



**JCTVC-N0142**

**AHG18: On 16-bits support for Range Extensions**

E. Francois, J. Taquet, P. Onno, G. Laroche, C. Gisquet

JCT-VC 14<sup>th</sup> Meeting, Vienna, July 2013

# 16-bit content support in HEVC RExt

## ■ Several recent contributions ask for support of 16-bit content in HEVC RExt

- JCTVC-M0094 – Proposal of the profile/level for Range extensions  
[T. Suzuki, N. Saunders, K. Sharman (Sony)]
- JCTVC-N0191 – AHG 5 and 18: Profiles for Range Extensions  
[K. Sharman, N. Saunders, J. Gamei, T. Suzuki (Sony)]
- JCTVC-M0190 – Requirements for medical imaging applications,  
[P. Amon, A. Hutter, U.-E. Martin, N. Wirsz, A. Klingler (Siemens)]
- JCTVC-N0178 – HEVC profiles for medical imaging applications,  
[P. Amon, A. Hutter, U.-E. Martin, N. Wirsz (Siemens)]
- In particular, support of 16-bit monochrome intra coding, lossless or near-lossless for Medical Applications (cf JCTVC-M0190)
  - support efficient coding of 12-bit, 14-bit, and 16-bit monochrome content
  - support for efficient reversible (i.e., lossless) and diagnostically acceptable irreversible coding

# 16-bit content support in HEVC RExt

## ■ Proposals to extend internal operations accuracy

- JCTVC-M0178 – AHG5: Range Extensions and High Bit Depths  
[K. Sharman, N. Saunders, J. Gamei (Sony)]
  - JCTVC-N0188 – AHG 5 and 18: Internal Precision for High Bit Depths  
[K. Sharman, N. Saunders, J. Gamei (Sony)]
- 
- Support negative QPs
  - Increase transform matrix precision to  $(\text{bitDepth} - 2)$
  - Increase dynamic range after transform  
(MAX\_TR\_DYNAMIC\_RANGE=15) to  $(\text{bitDepth} + 6)$
  - Increase clipped values before entropy coding to  $(\text{bitDepth} + 6)$

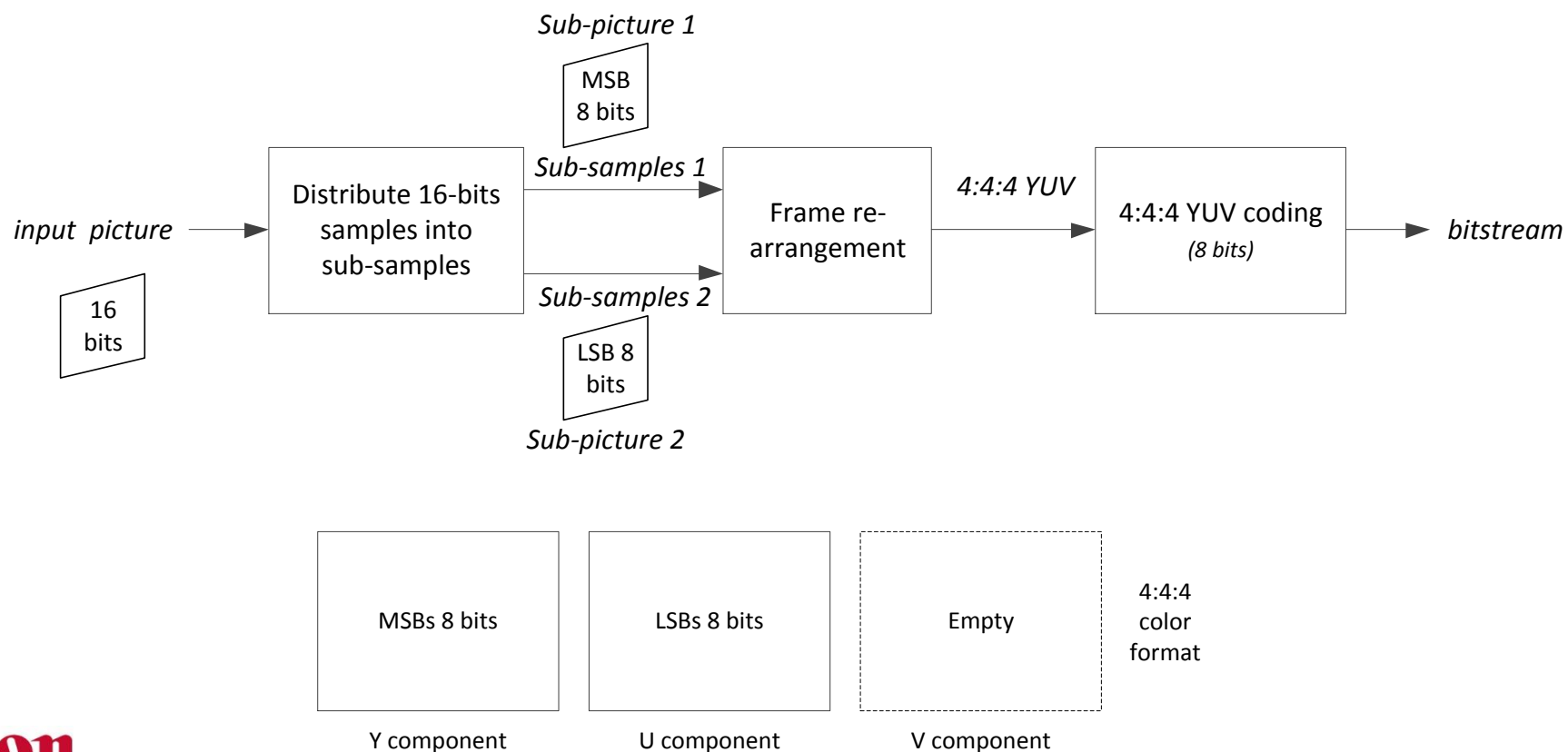
# Goal of the contribution

- Explore an alternate solution aiming at re-using at far as possible the existing HEVC 8-bit design
- Addresses 16-bit monochrome intra coding
- Provides preliminary results

# Proposed solution

## ■ Split 16-bits samples into 8-bits MSBs and LSBs samples

- Split 16-bit monochrome picture into a color picture whose components bit-depth is 8
- Luma contains 8-bit MSBs, chroma contains 8-bit LSBs

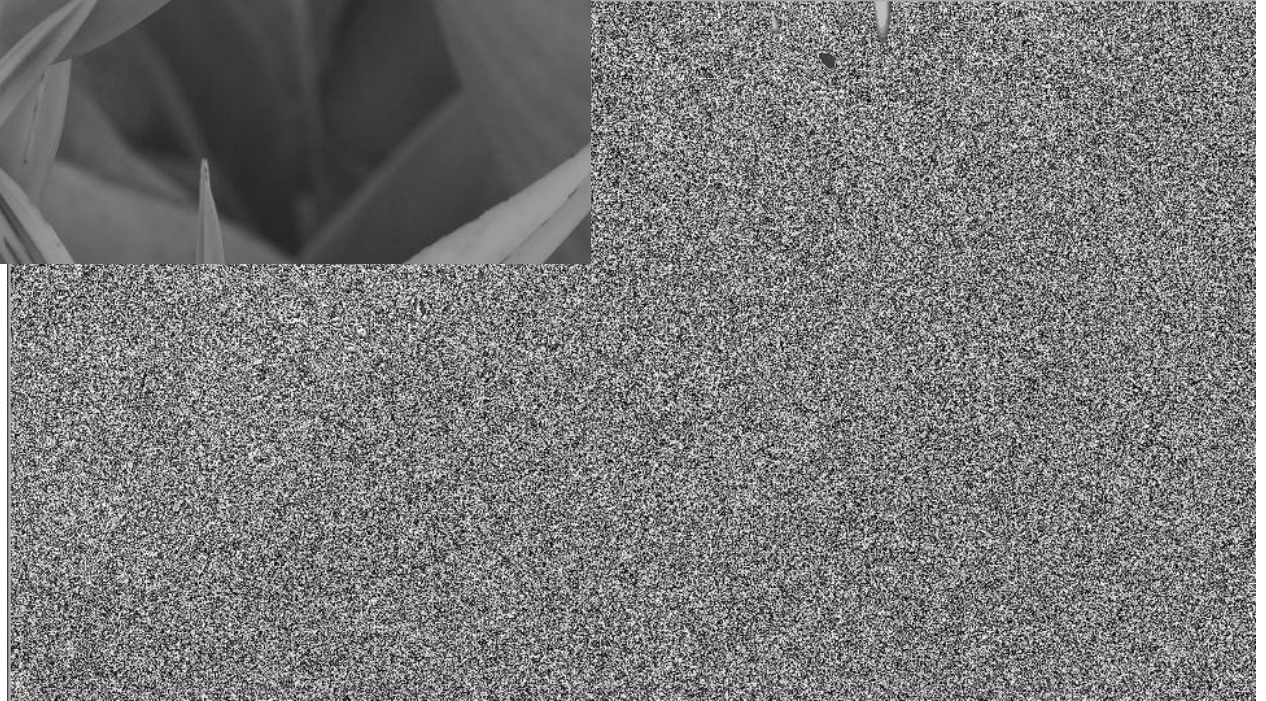


# Proposed solution



8-bit MSBs picture  
(Y-component)

8-bit LSBs picture  
(U-component)



# Proposed solution

## ■ Modifications in HM10.1\_RExt3.0

- Usage of Negative QPs
  - Used in lambda derivation
  - Anyway QP cropped to 0 in quantization
- Higher precision in rate–distortion calculation
  - FULL\_NBIT set to 1
  - No rounding in rate–distortion derivation
- $QP_C = QP_Y + 48$

# Experiments

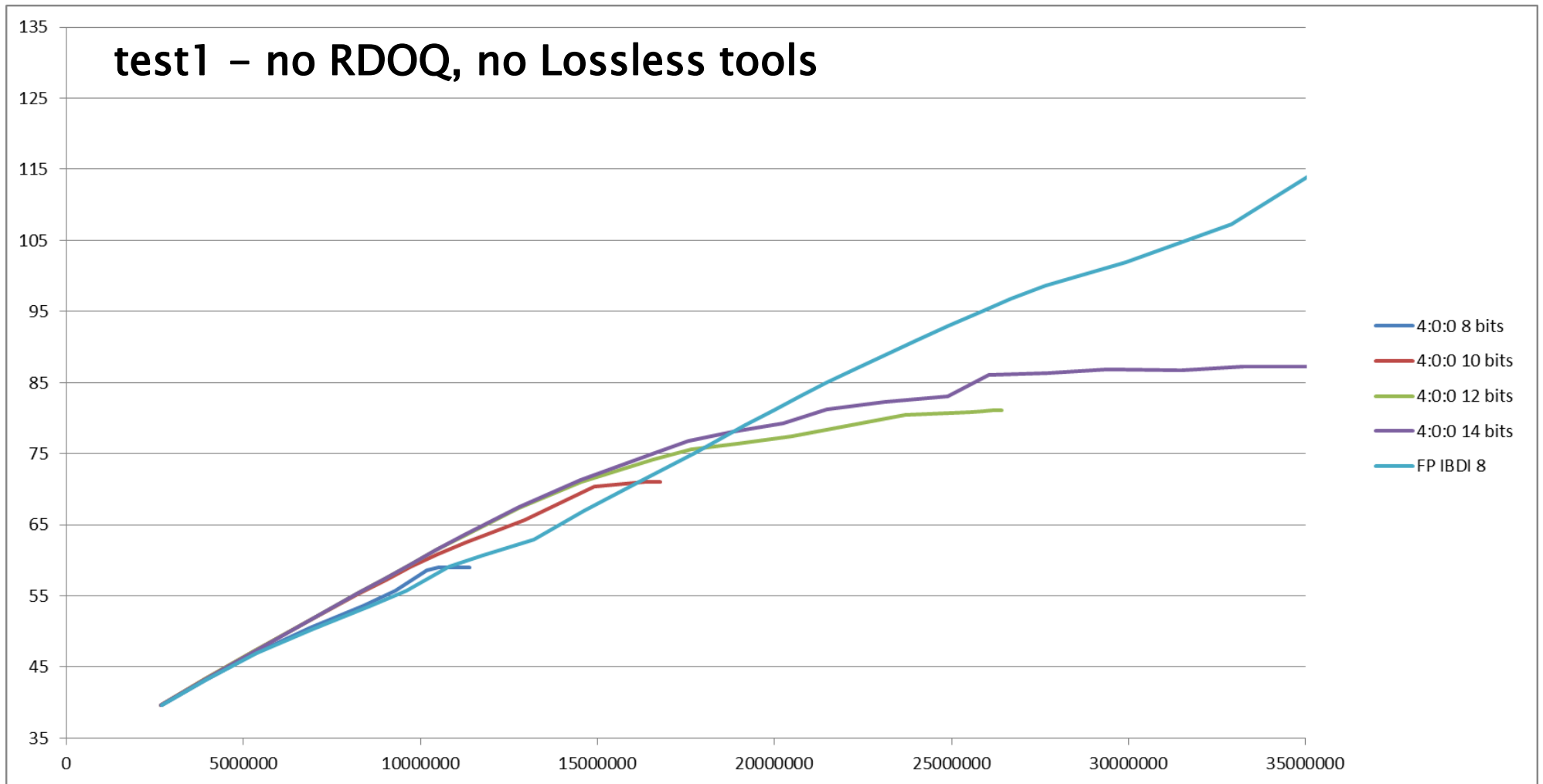
- Consider G component of 16-bit color pictures taken from JPEG
  - Less noisy than SVT 16-bit video content
  - Cropped to 1920x1080 pixels
- Reference
  - G-channel coded with HM10.1\_RExt3.0 as a 4:0:0 picture using internal bit-depth of 8, 10, 12 or 14 bits
  - The 2 other color components (R, B) not considered
- Test
  - G-channel coded as a 4:4:4 picture using internal bit-depth of 8
  - Y contains MSBs, U contains LSBs, V is empty



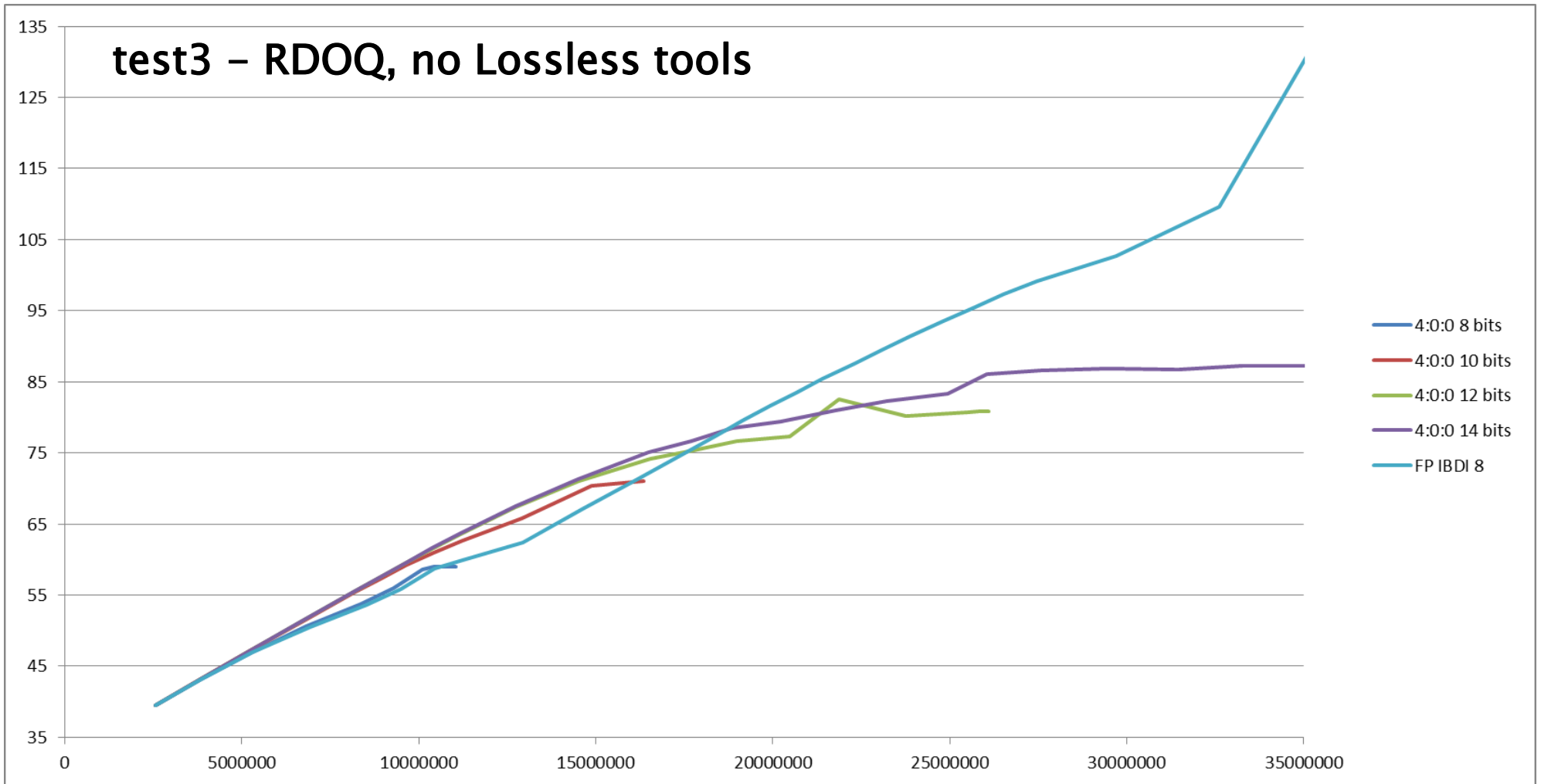
# Experiments

test	RDOQ	IPCM, TransQuantBypass	Transform Skip	Loop filters
test1	–	–	On	–
test2	–	On	On	–
test3	On	–	On	–
test4	On	On	On	–
test5	On	–	–	–

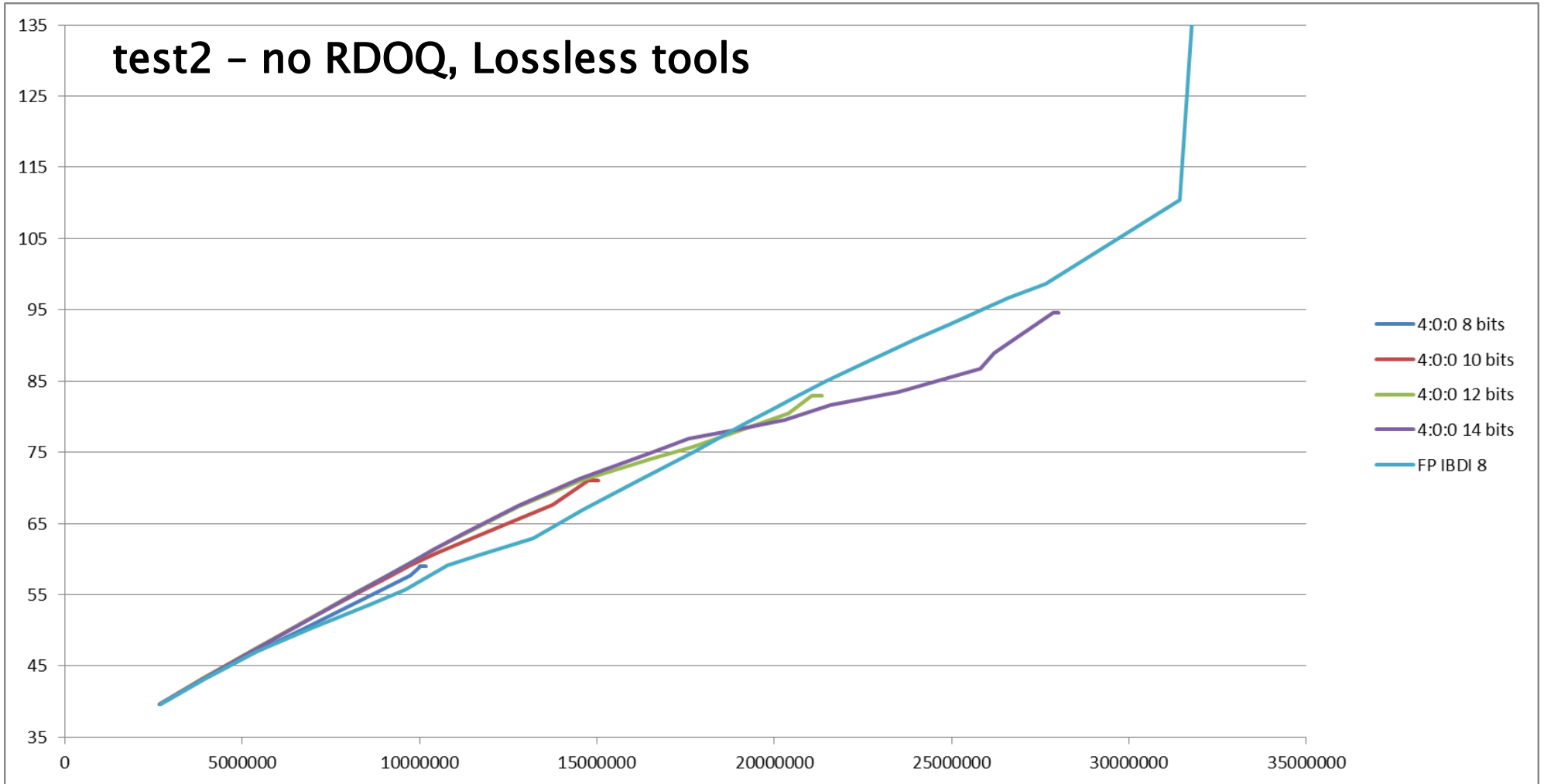
# Example – Honolulu Cathedral



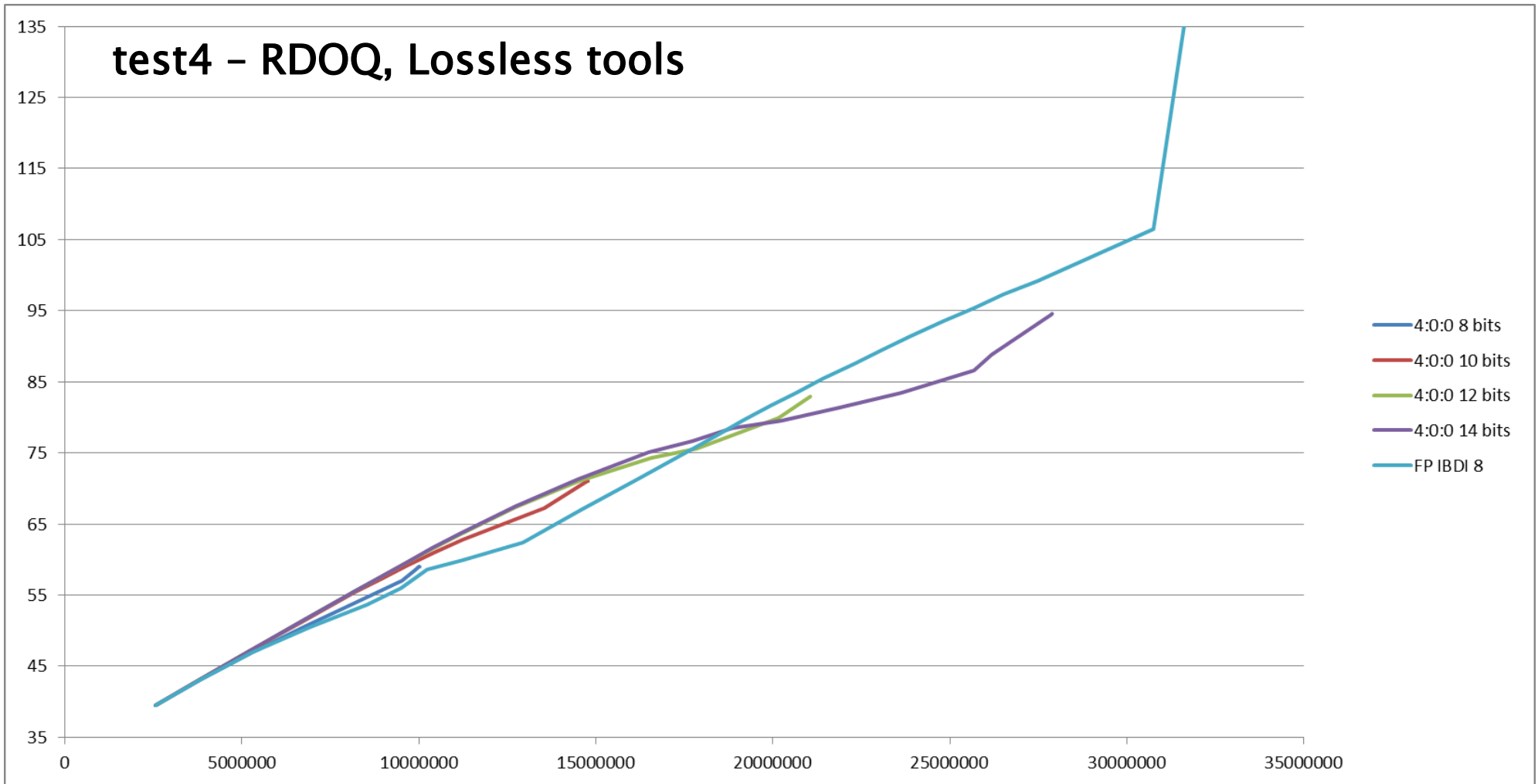
# Experiments



# Experiments



# Experiments



# Conclusions

- Provides preliminary results for coding 16-bit monochrome content using existing 8-bit HEVC tools
  - without requiring to increase the internal registers bit-depth
  - 16 bits samples split into MSBs and LSBs, respectively put into the luma and chroma components of a color picture
- Can reach higher PSNRs than using current HEVC with an internal bit-depth of 14
  - Lossless supported with existing tools
- Solution enabling to re-use most of the existing 8-bit HEVC tools instead of increasing bit-depth of internal operations
  - transform , quantization, entropy coding