Garros

Madeleine Noland, LG Electronics, Chair UHDF Guidelines WG (Moderator)

Jorg Sander, Chief Technical officer, HBS

Stephan Heimbecher, Director Innovations & Standards, Technology, Sky

Ian Nock, Founder, Fairmile West, Chair UHDF Interoperability WG

Dolf Schinkel, TV Architect, KPN Media Services

Mickaël Raulet, Director, Research & Innovations, Ateme
Ultra HD Forum promotes adoption of UHD services with a focus on end-to-end workflows

The Forum produces Guidelines and conducts Interops to inform and improve the UHD ecosystem

The Forum is pleased to announce publication of the 5th version of the Phase A Guidelines
The Forum’s UHD Phase A Guidelines v1.5 is available for download at www.ultrahdforum.org

Among the updates is the addition of 4 UHD productions of marquee television events

In today’s panel we will explore two such events:
FIFA World Cup (Stephan, Jorg, Ian, Dolf)
Roland Garros (Mickaël)
24 broadcasters subscribed to UHD HDR offer
Camera Plan

Standard 37 + 1 + 2

Camera Plan
• 2x Ultra Motion
• 8x Super Slow Motion
• 2x RF Steadicams
• 1x Cable Cam
• 2x In Goals
• 2x Box Cams (GLT)
• 2x Cranes
• 1x Tactical Camera
• Up to 5x Handhelds for pre/post match activities
• 2x RF Handhelds for fan colour from inside and outside stadium
UHD/HDR Operations

UHD/HDR Production
2 Layers, but single camera plan / no side-by-side production
Core layer 1080p/50 SDR REC.709 with HD Graphics
Enhanced Layer UHD 2160p/50 HDR BT.2020 without Graphics

Vision Mixer
8 Cameras Dual output UHD/HDR and 1080p/SDR
11 Cameras Dual output 1080p/HDR and 1080p/SDR
21 Cameras Single output 1080p/SDR
All Replays 1080p/SDR

Shading of all cameras is done on the 1080p/SDR layer
Dual Layer Workflow
UHD HDR vs HD SDR

Color properly represented
Wide angle

Color crunched
Narrow angle
HDR Workflows used for FIFA’18

- Production
  - S-log3
    - HDR10 (conversion)
    - HLG (conversion)
  - HDR10
    - conversion
    - HDRC-4000

- Broadcast
  - Taker 1 → HLG
  - Taker 2 → HDR10
  - Taker 3 → HDR10
  - Taker 4 → HLG
  - Taker 5 → HLG
  - Taker 6

- Distribution
  - STB 1 → TV 1
  - STB 2 → TV 2
  - STB 3 → TV 3
  - STB 4 → TV 4
  - STB 5a → TV 5
  - STB 5b → TV 5
  - STB 6 → TV 6

- STB 6

- TV 5

- Compare

- SDR

- SDR

- SDR

- SDR
Feedback on UHD/HDR QoE

UHD gives a wider pan and brings less fatigue to users than HD

HDR was not consistent between venues / cams

HDR was noticed in high shade/high brightness matches

TV processing (as noticed in Interop) not always good.

Some broadcasters had to do last-minute adjustments, causing troubles to consumers

“Can be better to have a good & stable SDR than a poor HDR”

SDR (UHD & HD) looked pale vs HDR

HDR wasn’t always “wow”, but SDR looked worse than HDR at all times

For operators & broadcasters who have deployed UHD, UHD was a success, even better with HDR
FIFA’18 was the most challenging event ever produced in HDR, it worked! Only prepared Broadcasters/Operators have succeeded to make HDR work. When working, HDR was showing a noticeable improvement vs SDR. All networks exercised: DTH, IPTV, IP Cable ABR (managed), OTT to TVs. HLG not supported on all STB, TV color mapping not always consistent. Ultra HD Forum Phase A was deployed during FIFA’18. Broadcasters & operators members of the Ultra HD Forum were all successful.

**Summary**

Time to join the Ultra HD Forum?
DTT /DTH distribution

On DTH: Compatible TV with CI+ smartcard
OTT mobile distribution

**Encoder**
- 3 representations up to 1080p50
  - Dolby vision profile
  - DD+
  - CMAF (hls/fmp4)

**Ac-4 Encoding**
- IMS (binaural)

**Dolby**

**Samsung S9**

**Iphone 8, X, Ipad Pro**

**Broadcast**
- UHD HLG BT.2020
  - Production
  - 16 audio channels
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In China, North America and Western Europe 4K represents over 50% of shipments. Japan lags, due to a preference for smaller (non-4K) screen sizes.
Screen size growth continues

Ongoing LCD display capacity investments and price erosion drive size growth.

Long-term trend of 1-inch per year size growth (over 10 years).

Chinese consumers buy largest TVs.

Small sizes preferred in Japan. Latin America decline 2014-15 caused by subsidised sets in Mexico for digital switch-over.
Channels...growing steadily

Unique channel brands per region.

Count does not duplicate channels eg. TravelXP or Insight TV on multiple platforms and countries per region

Count excludes ‘pop up’ channels, e.g. FIFA World Cup coverage.

Unique linear UHD channels

Source: IHS Markit

© 2018 IHS Markit
Content choice: limited, but growing:
UK (February-18)

UHD on-demand title availability

Source: IHS Markit

© 2018 IHS Markit
Content choice: limited, but growing:
UK (February-18)
Sony Pictures invested early in 4K and now has over 180 4K titles

56 Titles available in 4K with HDR
What are the main selling points for HDR content versus non HDR?

**HDR** (High Dynamic Range) gives you better contrast –
“You’ll see greater detail in the clouds on a sunny day, the foam on the ocean waves, and the sand in a sand trap.”

DIRECTV has 3 fully dedicated 4k channels

- **4K VOD** Nov 2014
- **Linear UHD** April 2016
- **HDR Dec 2017**
Thank you!

Questions?

maria.ruaquete@ihsmarkit.com
paul.gray@ihsmarkit.com
HDR ecosystem September 2018

Samsung HDR10+
ST2094-40

HDR 10
ST2084
ST2086

Philips/Technicolor
SL-HDR1 – ST2094-20/30

Dolby Vision
ST2094-10

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Ultra HD Forum – IBC 2018

Ultra HD in the World and in Europe – Amsterdam

17th September 2018
Michel CHABROL – Senior VP New TV Formats Eutelsat S.A. (mchabrol@eutelsat.com)
Ultra HD situation in the WORLD

180

ULTRA HD/4K

Channels Or feeds in the World

LYNGSAT, UHD Forum & Eutelsat Research – September 2018
World Ultra HD Channels/Services As Of August 2018

55 or 93 Channels
93 Feeds
85 Services
2 DTT Channels
Ultra HD situation in Europe

ULTRA HD/4K
Channels Or feeds in Europe

LYNGSAT, UHD Forum & Eutelsat Research – September 2018
Europe Ultra HD Channels/Services As Of August 2018

29 or 35 Channels

35 Feeds

41 Services

0 DTT Channels
(with local or temporary channels)
PANEL: Getting HDR to market in 2018

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