

**EBU**

OPERATING EUROVISION AND EURORADIO

# HDTV and what's next ...

WBU-ISOG FORUM LOS ANGELES MAY 2013

# EUROVISION NETWORK

	Major sports events	Other sports traffic
2008	HD/SD Olympics Beijing	SD
2010	HD/SD Olympics Vancouver	SD/HD
	HD/SD FIFA World Cup	HD/SD
2012	HD Olympics London	HD/SD
2013		HD
2014	HD/UHD(?) FIFA World Cup	HD

**The contribution network designed as follows:**

- Production HDTV
- Signal delivery on the network HDTV (h.264 compression)
- Broadcasters optionally convert to SDTV at the reception side

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**What is required to cover a major sport event in Ultra HD ?**

**Not an easy answer ...**

# THE NOMENCLATURE AND STANDARDS

- CEA: Ultra-HD
- **EBU: UHD-1 3840x2160**  
**UHD-2 7680x4320**
- ITU-R recently approved 08/2012:  
ITU-R BT 2020 (UHDTV)
- SMPTE is updating the 2036-1  
base band document on UHDTV
- SMPTE 2036-3 interface specifications
- 4K (**4096x2160**) designed for CINEMA
- “4K” is a marketing name



## THE ELEMENTS TO BE STANDARDIZED

### ■ Production

- The main-stream production systems are required
- Colour? Frame Rate? Bit depth?
- Full support of BT2020 and SMPTE 2036-1-2-3

### ■ Contribution

- HEVC for contribution highly required ... not ready yet, need ensure new tools to create significant bit rate savings
- Intermediate: Quad-HD H.264 ?

### ■ Distribution

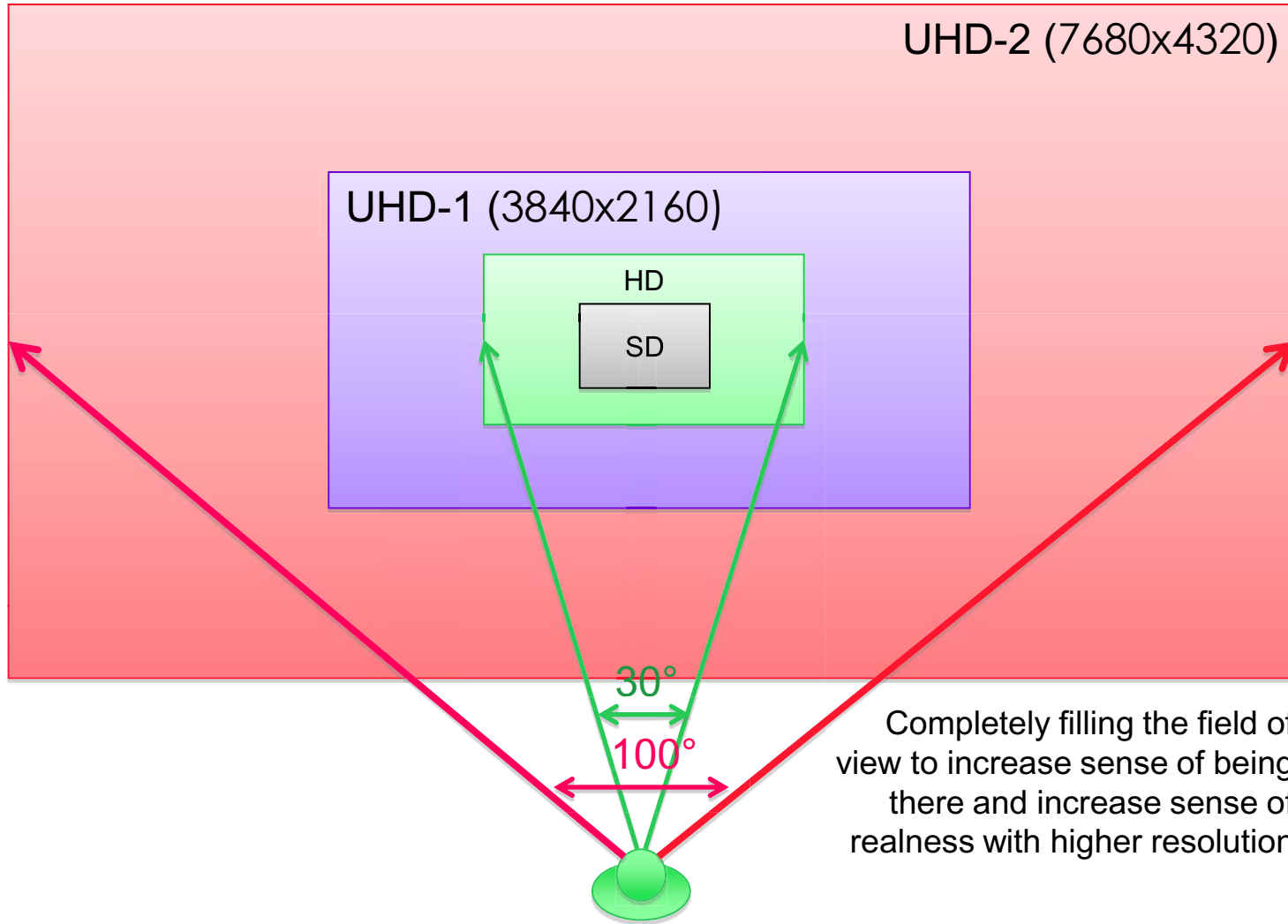
- HEVC ready, but patent pool unclear
- Standard Profile (urgent): HEVC with 10 bit, 50p, colour?, luminance?
- Extended Profile (?): HEVC with UHD-1 BT2020 parameters.

### ■ Consumer domain

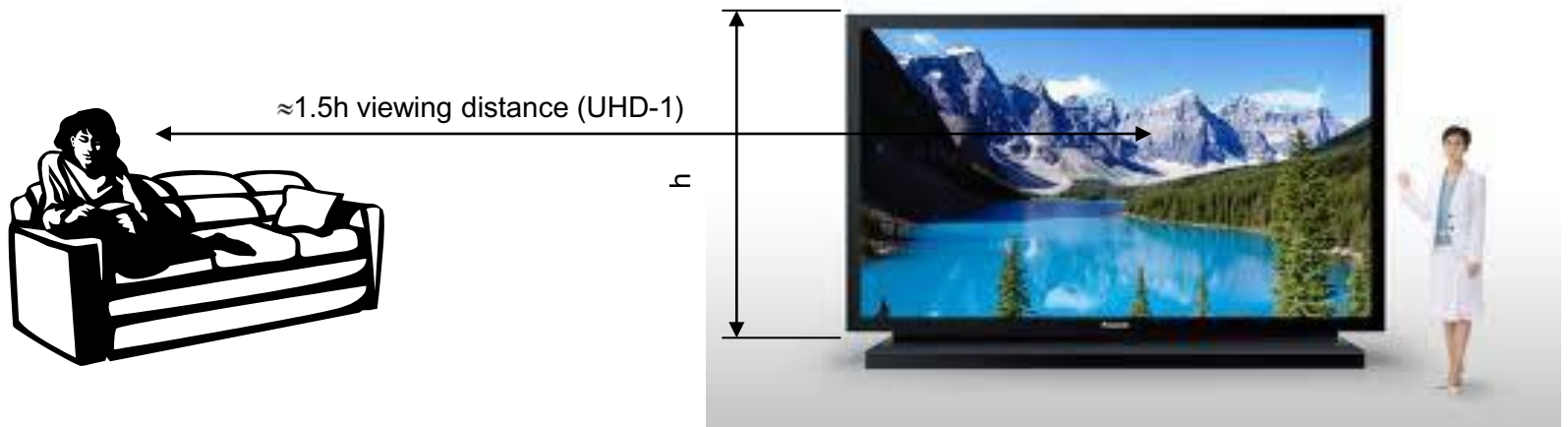
- Display Label to avoid consumer confusion (4K or UHD ? QuadHD ?)
- An "interface" that can carry ITU-R BT.2020 (HDMI x, Display Port ..... )
- All over signalisation scheme to ensure best setting of the consumer display

### ■ Content production

- How to produce live events ?
- Best practise sharing



## MORE PIXELS



We observe the (consumer) industry is very much focused on the resolution.

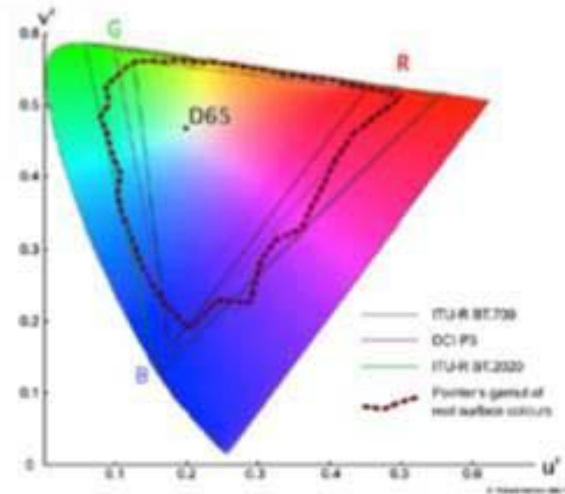
But is this really enough?

# KEY PARAMETERS IN ITU-R BT. 2020



## UHDTV

- Image format
- Bit depth and TF
- Frame Rate
- Color encoding
- Color Gamut



3840x2160 (UHD-1) , 7680x4320 (UHD-2)

10, 12bit

24, 24/1001, 25, 30, 50, 60, 60/1001, 120fps

( Constant vs Non-Constant luminance )

Wider than Rec 709 and P3.

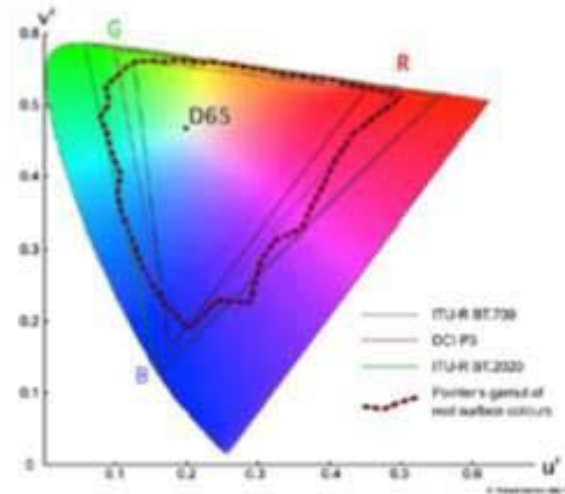


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## MORE FRAMES – WHY ?

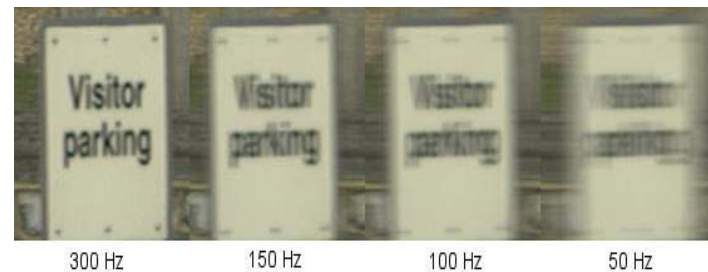
- Motion portrayal (genre dependent)
- Increasing spatial resolution seems to call for an increase of frame rate too!

What needs to be investigated:

- Compression efficiency
- Impact to GOP length
- Interfaces for RT >>60p



Figure 3. Still from BBC test shoot, above as it would have been captured with 50 Hz frame rate, and below, at 300 fps.

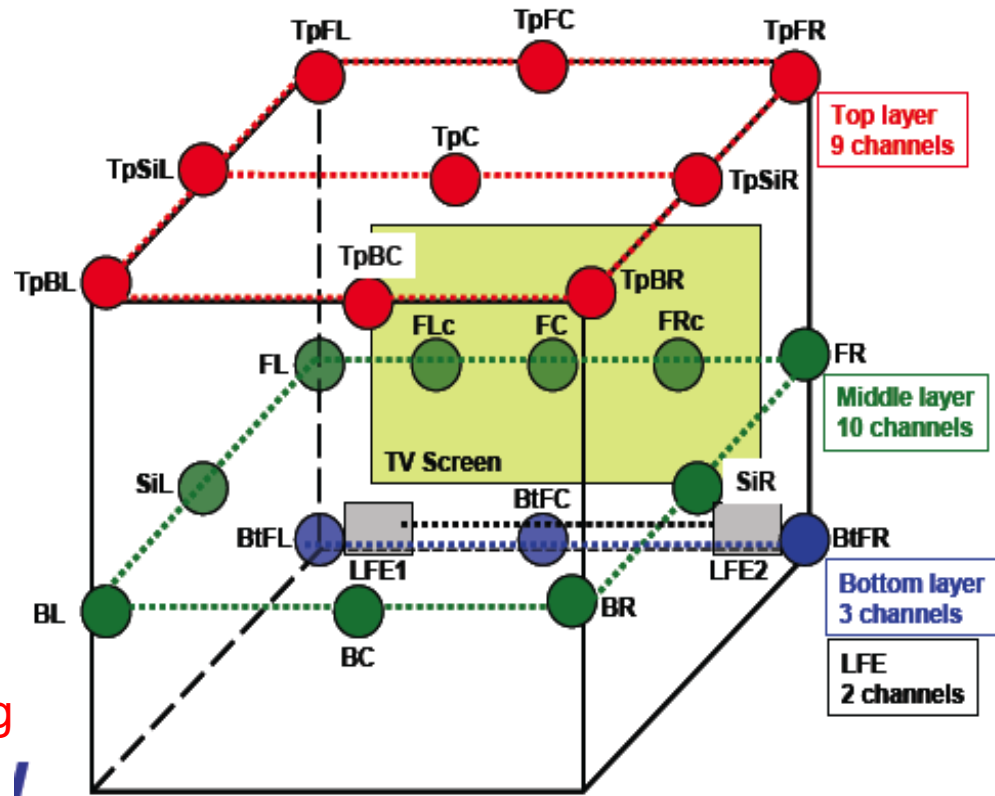


**Camera panning (BBC content)**

# Important part - AUDIO

- Reproduce the sound image in all direction around the viewer.
- Produce a very wide listening area with high sense of presence.
  - 22.2 Chanel system

- Cinema vs. broadcasting



# **First investigation of the team in EBU BeyondHD**

**“Can we see a difference when  
looking between HDTV and UHDTV  
on a UHDTV screen?”**

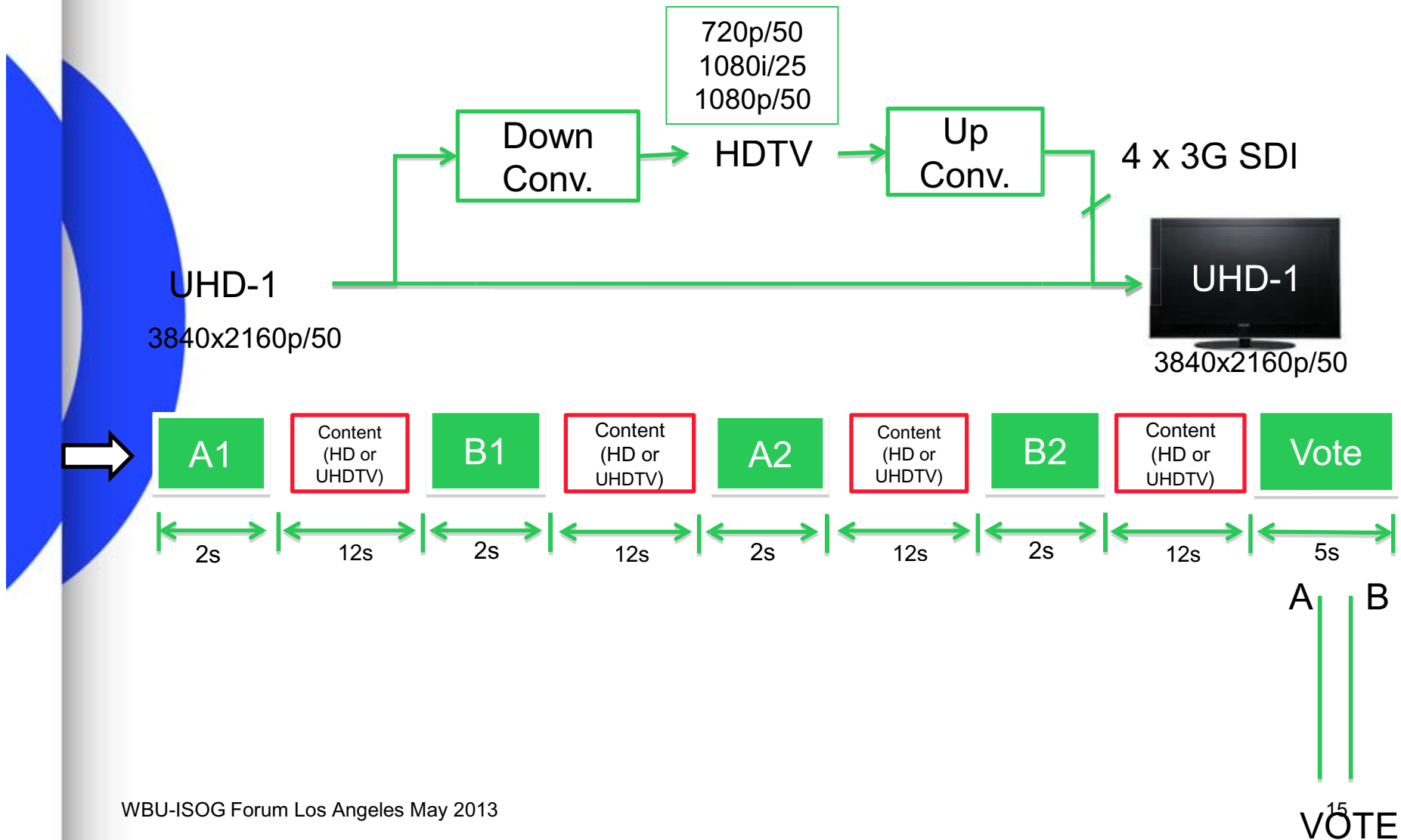
## OUTLINE OF THE FIRST TEST

- 72 participants
- Using ITU Rec.500 DSCQS test procedure
- Material sourced from test shoots with Sony F65 @ 50p
- Cropped from 4k to 3840 pixels horizontally.
- Reference sequence was the full resolution UHD-1 (3840 x 2160) signal at 50fps frame rate.
- HD sequences:
  - UHD-1 down-conversion to 1080p/50 and 720p/50 using state of the art hardware converter. Same procedure to up-convert back to UHD-1.
  - 1080p/50 conversion to 1080i/25 using “HHI filter” and subsequent de-interlacing using state of the art hardware converter. Up-conversion like above.

## TEST CONDITION

- Monitor used: 56 inch UHD-1, (but not “Grade 1”)
  - 6 sequences:  
*Airmen, Long Shot, Lupo Boa, Lupo Candle, Free Kick & Park Dance*
  - 4 test conditions, all compared to UHD-1:
    - UHD-1 itself, plus 1080p/50, 1080i/25 & 720p/50
    - Hidden reference
  - 2 viewing distances (effectively independent tests)
    - 1.5 H (the standard viewing distance for UHD-1)
    - 2.7 m (the average domestic viewing distance in UK)
- <http://www.bbc.co.uk/rd/publications/whitepaper090.shtml>

# TEST SET-UP: UHD-1 VS HDTV



# ITU-R BT 500 DSCQS VOTING

FTV-BEYONDHD – Test 1 : UHD-1 vs H  
Rate Card

**Name:** .....

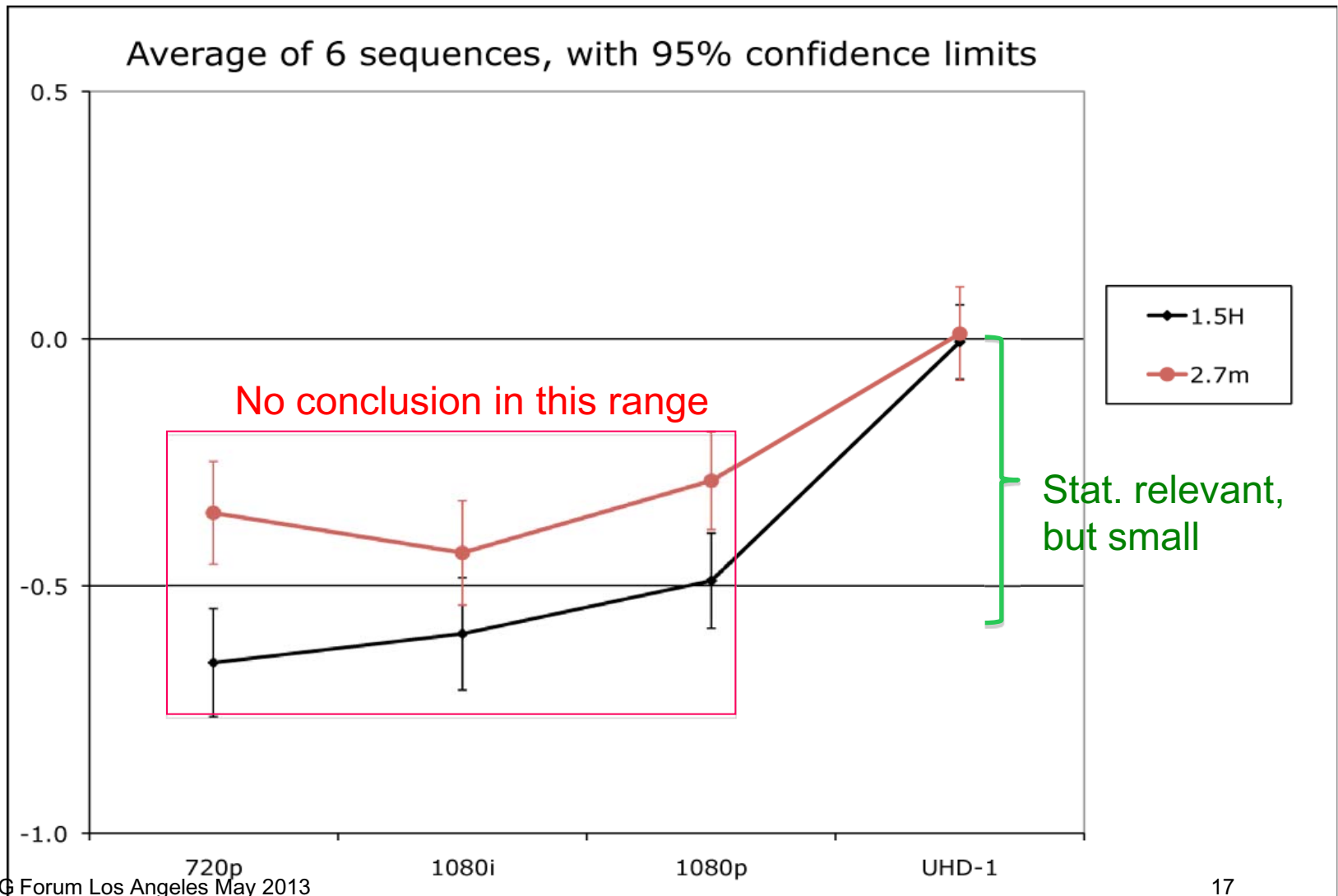
**Email:** .....

**Session N°:**.....



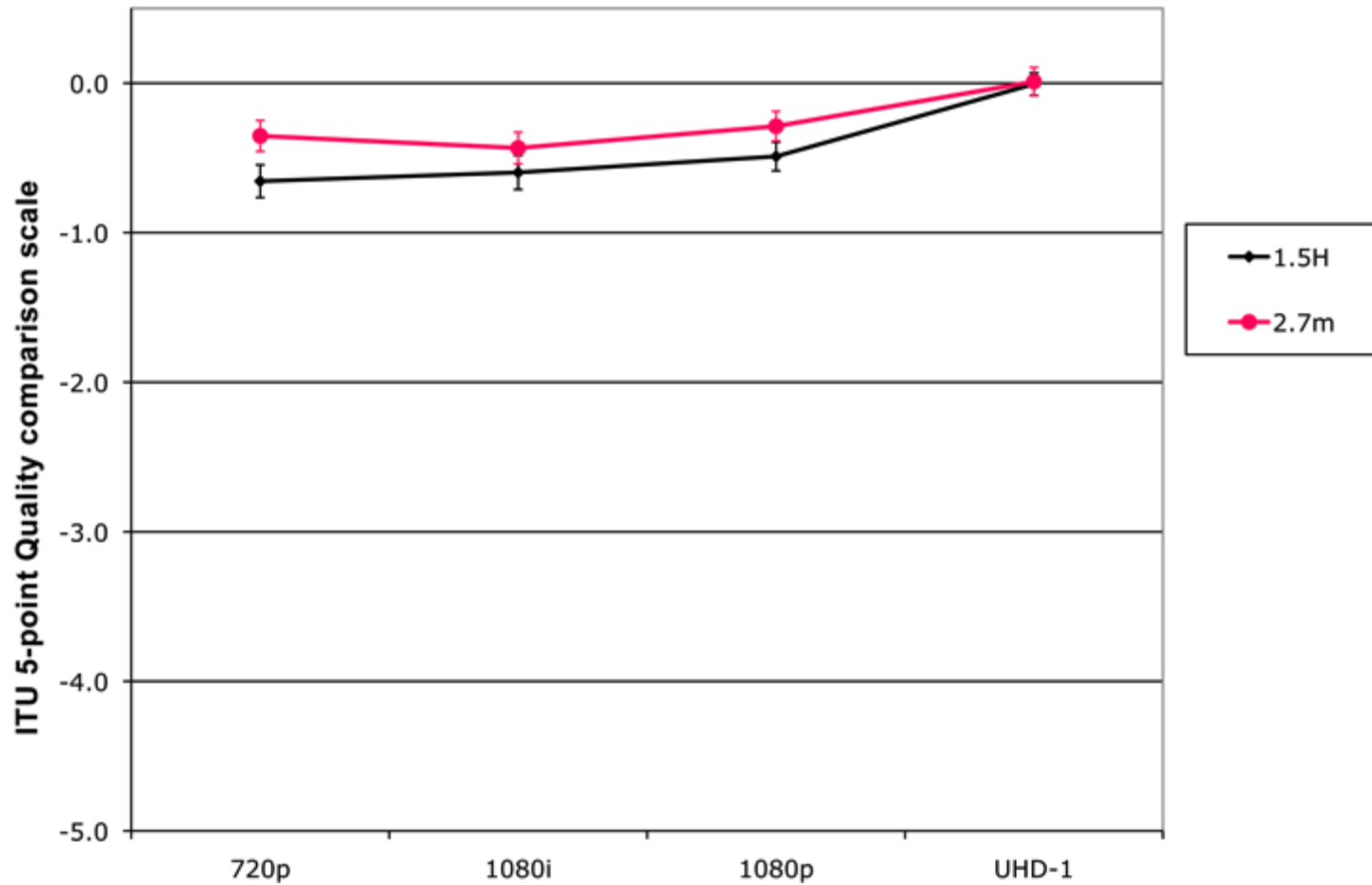


# AVERAGE OF 6 SEQUENCES



# ON 5 POINT SCALE

Average of 6 sequences, with 95% confidence limits



## INDICATIVE CONCLUSIONS

- Clear statistical advantage in UHD-1 at both 1.5H\* and 2.7m\*\* (just over 3H\* for HDTV).
- **Difference is however relatively small.**
- The 95% confidence limits show that no conclusion can be drawn regarding 1080p/50, 1080i/25 and 720p/50 in these tests.
- Results are only applicable to uncompressed source – transmission compression may change these results significantly.
- Further test needed with HEVC (UHD) and H.264 (HD)
- To really create an immersive impact we need to consider more parameters than only resolution

\* Recommended viewing distance for UHD TV (1.5H) and HDTV (3H)

\*\* Average viewing distance in the UK households (2.7m)

# HIGHER FRAME RATE (>60P)



Cameras



Higher frame rate ? Yes, but ....

No production or distribution or home infrastructure for HFR >60p



Displays



# HIGH DYNAMIC RANGE



Cameras



High dynamic range ? Yes, but ...

No production or distribution or home infrastructure for HDR



Displays



## LET'S THINK ABOUT HFR AND HDR FURTHER

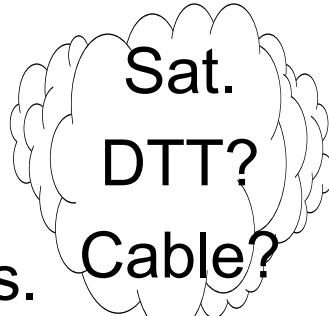
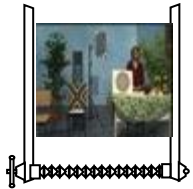
Imagine you are at viewing distance  $4H$  or  $5H$

- Pixel resolution loses importance !

On the other hand

- Blurred objects would be still perceived
- The HDR improvements would likely be welcome
- Object colour improvements would be perceived
- Bit depth could be recognised

# UHD-1 real-time TV chain at "709" equivalent conditions

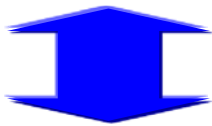


Sig. Process.  
Compression

IP!

STB  
Decoder

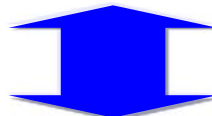
Display



Infrastructure



Signal Processing



Distribution



New STB



Display

Camera

UHD-1, 422, 10  
bit, 60p = 10,62  
Gbit/s

Multilink 3G-SDI  
SMPTE 10 Gbit/s  
SMPTE 20/25  
Gbit/s

Studio

Compression  
are available (promise up to 50 % saving  
compared to H.264)  
XAVC&AVC-ULTRA HEVC

New single link  
HDMI needed  
(HDMI 1.4 has a  
limit at 30p for  
UHD-1)

**Mainstream TV production and distribution interfaces not available, yet, but soon**

## UHD-1 SATELLITE DELIVERY

- HEVC is now standardized for distribution
  - When do we see first products ?
  - What options of BT.2020 are used in the chips ?
  - How much bit-rate do we need ?
- EBU UHD-1 reference material
  - 4k at 50 frames per second (using Sony F65)
  - cropped to UHD-1
  - some uncompressed sequences are available to the public
  - HEVC software encoding with HHI to get a first feeling



<http://tech.ebu.ch/testsequences>



NAB 2013

UltraHD1 5000USD



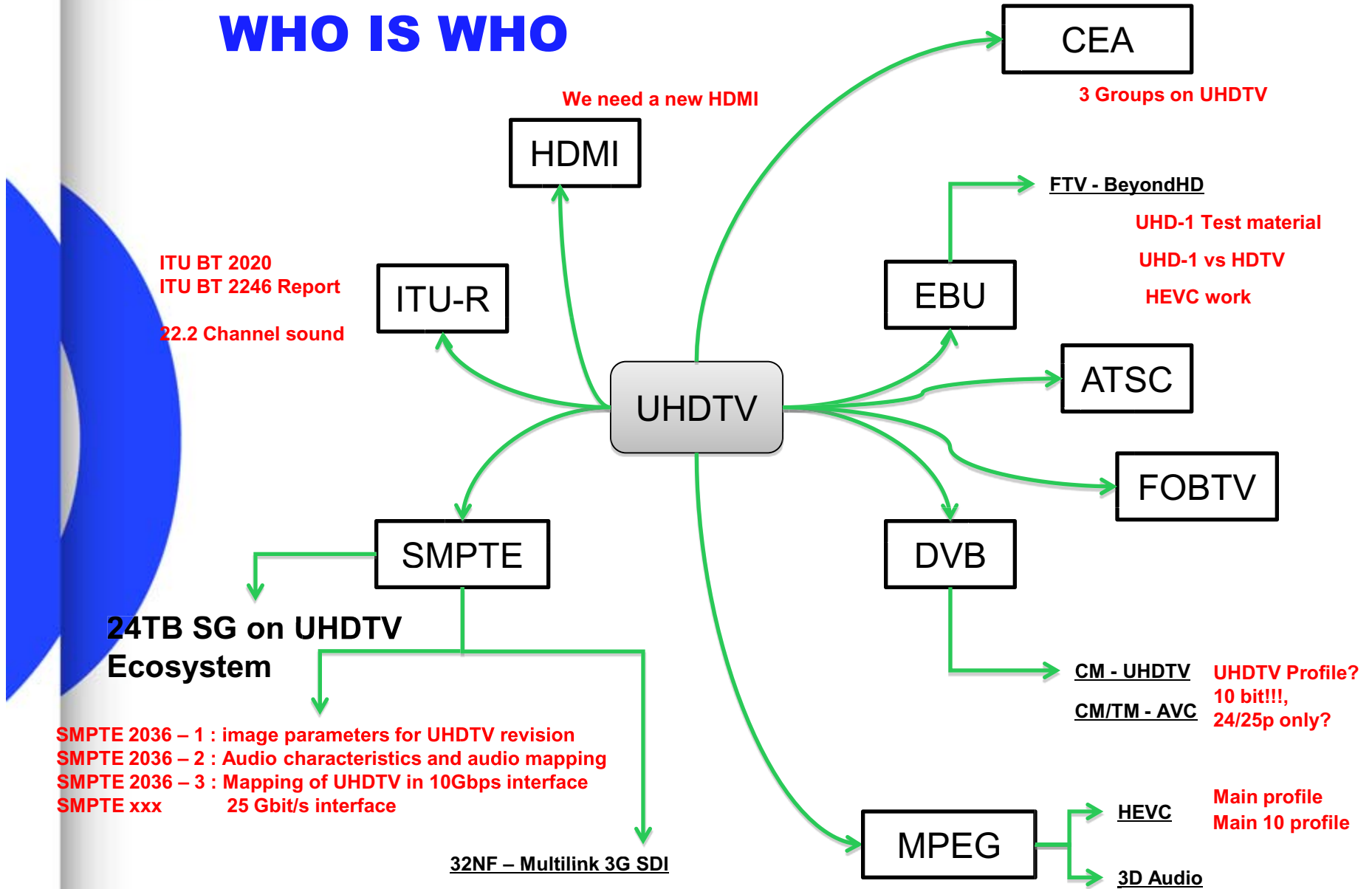


## **Some conclusions ...**

## A cooperation is highly required

- UHDTV must meet the criteria of providing a much better audio-visual experience to the viewer in the home
- Content counts
- Cost effective infrastructures
- There is absolutely **no room for proprietary systems**
- We need a coordinated effort in Europe: between standardization bodies, national and international forums, the professional and consumer industry, associations and broadcasters that gives clear focus to UHDTV
- Only a focused platform for all stakeholders and interested bodies will avoid that UHDTV will have a 3D future.

# WHO IS WHO



**EBU**

# **THANK YOU**

Vlastimil Benovsky Eurovision  
Hans Hoffmann EBU

**UHD-1 Test sequences**

**<http://tech.ebu.ch/testsequences>**