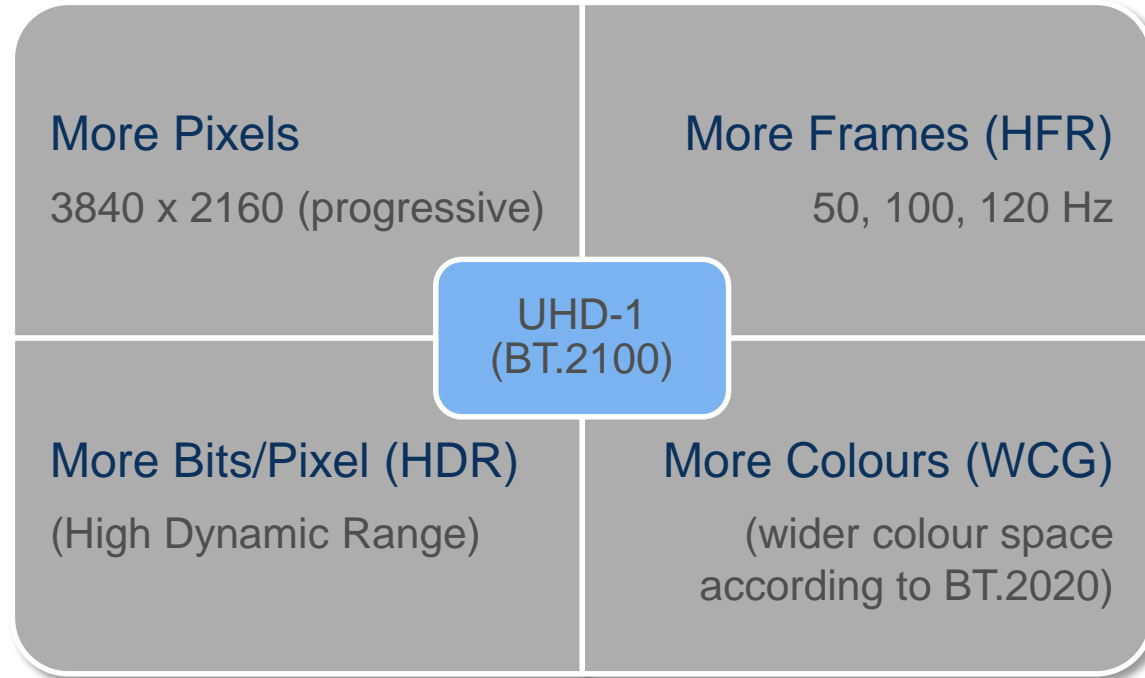


UHD – Features and Tests

EBU Webinar, March 2018

Dagmar Driesnack, IRT

UHD as a package



....all parameters are also valid for 1080p

More Pixels?

More Pixels
3840 x 2160
(progressive)

UHD-1
(BT.2100)

More Frames
(HFR)
50, 100, 120Hz

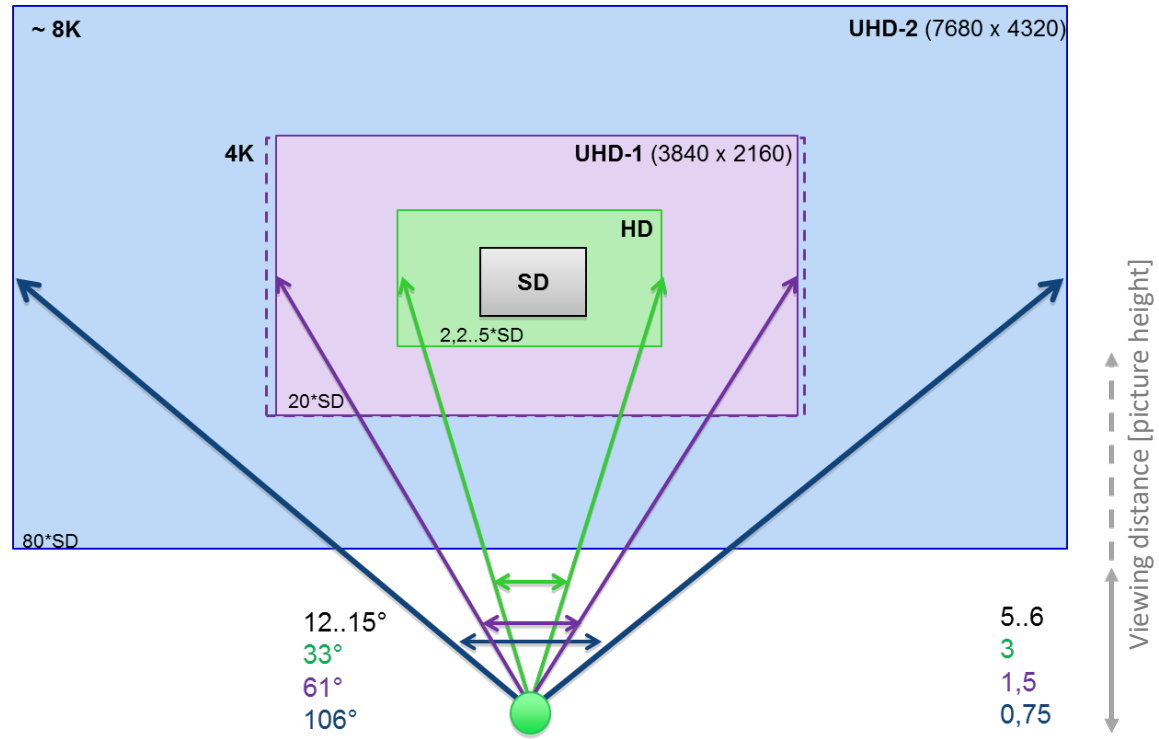
More Bit/Pixel (HDR)
(High Dynamic Range)

More Colours
(wider colour space:
BT.2020)

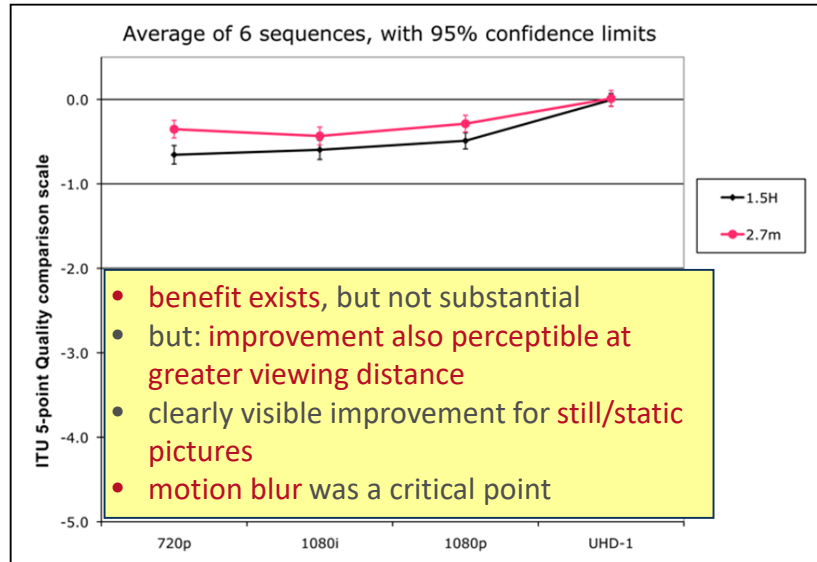
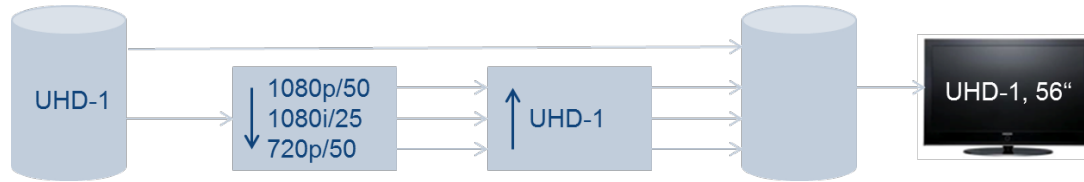


Benefit of Higher Resolution

- „It's reality“ (no pixels visible)
- „Being part of it“ (Telepresence)



Just higher resolution – is it enough? (Jan 2013)



Subjective tests according to ITU-R BT.500 (DSCQS), 6 sequences, 72 people

@ 1.5H and 2.7m (3.8H)

Assessment: 5-point scale

- Excellent
- Good
- Fair
- Poor
- Bad

(no compression used)

Subjective Tests by EBU: HD vs. UHD-1

More colours?

More Pixels
3840 x 2160
(progressive)

UHD-1
(BT.2100)

More Frames
(HFR)
50, 100, 120Hz

More Bit/Pixel (HDR)
(High Dynamic Range)

More Colours
(wider colour space:
BT.2020)

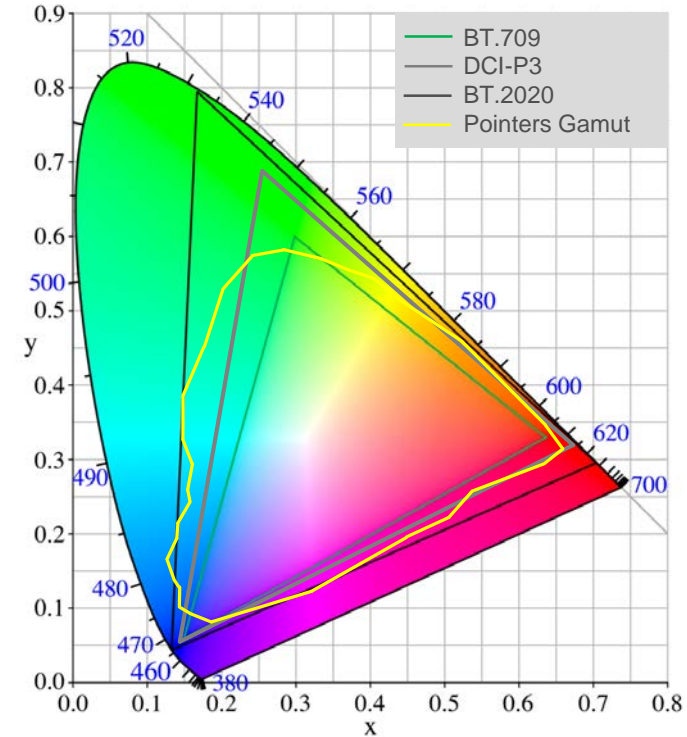


Wider colour gamut

Different colour spaces:

- Today's HDTV uses BT.709 (small difference compared to BT.601)
- UHD is defined as BT.2020 but currently no monitor can display the full colour gamut

		BT.709		DCI P3		BT.2020	
		x	y	x	y	x	y
Primaries	R	0.640	0.330	0.680	0.320	0.708	0.292
	G	0.300	0.600	0.265	0.690	0.170	0.797
	B	0.150	0.060	0.150	0.060	0.131	0.046



High Dynamic Range

More Pixels
3840 x 2160
(progressive)

UHD-1
(BT.2100)

More Frames
(HFR)
50, 100, 120Hz

More Bit/Pixel (HDR)
(High Dynamic Range)

More Colours
(wider colour space:
BT.2020)



CONTEXT

- DVB UltraHD Phase2 includes the support for HDR distribution, mainly two candidates HLG10 and PQ10
- EBU, Orange, Rai and IRT together proposed to conduct subjective tests so as to crosscheck the solution performance with regards to
 - Subjective picture quality
 - Encoding performance (HEVC Main10)
- Need to test the SDR backward compatible version for HLG and its performance compared to a legacy SDR service (manual grade)

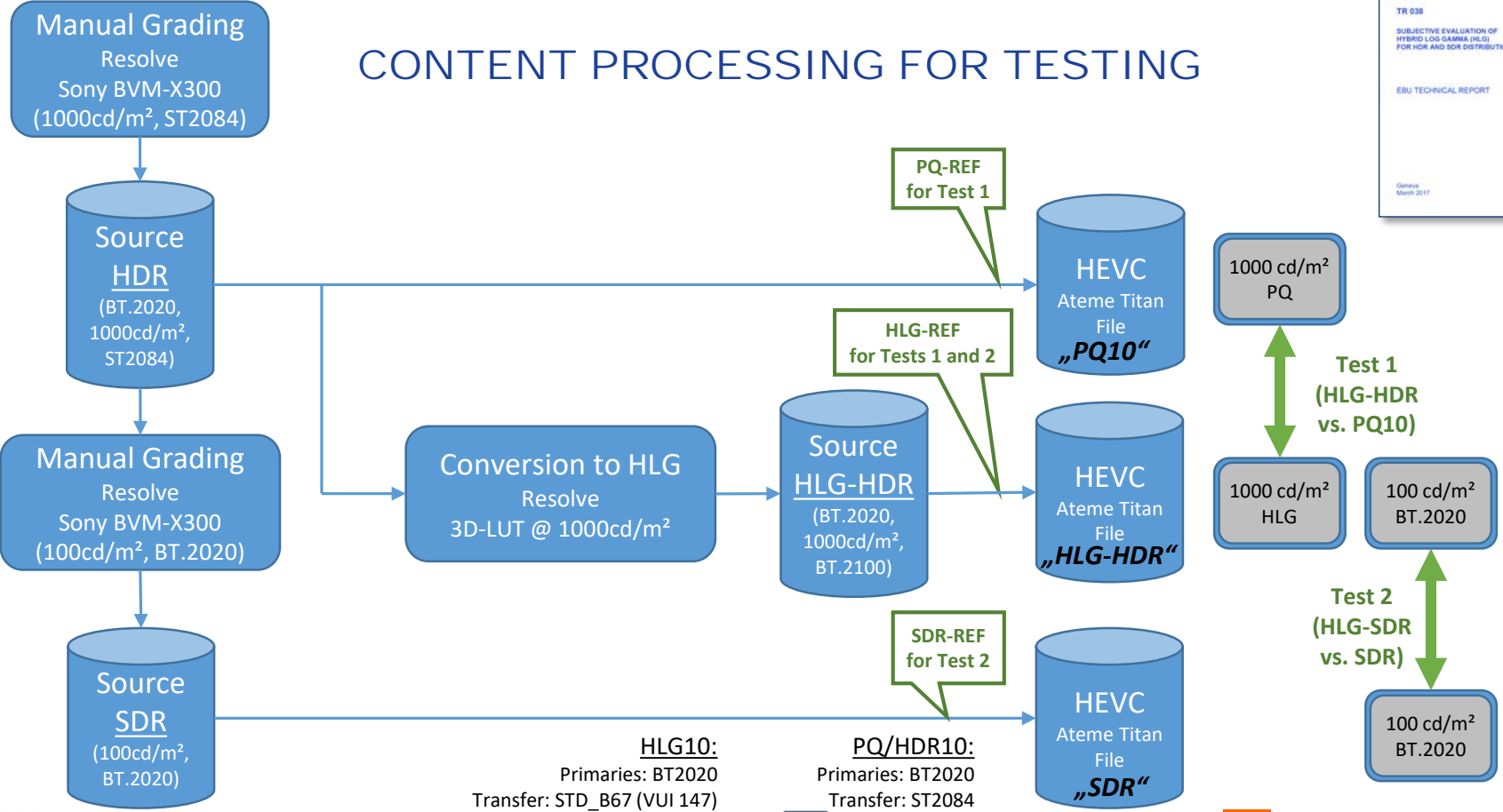




TEST CONFIGURATION

- Each sequence was produced in PQ (1000 cd/m²)
- SDR grading was done following the live production environment constraints (100 cd/m²) to create a "SDR for comparison"
- HLG version was generated with the conversion procedures defined in BT.2100-0 annex 2.
- The following bitrates were used and generated with a professional HEVC encoder (HEVC Main10; RAP period 1s):
 - 2.5 ; 5 ; 10 ; 20 Mbps

CONTENT PROCESSING FOR TESTING



HLG10:
 Primaries: BT2020
 Transfer: STD_B67 (VUI 147)

PQ/HDR10:
 Primaries: BT2020
 Transfer: ST2084
 MaxCLL: 1000
 MaxFALL: 100



CONCLUSIONS (1/2)

On methodologies and labs:

The **test results** are **consistent across the labs**:

- *Using the SAMVIQ methodology (RAI & Orange)*
- *Using the DSCQS methodology (IRT)*

On HDR:

HDR-HLG provides quality results **similar** to PQ and statistically slightly better than PQ.

On SDR:

HLG-SDR and “SDR manual grade” provide **equivalent** quality results after compression.

CONCLUSION (2/2)

Bonus:

The use of two references (PQ and hidden reference in HLG) allowed to identify whether the conversion from one format to another had visual impacts or not. The **conversion process between PQ and HLG has no visual impact** under the configurations (both candidates with the same peak brightness) used for this test (PQ 1000 cd/m²).



Faster Pixels?

More Pixels
3840 x 2160
(progressive)

UHD-1
(BT.2100)

More Frames
(HFR)
50, 100, 120Hz

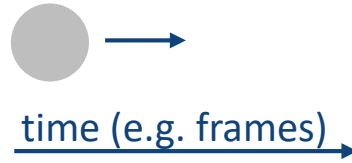
More Bit/Pixel (HDR)
(High Dynamic Range)

More Colours
(wider colour space:
BT.2020)



Frames per second – shutter – sharpness – strobe effect

Moving ball,
velocity v



Results NHK (no compression, UHD-2):

- Large area flicker: fps > 80Hz
- motion blur: shutter < 1/320s
- Strobging: fps > 100Hz

50 Hz, „perfect sampling“



100 Hz, „perfect sampling“



50 Hz, 50% Shutter



100 Hz, 50% Shutter



50 Hz, 25% Shutter



Development of an HFR display (1080p x 1920)

- Support of multiples of 50/60 Hz up to 200/240 Hz
- Tests included motion-compensated frame interpolation (MCFI)
- Bit-rate needed (HEVC)?
- Test sequences by EBU, BBC, 4ever



Subjektive tests @ IRT (October 2015)

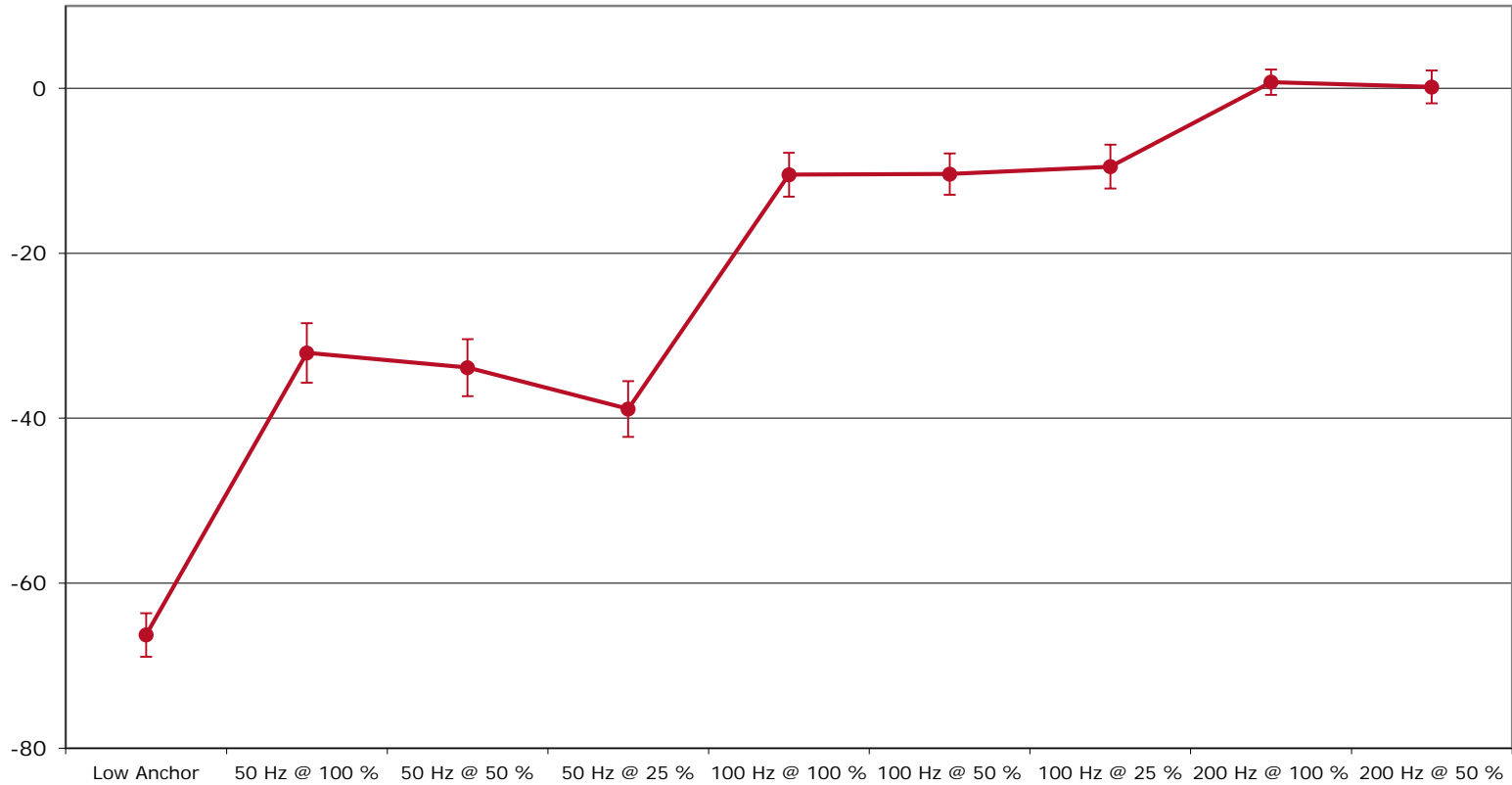
Is there a benefit of HFR up to 200 Hz vs. today's 50 Hz?

- Without interpolation
- With interpolation
- Effect of different shutter angles
- Effect on coding efficiency

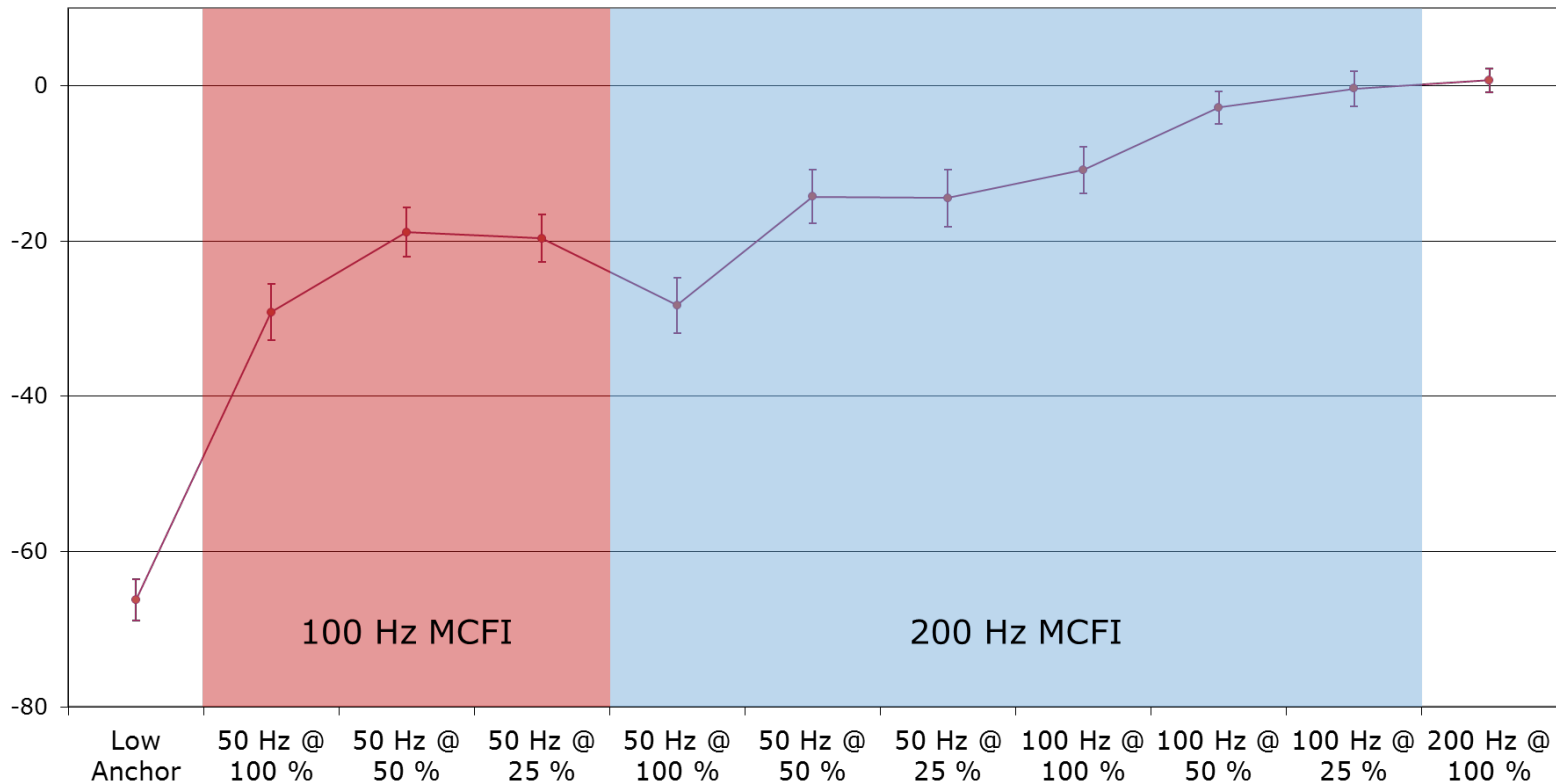
→ Using HFR within the production chain?

→ Compromise between fps, shutter and interpolation?

Average of 5 sequences, without interpolation (with 95 % confidence interval)



Average of 5 sequences, with interpolation (with 95 % confidence interval)



Subjektive tests @ IRT - results (October 2015)

Results without compression for 1080p

- Big step from 50 Hz to 100 Hz (native)
- The shorter the shutter the better the benefit of MCFI
- MCFI even improves quality from 100 Hz to 200 Hz

Results with HEVC compression for 1080p

- In the average (content dependent) HFR needs ~ 20% more bit-rate

Results where also confirmed during the tests performed during EBU-BTF-tests

Preliminary indications for 2160p and HFR (Spring 2017)

Prototype display capable which can handle 2160p/100 via DVB-S/C/T

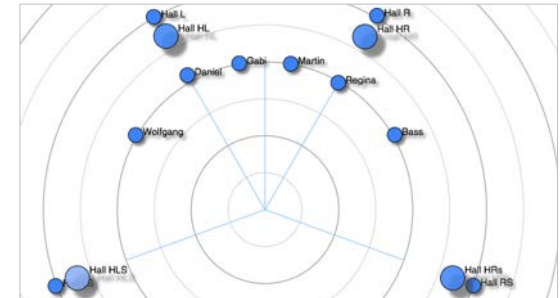
- All display processing switched off
- Offline-encoding, HEVC, up to 20 Mbit/s, sports content
- First tests indicate that there is no bit-rate overhead when native 100 Hz is encoded (compared to 50 Hz, both same shutter)
- More tests to be conducted (MCFI, detailed test of prototype display etc.)

What about Audio?



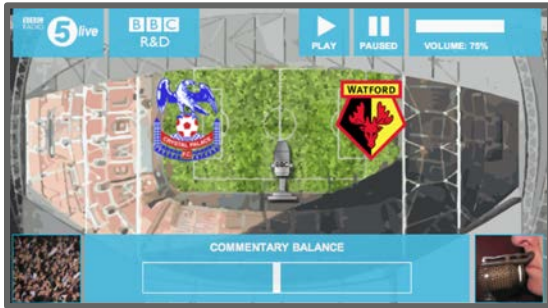
Next Generation Audio – Technologies

- Channel-based audio (traditional but more channels, 9.1, 22.2, ...)
 - Scene-based audio (Ambisonics / HOA, suitable for soundfields)
 - Object-based audio (individual elements mixed only in end device)
-
- All technologies can be combined in one mix / stream



Next Generation Audio – Benefits

- Personalisation & Interactivity (e.g. mix presets or 360/VR content)
- Immersive/ 3D Sound (loudspeaker/ headphones)
- Accessibility (e.g. dialog level)



UHD-tests - summary

Tests done so far have shown that

- there is a small improvement having „just more pixel“
- WCG (BT.2020) is not yet possible to fully display with existing equipment
- HDR has a big impact on immersive viewing experience
- HFR is still a challenge (bandwidth in production)

UHD as a package is

- a big step towards a great viewers experience. The features WCG, HDR and HFR can also improve 1080p.

Do not forget Audio

Thank you for your attention!

Experts in audio-visual media

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