4K UHDTV: What’s Real for 2014 and Where Will We Be by 2016?

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4K TV = UHDTV-1

In context of broadcast television, “4K TV” is UHDTV Level 1 or 4K UHDTV

- **UHDTV as a standard**
  - SMPTE 2036-1, 2009
    - UHDTV Level 1 = 3840 x 2160
    - UHDTV Level 2 = 7680 x 4320

- **Consumer Electronics Association (CEA), Oct. 2012**
  - “Ultra High Definition” or “Ultra HD”
    - >8 million active pixels
    - At least 3840 (H) x 2160 (V)
    - At least 16:9 aspect ratio
    - At least 1 digital input capable of carrying and displaying native 3840x2160 resolution without relying on up-conversion
UHDTV is More Immersive

Proper viewing distance
HD ~ 3H
4K UHD ~ 1.5H

HDTV field-of-view ~30°

4K UHDTV field-of-view ~60°
Increased Motion Sensitivity …

Wider viewing angle = more immersive viewing experience

Still from BBC test shoot, above as it would have been captured with 50 Hz frame rate, and below, at 300 fps.

Images courtesy of BBC

… Increases perceived Motion Blur or …
Motion judder*

*simulated for illustration purposes by a strobing effect

Higher frame rates are needed to compensate

50/60 fps minimum (100/120 fps being vetted)
Expanded Color Space

Color Distribution of Objects on X-Y Chromaticity Coordinates

Inner triangle: HD, Rec. ITU-R BT.709
Outer triangle: UHDTV, Rec. ITU-R BT.2020

From Report ITU-R BT.2246-1
High Dynamic Range

Clipping at 40 % Luminance reduction

Displayed at 100% luminance

Images courtesy of Dolby Laboratories
Sample bit depth: 8 is not enough

10-bit DTH, 10-/12-bit Contribution

- Not needed just for extended color space and high dynamic range …

- Banding (posterization) with 8b, especially in plain areas
  - Sky, backgrounds, graphics, logo
  - More noticeable with slow changes, such as fades

10-bit operation does not cost bitrate
What format will industry settle on for 4K UHDTV?

For Content Acquisition and Primary Distribution, new High Efficiency Video Coding profiles (HEVC Range Extensions) just standardized April 2014

True 4K UHDTV HEVC requires 80x more processing power than HD AVC

Note: the preferred audio formats for UHDTV are still under discussion
Until HEVC is ready ... live 4K UHDTV

Contribution & Distribution using AVC

4K UHD source → 4x 3G-SDI

4x AVC encoders synchronized

or

4x AVC IRDs phase-locked

and/or storage

4K UHD display
Live 4K UHDTV C&D HEVC ecosystem
Early adopters in 2016

4K UHD source →
12G-SDI or Video over IP i/f

HEVC Encoder

or

or

HEVC IRD

4K UHD display

and/or storage
UHD-1 uncertainties

› UHDTV is all about the consumer experience
  – UHD-1 Phase 1 defined, but many proposals to create a UHD-1 Phase 2 for 2017+

› The whole baseband-to-consumer ecosystem costs need considering
  – Cameras, production, post production, infrastructure, delivery

› High Frame Rate (> 60 fps) enhances motion depiction, especially for sport
  – Higher frame rates will, however, increase live and post production costs

› High Dynamic Range enhances reality of scene
  – Depending on which route taken will increase some costs

› Audio and other issues still under discussion
Summary

› “Will 4K UHDTV’s adoption be more like 3DTV or HDTV?”
  – Depends on how we in the industry present it!
  – *Can be transformative if the experience is immersive*

› Not all solutions being touted are “full” or “true” 4K UHDTV
  – For an immersive experience,
    › 50-60 fps required for sports and other complex motion content
    › 10-bit depth data values required for all content

› Enabling acquisition & delivery of compelling UHDTV content today
  – HEVC Range Extensions (for C&D) *just completed* this past week
  – Live AVC-based C&D ecosystem will jumpstart premium service
  – Live HEVC-based C&D ecosystem will begin to come together during 2016
4K Technology Breakfast

NAB 2014
Peter Ostapiuk, VP Media Product Management
4K UHDTV Opportunities and Challenges

Opportunities
- 4K UHDTV is a natural resolution evolution for television.
- Offers more immersive viewing experience.
- Enhanced viewing experience for Tier 1 content of movies, sports and documentaries.
- Additional revenue opportunity for content companies and Pay TV operators.

Challenges
- It takes a lot of bandwidth if you want to “do it right”.
- Industry focus is on resolution versus frame rate and color depth.
- Viewing requires large screens and shorter viewing distance.
- 4K UHDTV requires upgrades of technology in each segment of the media value chain.
4K Delivery Chain Elements

Production
- Content Availability
- 4K UHDTV Upconversion
- Studio and Post Production Infrastructure

Primary Distribution
- Encoding Standards & Hardware
- Modulation
- Transport

Secondary Distribution
- Linear; OTT On Demand; Download
- Satellite DTH
- Cable
- IPTV

Consumer Premises
- Set Top Boxes
- Cabling
- Displays
- Consumer Viewing Habits
Likely Next Steps in 4K UHDTV Evolution

4K UHDTV penetration will continue to increase.

DTH providers will pioneer 4K UHDTV linear transmission to differentiate.

4K UHDTV content libraries will continue to build up.

4K will need to be adopted by consumers as a premium service to justify linear channel launch.

HEVC encoding and DVB-S2X will make 4K contribution and distribution economical.

Unlikely that all current SD and HD channels will become 4K UHDTV in the near future.

Many OTT providers will offer On Demand/Streaming 4K UHDTV services.

4K UHDTV will contribute to further fragmentation of market.
Live Transmission in True 4K, Ultra High Definition Broadcast over Hybrid Network from London to Las Vegas

- **36 MHz DVB-S2X 16APSK 3/4FEC 5% roll off**
- **4K UHD TV at Ericsson**
- **3840 x 2160, P60, 4:2:2, 10 bit**
- **1+1 DVB ASI 100 Mbs**
- **Four 3G HD-SDI 1080p 59.94Hz**
Questions