For Enhanced Video ExpeRience

Go for UHD-TV phase 2!

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AMPVISUALTV
12345 francetélévisions
Highlands Technologies Solutions
GLOBECAST
TeamCast
INSA RENNES IETR
TELECOM ParisTech

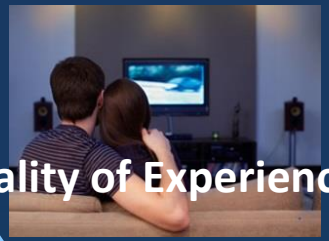
What is 4EVER-2?

What do we work on? How?

4EVER: All about visual quality of TV content

UHD-TV phase 1

spatial definition (4K)



Quality of Experience?

Extended colors (Wide Color Gamut, WCG)

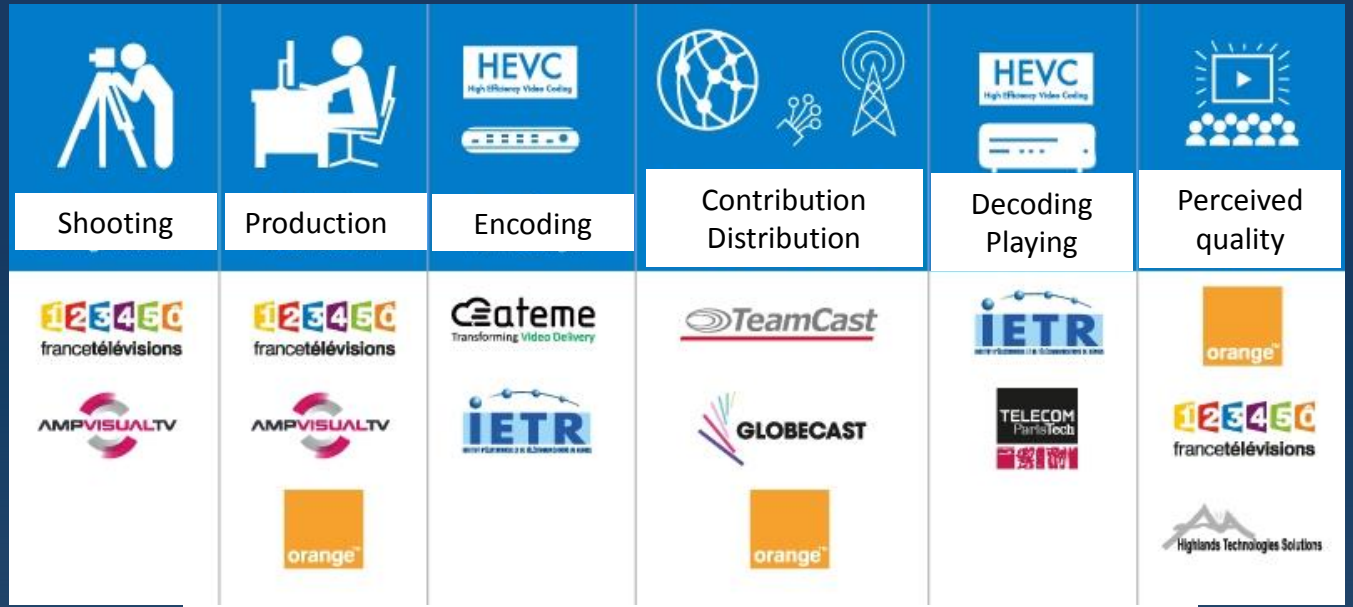
Temporal definition (High Frame Rate, HFR)

Contrast definition (High Dynamic Range, HDR)

UHD-TV phase 2

Nine French partners

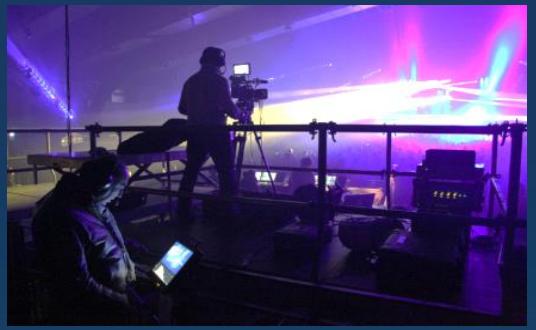
- In a collaborative project funded by French government and local authorities
- Complementary expertise on the complete end-to-end audiovisual chain



June 2012-June2015, then June 2015-June 2017

1/Experimental shooting sessions

- Evaluate production equipments and complete workflow
- Generate ultra high quality sequences with controled parameters
  - Sequences often shared worldwide!



V phase

2/Evaluation of video perceived quality

Subjective tests in standardized environment (REC ITU-R BT.500)

- Display parameters: brightness, contrast
- In the room: light control around the display
- Distance to the screen

- SAMVIQ method (ITU-R BT 1788): adapted to evaluation of video quality on short sequences
- 25 to 30 non expert observers
- SEOVQ software

3/Research and software development

- Colorimetry: science of color
- Research and development
  - HEVC encoding
    - Professional prototypes for encoder: ATEME
  - HEVC decoder
    - Academic research and open source for decoder : INSA-IETR (*open HEVC*)
  - Video player: Télécom ParisTech (*GPAC*)
    - Academic research and open source to integrate HEVC decoding and UHD-TV specificities

4/Experiment on visible events

Go on actual premium events to experiment prototype audiovisual end-to-end chain

Stressful, but extremely useful!

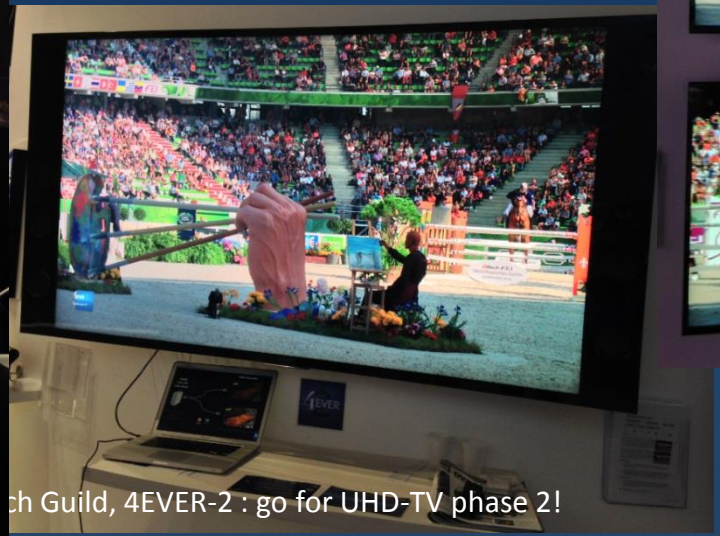
5/Disseminate results and conclusions

September 2015

On EBU booth, demonstrating

HDR in collaboration with BBC

HFR in collaboration with EBU, BBC, IRT, RAI



5/Disseminate results and conclusions

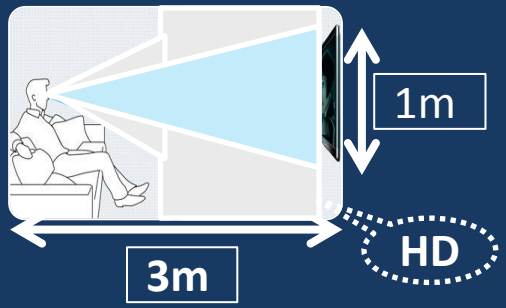
- Major communication events in 2016
  - MIPTV 2016, Cannes France, April
  - NAB 2016, selected for Future Labs Park
    - Demonstrations : HFR, HDR, ATSC, 4K, HEVC, live, …
    - Please visit ☺
  - IBC 2016?
    - If interesting demonstrations to propose
    - If selected for Future Zone…

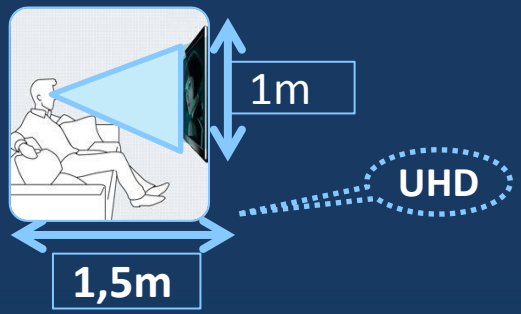
Ultra HD-TV phase 2

What for?

Why a need for WCG, HDR and HFR?

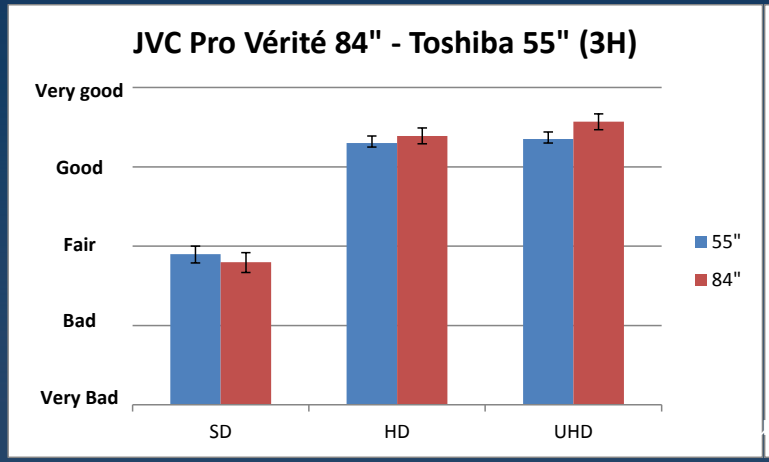
4K not « better enough » in normal TV viewing conditions

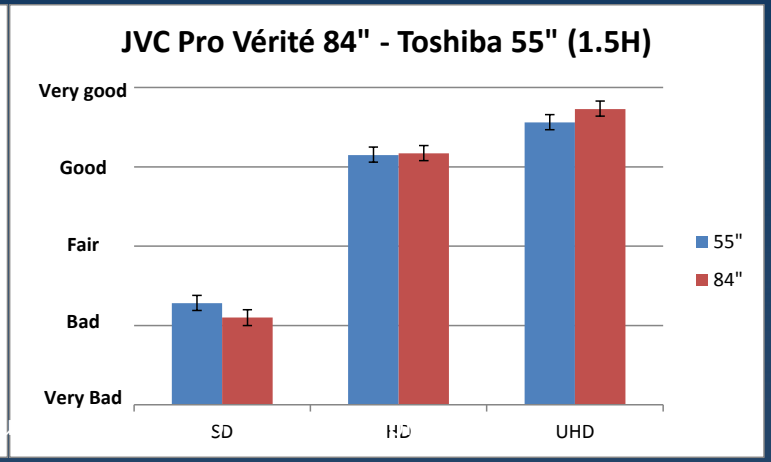




10 points better on a scale of 100

but only when sitting at 1,5*height of the display

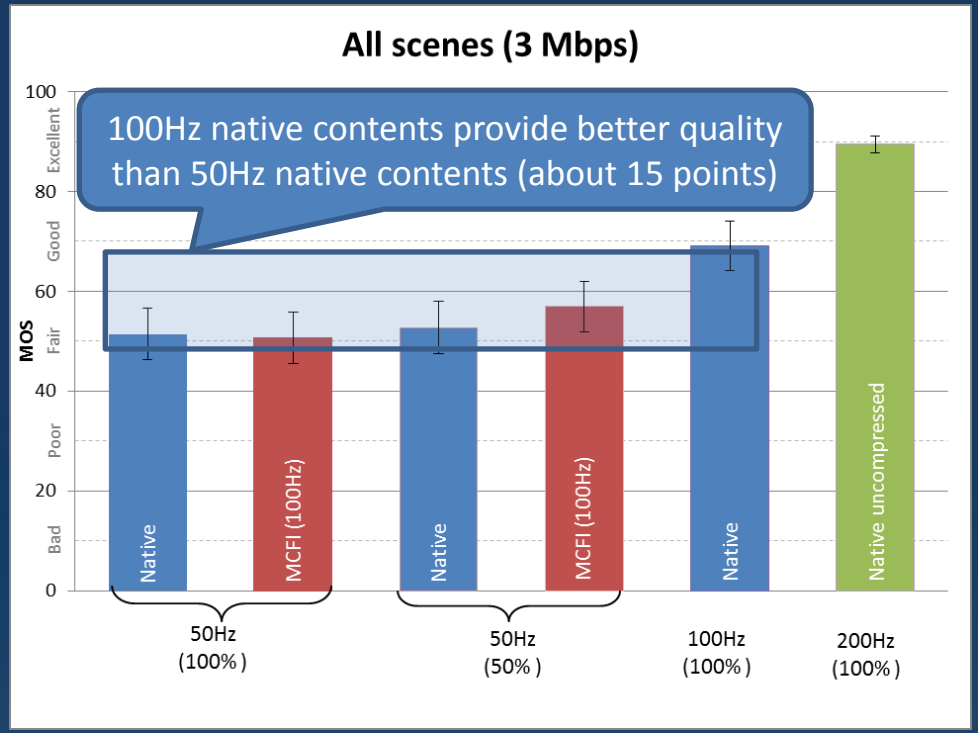




HFR: always better even at same bitrate

- 100Hz native: much better perceived video quality than 50Hz native ones
- The performance of Interpolation (MCFI) depends on the content's motion features but in average, 50Hz interpolated at 100Hz cannot reach the perceived video quality of native 100Hz

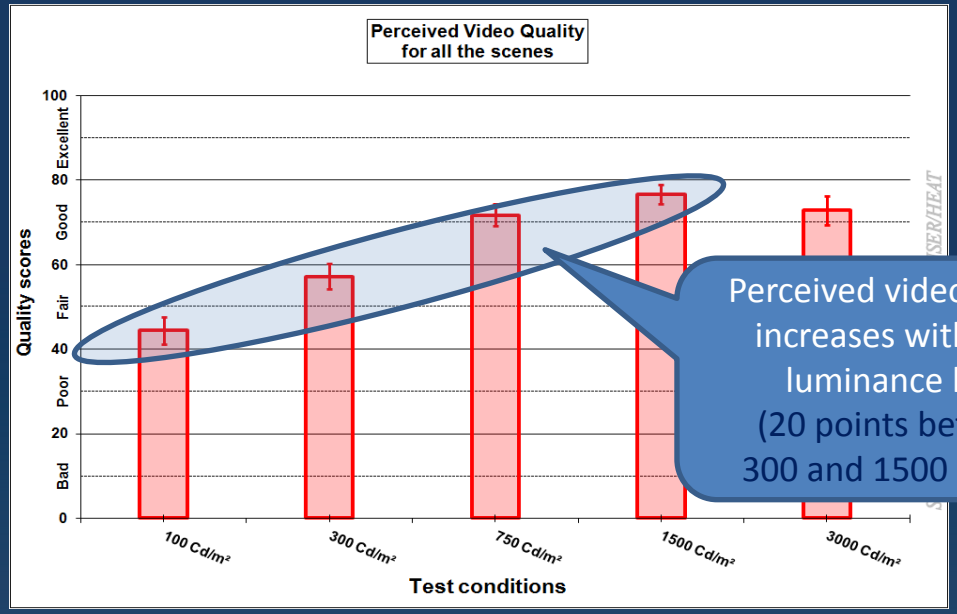
At the same bitrate, the perceived quality of a 100Hz source remains better than a 50Hz source (interpolated or not)

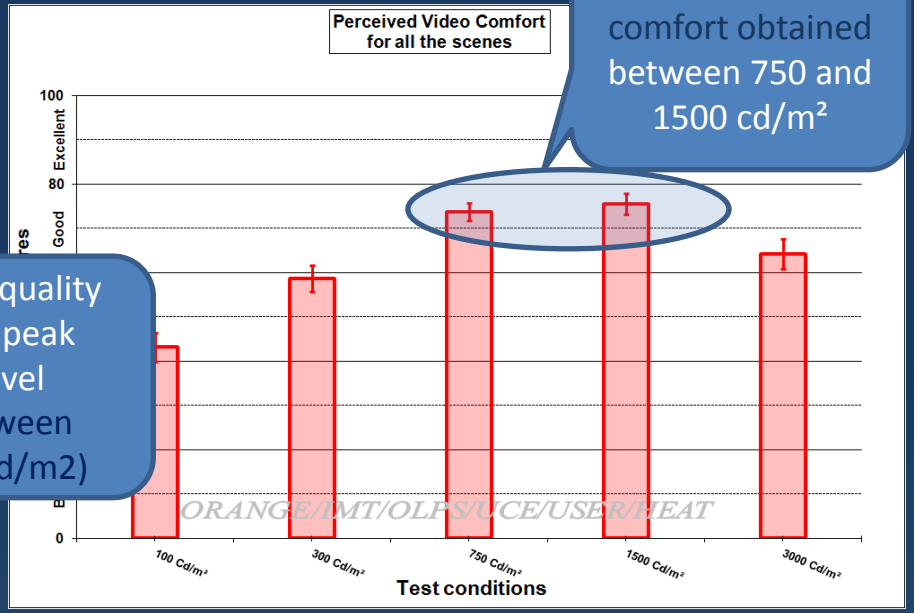


work done in collaboration with

HDR: a real benefit expected

Actual improvement potential if conditions are respected



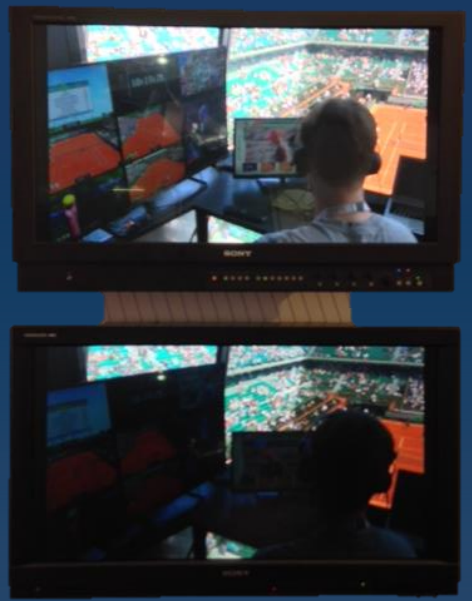


4ever subjective tests results - 2014

HDR: a good improvement… soon?

High Dynamic Range: sequences look more natural, sensation of immersion

- Better contrasts: better dark areas, better bright areas



Several alternative HDR Solutions

- Usual suspects: HDR10, Philips, Technicolor, Dolby and, BBC/NHK
- OETF: New transfer functions
- Single or Dual layer
- Metadata (static, dynamic)
- SDR (Standard Dynamic Range) backward compatibility

	Provider	OETF	Method	Metadata	Backward Compatible	Layers
1	BDA/HDR 10	PQ	HDR (SL)	Static	No	Single
2	BBC/NHK	HLG	OETF (SL)	No	Yes	Single
3	Philips/Technicolor -1	PQ	HDR (BL)	Static + Dynamic	Yes (with IP)	Single
4	Philips/Technicolor-2	PQ	SDR (BL)	Static + Dynamic	Yes	Single
5	Dolby Vision-1	PQ	HDR (BL) +EL	Static + Dynamic	Yes (with IP)	Dual
6	Dolby Vision-2	PQ	SDR (BL) + EL	Dynamic	Yes (with IP)	Dual

HDR Eco-System Standardization Status (1/2)

- OETF
  - PQ (Perceptual Quantizer) - SMPTE ST 2084 , based on Barten psychophysics model
  - HLG (Hybrid Log-Gamma)- ARIB STD-B67
- HDR Metadata
  - SMPTE ST 2086: mastering display metadata
  - SMPTE ST 2094: dynamic metadata describing transformation HDR <->SDR (On-going)
- HDMI
  - 2.0a: Support ST 2084 + metadata ST 2086
  - 2.1: HLG, ST 2094 ? (On-going)
- IMF: Incoming specs: Support ST 2084 + metadata ST 2086

HDR Eco-System Standardization Status (2/2)

- Blu-Ray Disc Association (BDA)
  - HDR 10: HEVC main 10-bits + ST 2084 + metadata ST 2086
  - Optional: Proprietary metadata: Dolby, Philips, Technicolor
- MPEG/ITU HEVC: VUI values for PQ and HLG (in 10 bits) + 5 SEI messages (metadata)
- ARIB: standardized the usage of HLG: STD B67
- DVB: Ultra HD phase2 => PQ based + metadata, HLG under consideration (Q3 2016?)
- ETSI: Dolby Vision, Technicolor/Philips under consideration
- ITU: BT.2020 without HDR => PQ, HLG transfer functions under consideration

Backward compatibility in TV production

- Main drawback of PQ is that it is **not SDR backward compatible**
  - SDR and HDR shall be simulcasted
- The goal is to produce HD 709 + Ultra HD Phase 1 709 or 2020 and add HDR in the same workflow
- With few extra costs !
  - no additional cameras
  - using current technology (SDI 10 bits …)
  - with few extra charge for production teams
- Because **TV distribution will remain mostly HD 709** at least for a number of years!

Candidates for TV production in HDR

1. Each camera outputs two (independent) signals
   - one HD/UHD phase1
   - one PQ 10
   - vision engineering can optimize SDR and HDR separately
2. Hybrid Log Gamma
   - HDR and SDR are controled using one video signal
   - vision engineering shall optimize SDR and HDR jointly
3. HDR or SDR + Metadata ?
   - in a static or dynamic way?

Two recent trials for HDR live

set up real live TV production and distribution

1/ Live sport in HDR and HFR

13-14 November 2015
Bordeaux, France

- **But, 13/11/2015 in France ☹ … experimentation shortened, only HDR tested**

- 2 different cameras, one at a time
  - GrassValley LDX
  - Sony HDC4300
- 4K zooms: Fujinon 80x (UA80X9BE)

Figure ice skating:

HDR for brightness on ice and costumes,

HFR for figure motion

1/ Live sport in HDR

- 1st test (LDX) => a single camera to generate two streams: one HDR and one SDR
- 2nd test => an HDR-PQ camera (Sony 4300) and a SDR camera on a rig (Sony 2400)
- Remote control from production truck
- HDR and SDR comparisons

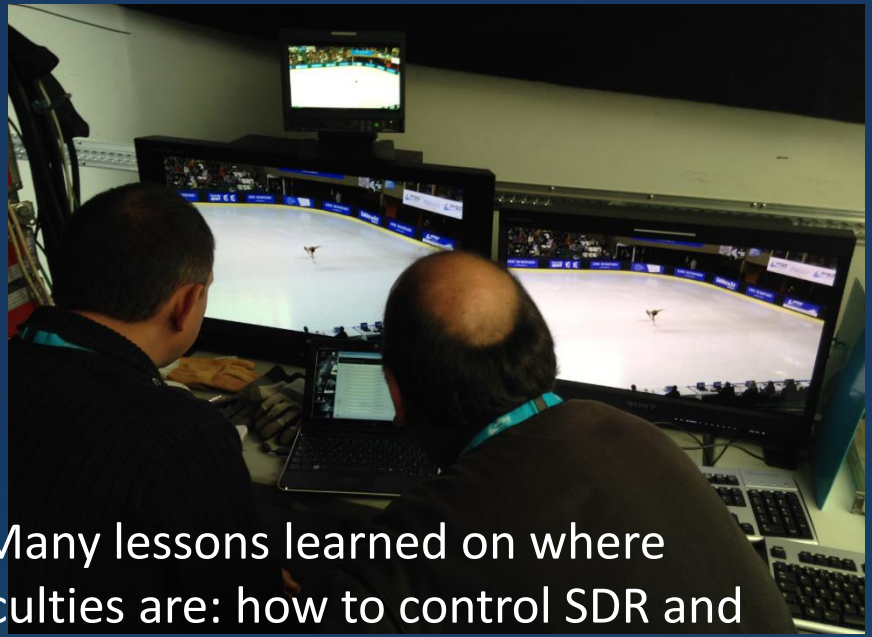
1/ Live sport in HDR

Production truck:

simulation of what will be next, when…

An extremely valuable experimentation, very own production space for HDR camera remote control

1/ Live sport in HDR

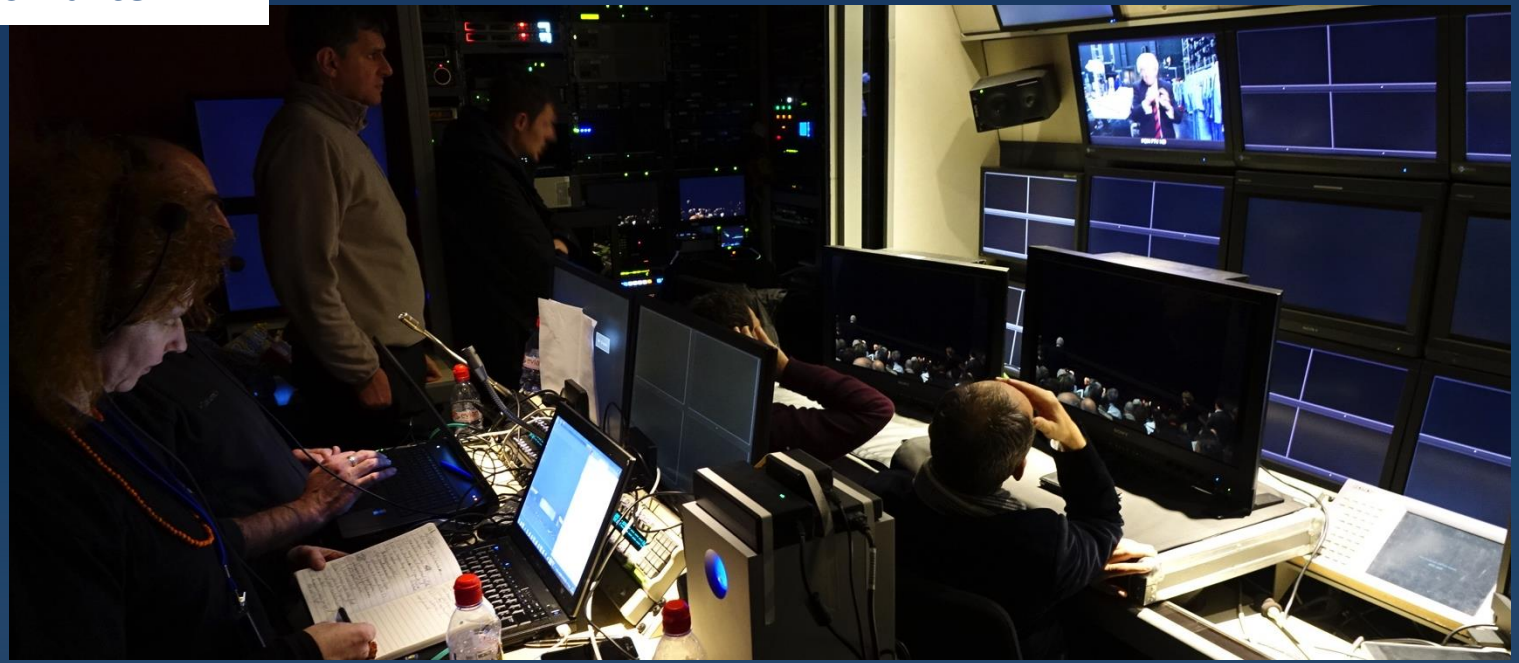


Many lessons learned on where difficulties are: how to control SDR and HDR independently, yet in a single production?

2/ Bastille Opera live HDR production

15 December 2015
Bastille Opera,
Paris France

A single production to serve both HDR and non HDR: use of HLG technology



2/ Bastille Opera live HDR production

vision engineer focus in SDR, then control HDR result

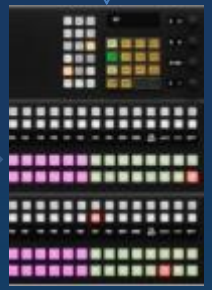
potential 709 graphics mapped to HLG with LUT

Our HLG workflow, generating both 4K-HDR and HD-SDR

Sony 4300 *(HLG prototype version)*
zoom Canon 90x (J90x9B)

709 color gamut

Quad 3G SDI
4K HLG



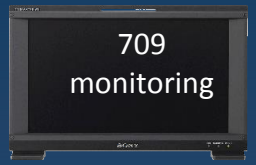
Quad 3G SDI
4K HLG

for instance towards HEVC encoder with HLG signaling

HD 709

downsizing

for instance towards H264 encoder



OBvan HD signal

for comparison to broadcasted commercial HDTV signal

2/ Bastille Opera live HDR production

Comparison between HD and UHD + HDR

2/ Bastille Opera live HDR production

A big success for invited producers
and directors of photography:
loved both the SDR quality and the HDR potential

2/ Bastille Opera live HDR production

Despite tough content parameters…

And a TV fiction where 4K, HDR, HFR and WCG serve story telling

using all UHD-TV phase 2 technologies

plus NextGen Audio

First fiction in UHD-TV phase 2 + 3D audio

4-7 November 2015

Paris, France

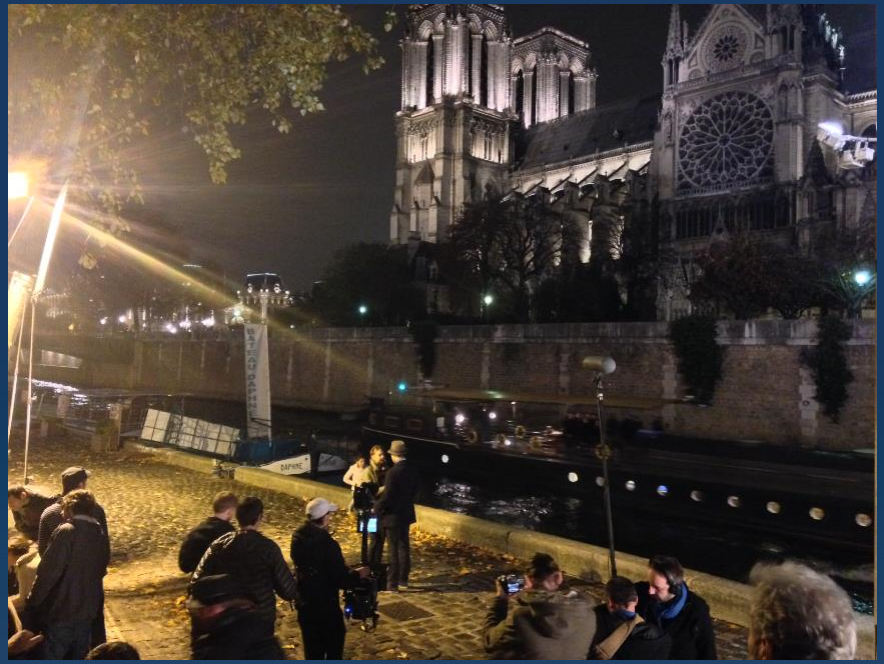
« 4EVER short »,

« Une danse pour la vie »

Quote from the author

« All the technical tools to define tomorrow's TV have a common goal: researching viewer immersion. This short story narrative goes the same way, immerging the audience into emotion »

Fiction in 4K, HDR, HFR, WCG and 3D audio

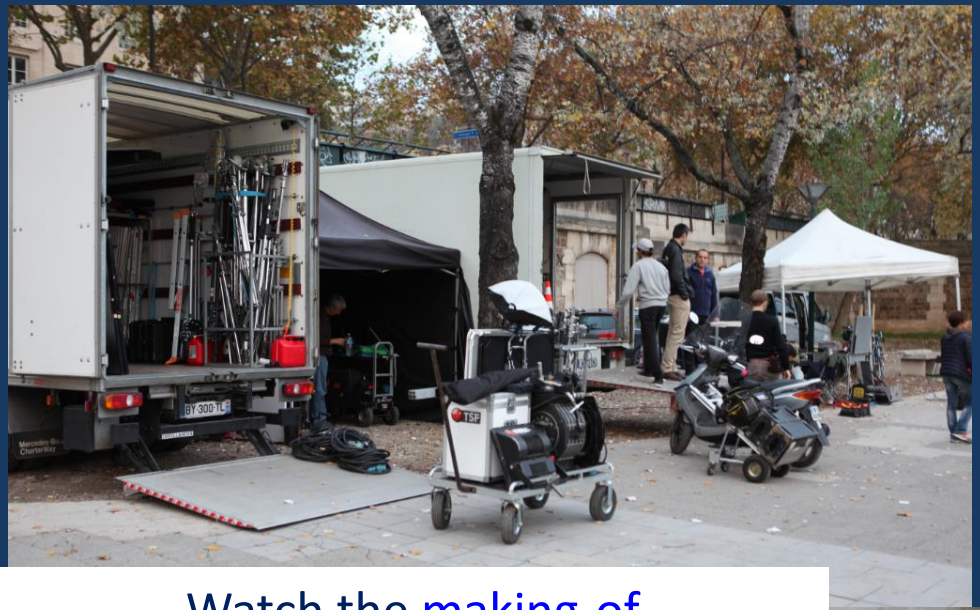


Bright lights in motion at night…

Motion inside a structure

Ultra High Technology to serve artistic intention, taking into account the power of the story

All about lights and contrast



Director of photography and HDR experts team

Watch the making-of

http://www.dailymotion.com/video/x3iw04w_4evershort_tv

www.4ever-2.com

HDR: high expectations… still some issues

- No standards yet, too many options
  - Transfer functions (EOTF) => Dolby PQ, BBC/NHK HLG
  - Format: 1 or 2 layers? Metadata or not? => Technicolor, Dolby, Philips
  - Encoding: HEVC Main 10 or future MPEG technology
- No bitrate defined yet
  - New nature of the video signal impacts encoder performance
- Current HDR TV sets are first generation
  - Between 500 and 1000 cd/m² in 2015 (target = 1500 cd/m²)

But live production can be operational pretty soon!

Conclusions and perspectives

Technology impact on perceived quality

- Video subjective tests target in 2016
  - HDR
    - Comparison of solutions in terms of perceived video quality
    - Impact of compression on HDR perceived video quality
  - HFR
    - Impact of HFR on 4K resolution in terms of perceived video quality
    - but displays?
  - HFR + HDR
    - Impact of HFR + HDR combination in terms of perceived video quality
- NextGen Audio with UHD-Phase 2: tests end 2016/2017

Towards live HDR - WCG - HFR - 4K

- Continue independent evaluations of
  - Technology (visual assessments)
  - Equipment : characterization of displays or cameras
  - End-to-end workflow
- Promote HFR: a major added value for the first to jump in, a great way to differentiate
- Shoot sequences ourselves: complete parameter control and rights
  - Feb/Mar16: tbd – second HDR test – distribution trial
- Visible events
  - Apr16: HD/4K/HDR live production and distribution
  - Jun/Jul16: Sports - HD/4K HDR/HD HFR live production and distribution test

Towards live HDR - HFR - 4K

- Disseminate results in standardization committees and conferences
  - DVB, ITU, MPEG, SMPTE
  - For information to be where and when people make decisions, worldwide
  - Selected for NAB2016 Futures Parks;
  - IBC2016 FutureZone?

- Collaborations
  - display/camera manufacturers and everyone welcome!

Merci !
Thank you!

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