The consumer experience of UHD - results of an in-depth study

Claudia Becker – Orange Labs, November 2014
Orange at a glance

239 million+ customers worldwide

2013 €40.9 billion revenue
€1.873 billion net profit

450,000 km of undersea cables
enough to go around the earth 10 times!

382,000+ Fibre customers in 10 countries

IPTV launched in France 10 years ago

6.5 million digital TV (IPTV / satellite) customers in Europe
2006 – H.264/AVC SD, then HD IPTV live channels

164,000 employees
(including 101,000 in France)
Introduction
What is Ultra-HD?

Resolution
more details

High Frame Rate
no jerkiness,
no motion blur

Wide Color Gamut:
better colors

High-Dynamic Range
more contrast

Quality of Experience?
spatial
colors
temporal
d-range

Dynamic Range
more contrast

Dynamic Range
more contrast
What is Ultra-HD?


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<thead>
<tr>
<th>Image parameter</th>
<th>SD</th>
<th>HD-1</th>
<th>HD-2</th>
<th>UHD-1</th>
<th>UHD-2</th>
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<td>Rec. 709</td>
<td>Rec. 2020</td>
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<td>720p</td>
<td>1080i</td>
<td>QuadHD, 4K</td>
<td>SHV, 8K</td>
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How can UHD be delivered to end-user?

- As usual like any Live TV or Video content
  - Live TV: Broadcast (DTT, SAT, IPTV, …)
  - Video: Physical support, VOD over IP, Broadcast

- Current encoding aka H.264/AVC not sufficient

HEVC
- Defined by the joint collaboration of MPEG and ITU-T (JCT-VC)
- Finalized in January 2013

Source: MPEG N14420, Report on HEVC compression performance verification testing
Will Ultra-HD improve user experience?

- Ultra HD promises are many:
  - better immersion thanks to improved realism
  - smoother and sharper movements
  - better perception of details
  - more natural colors and contrasts

But the final perceived quality depends on the viewing conditions.

![Diagram showing spatial resolution and viewing distance for 50" HD TV, 50" 4K TV, and 100" 4K TV.](image)
UHD-1
Phase 1 consumer experience results
What is UHD-1 Phase 1?

- UHD-1 Phase 1 defined by DVB

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- Audio encoding within existing DVB toolbox, Video encoding with HEVC
Visual assessment for UHD-1 Phase 1 (4K)

- Visual assessment tests done by Orange Labs within 4EVER project

- Assess using subjective testing
  - comparison to HD
  - bitrate encoding (HEVC)
  - distance to the screen

- Tests results shared
Test methodology

Standardized ITU method - **SAMVIQ** Method (ITU-R BT 1788)

- Dedicated method to determine the video quality by giving accurate quality scores
- Global notation for short duration sequences
- Continuous quality scale (0-100) using quality items (Bad, Poor, Fair, Good and Excellent)
- Use of explicit and hidden references and anchoring
- Over 15 non expert testers
UHD-1 Phase 1 (4K) – Comparison to HD

- UHD-1 resolution better than HD but not as much as HD vs SD
- UHD-1 resolution only, not sufficient to ensure disruptive QoE
- Perceived quality differences are content dependent (motion and textures)
Perceived video quality increases with video bitrate.

The video quality range is from “Fair” to “Excellent”. “Good” to “Excellent” from 12 to 16 Mbits.

But need to be refined:
- by adding more challenging content (e.g. sport)
- and changing distance to the screen (=> 3 meters) and screen size.
UDH-1 Phase 1 (4K) – Limited success

- **Status in 2014**
  - Devices and encoding are there
  - End to end production chain is not mature
  - Additional security requirements
  - Lack of content and closed market for video

- **Reminder**: the extra sharpness is invisible unless the television screen is really large — or unless viewers sit very close to the screen
UHD-1
Phase 2
consumer experience
What is UHD-1 Phase 2?

- DVB requirements for UHD-1 Phase 2 “not only more pixels... but better pixels!”
  - higher frame rates (HFR) ?
  - higher dynamic range (HDR) ?
  - higher color gamut (WCG) ?

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Specifications expected by **2016/2017** for services around 2017/2018.
Better motion – High Frame Rate (HFR)

- Improved fluidity of movement

- Capture and rendering devices
  - From 100 images/s cameras to slow-motion cameras
  - No rendering devices.
  - Screens going up to 100 to 200 images/s
  - HDMI 2.0 limited to 50 fps or 60 fps
  - Temporal up-sampling

- Impact on Quality of Experience
  - 50 fps vs interpolated 50 fps vs 100 fps vs 200 fps
  - Does it improve realness, comfort…?

- Adaptation of SAMVIQ test method: criteria…?
More or better contrast – High Dynamic Range (HDR)

- Contrast information preserved in high and low luminance areas
- Capture and rendering devices
  - Some cameras and scanners
  - Some displays with more brightness including technologies for upscaling and adaptation
- Impact on Quality of Experience
  - SDR (200 cd/m²) vs HDR (1000, 2000 and 4000 cd/m²)
  - 10 or 12 bits and transfer functions
- Adaptation of SAMVIQ test method: environment, criteria … ?
More or better color - Wide Color Gamut (WCG)

- More realistic colors can be rendered using a larger color space
- More colors can be rendered according to quantization: 10 or 12-bit
- No fully compliant devices
  - Very few cameras
  - OLED displays announced but not UHDTV gamut compliant
- Subject addressed by Technicolor within 4EVER project

Source: http://www.4ever-project.com
Shooting and tests

- Latest shooting performed with partners within 4EVER project already demonstrated at IBC 2014 – 4K, HFR and HDR
  - December 2013 – Sport (rugby), Ballet
  - March 2014 - Hip Hop Dance
  - September 2014 – “World Equestrian Games” in Normandy
- Tests and subjective evaluations to assess visual improvement
- HDR and HFR tests
  - October – December 2014 - Image format tests currently being conducted
  - Compressed format tests to come
- Definition of collaboration with EBU and DVB in progress
As a conclusion

- For the maximum impact, the whole chain - content creation, production, distribution and rendering - needs to be in harmony.

- We aim at finding the good compromise based on current and short term capabilities (capture, rendering, encoding, transport…) and visual improvement assessment.

- Importance of the standards bodies.
thank you
4EVER (M. Clare) : French collaborative project (June 2012- June 2015): Full HEVC encoding-decoding chain in applicative environment

- Providing better video experience
  - Ultra HD over ADLS/FTTH
  - HD over 3G/LTE
- Integration in operational environment
  - Development of pre-industrial encoders (platform oriented) and decoders (multiplatform)
  - Subjective/Objective evaluations performed during end-to-end “real life operations”
- Partners: INSA/IETR, ParisTech, Globecast, ATEME, Teamcast, DOREMI/Highlands, franceTV, Technicolor

http://4ever-project.com