

# JCTVC-I0108

## High Bit Depth considerations in HEVC

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# High Bit Depth: context & facts

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## New formats emergence

- **UHDTV** draft: ITU-R WP6C/564-E Annex 4 (17 Oct. 2011)

Parameter	Value
Aspect Ratio	16x9
Resolution	3840x2160 (4k) 7680x4320 (8k)
Precision	10/12 bits

- **DCI** v1.2: 2k/4k 12 bits
- NHK Super Hi-Vision e-2-e chain
  - 8k 12 bits @120fps

## Already available technology

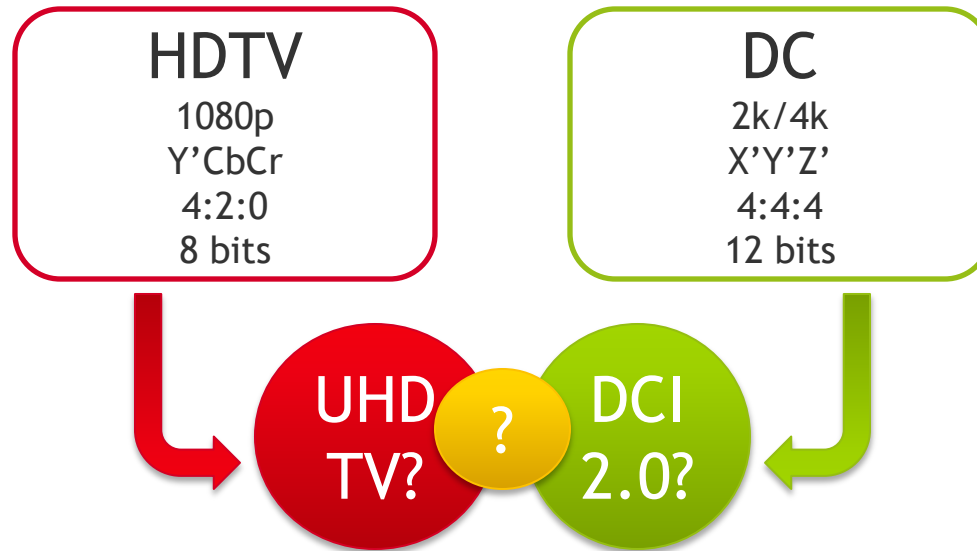
- High quality acquisition (Sony F65, Red One 4k, Arri Alexa...)
- Encoding format supporting HQ (AVC-Intra 10...)
- Advent of consumer 10/12 bits flat panels
- HDMI 1.4a/DisplayPort support 4k with 12 bits per component at least

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# High Bit Depth: rationale & market needs

## ■ Convergence between broadcast & D-Cinema?



- Needs for High accuracy production
  - Trends using HBD formats in workflow (IIF-ACES)
- Needs for new distribution/contribution formats
  - Future broadcast (HDTV → full HDTV → 3DTV → UHD TV?)
  - Non-linear distribution (Blu-ray, VoD)
- Needs for High Quality rendering
  - UHD TV (LCD, OLED...), D-Cinema (Laser videoprojector)

# HEVC High Bit Depth WD/code maturity considerations

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CD stage: Reference Software (HM6.0) and WD (JCT-VC-H1003\_dK) are being stabilized

- High Level Syntax from H.264/AVC + PCM case
  - SPS
- Motion compensation process compliant with up to 14 bits (F537)
  - Inverse Quantization
  - Inverse Transform and Scaling
  - Interpolation
- QP wrapping and *cu\_qp\_delta* binarization: OK (H0053+H0736)
- SAO takes into account bitdepth larger than 8 bits
- When bit depth and its limit are considered then limit = 14 bits (AVC-legacy)
  - Weighted Prediction
  - Intra from luma prediction
  - Interpolation process
  - MC
  - ...
- Further study, influence on:
  - Deblocking?
  - ALF?
  - ...

# Experiment: JM18.3 vs HM6.0 - 8/10/12/14 bits

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## Test material

### ■ 6 SVT sequences, 250 frames

- [ftp://vqeg.its.blrdoc.gov/HDTV/SVT\\_MultiFormat/1080p50\\_CgrLevels\\_Master\\_SVTdec05\\_/](ftp://vqeg.its.blrdoc.gov/HDTV/SVT_MultiFormat/1080p50_CgrLevels_Master_SVTdec05_/)
- 4K scan linear RGB → 1080p R'G'B' sgi16 (FR) → **1080p Y'CbCr 4:2:0 n bits**
  - Lanczos-3 downsampling
  - Truncate 16 bits → n bits with  $n = \{8, 10, 12, 14\}$
  - **Rec. BT.709/Rec. BT.1361**

## Test Conditions

- JM18.3: « HM-like » RA and AI configuration files
  - Same as in *JCTVC-H0360/JCTVC-I0409*
- HM6.0: RA, AI HE10 common conditions adapted configuration files
  - SAO, ALF, AMP, NSQT, LMChroma, RDOQ...
- BD-rate (4 QP)

# Test material: SVT sequences - Class B

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CrowdRun



DucksTakeOff



InToTree



OldTownCross



Seeking



ParkJoy



# Experiment: Results

Reference: JM18.3

Tested: HM6.0

Bitdepth/ GoP	8			10			12			14		
	Y	U	V	Y	U	V	Y	U	V	Y	U	V
AI-HE	-18.3	-29.6	-23.3	-17.7	-28.4	-20.9	-17.4	-28.3	-21.0	-13.0	-21.5	-12.4
RA-HE	-33.2	-51.1	-40.1	-33.0	-47.7	-32.4	-31.4	-47.2	-32.6	x	x	x

- *x: JM18.3 issues for 5 out of 6 sequences for RA-HE 14 bit test conditions*

## Comments

- 8 bits results quite consistent with JCTVC-I0409 (a bit below)
- Coherency between 8, 10, 12 bits comparative tests
- Performances regress for 14 bits AI but results are still encouraging
- JM18.3: Issues with RA 14 bits configuration

# Experiment: Notes

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## PSNR calculation

### ■ JM18.3

- $\text{format->max\_value}[0] = (1 \ll \text{format->bit\_depth}[0]) - 1;$

### ■ HM6.0

- $\text{maxval} = 255 * (1 \ll (\text{g\_uiBitDepth} + \text{g\_uiBitIncrement} - 8));$

→ We propose to harmonize with JM (full range PSNR)

## JM18.3 issues

- Proposed a fix for an issue with integer promotion on 32-bit platform
- Issues RA 14 bits high QP (pending work)



# Conclusion

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## Current High Bit Depth support in HM6.0

- Big analysis work to be performed but:
  - many modules seem to take bitdepth into account
  - first results encouraging
- Stalling for AI 14 bits

## Suggested actions

- **AhG to prepare HBD support in HEVC?**
- Synchronization with:
  - Software coordinator
  - «AhG 14: chroma format support» chair
- Further study of stabilized modules (start with Intra?)
- Test LowDelay cases and other test material classes
- PSNR computation should be harmonized with JM