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| *Title:* | **AHG8: Results from coding 4:4:4 screen content sequences** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Information | | |
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# Abstract

This contribution presents the latest investigation results on screen content coding. In the investigation, the coding performance of HM12.0\_RExt4.1 was studied and evaluated against the coding results from two modified versions of HM12.0\_RExt4.1 where additional coding tools had been added to the base software. Based on the outcome of our investigation, we would like to suggest further development of HEVC extensions for coding screen content.

# Investigation overview

## Objectives

The main objective of this investigation is to gain a good understanding on the potential for further improving the compression efficiency of the current draft HEVC 4:4:4 extension on coding screen content. In particular, our investigation is focused on the tools that are known to JCTVC. This investigation has become indispensable after the recent adoption of new tools that only benefit the coding of screen content.

## Test sequences

The 32 4:4:4 screen sequences listed in Table 1 were tested in this investigation. Besides all the 4:4:4 screen content in RCE2 and RCE3 (including those in the Optional Group), we also used the new test material proposed in JCTVC-O0256. Sample frames of these sequences are shown in [1], [2].

Table 1 4:4:4 screen content test sequences

|  |  |
| --- | --- |
| RGB | YCbCr |
| Map\_1280x720\_60\_8bit\_rgb | Map\_1280x720\_60\_8bit\_444 |
| WebBrowsing\_1280x720\_30\_8bit\_rgb | WebBrowsing\_1280x720\_30\_8bit\_444 |
| WordEditing\_1280x720\_60\_8bit\_rgb | WordEditing\_1280x720\_60\_8bit\_444 |
| SlideShow\_1280x720\_20\_8bit\_rgb | SlideShow\_1280x720\_20\_8bit\_444 |
| Programming\_1280x720\_60\_8bit\_rgb | Programming\_1280x720\_60\_8bit\_444 |
| PptDocXls\_1920x0180\_20\_8bit\_rgb | PptDocXls\_1920x0180\_20\_8bit\_444 |
| VideoConferencingDocSharing\_1280x720\_30\_8bit\_rgb | VideoConferencingDocSharing\_1280x720\_30\_8bit\_444 |
| FlyingGraphics\_1920x1080\_60\_8bit\_rgb | FlyingGraphics\_1920x1080\_60\_8bit\_444 |
| Desktop\_1920x1080\_60\_8bit\_rgb | Desktop\_1920x1080\_60\_8bit\_444 |
| RealtimeData\_1920x1080\_60\_8bit\_rgb | RealtimeData\_1920x1080\_60\_8bit\_444 |
| Console\_1920x1080\_60\_8bit\_rgb | Console\_1920x1080\_60\_8bit\_444 |
| * + - 1. VideoTesting\_1920x1080\_60\_8bit\_rgb | * + - 1. VideoTesting\_1920x1080\_60\_8bit\_444 |
| socialNetworkmap\_1920x1080\_60\_8bit\_rgb | socialNetworkmap\_1920x1080\_60\_8bit\_444 |
| CadWaveform\_1920x1080\_20\_8bit\_rgb | CadWaveform\_1920x1080\_20\_8bit\_444 |
| PcbLayout\_1920x1080\_20\_8bit\_rgb | PcbLayout\_1920x1080\_20\_8bit\_444 |
| TwistTunel\_1280x720\_30\_8bit\_rgb | TwistTunel\_1280x720\_30\_8bit\_444 |

## Software and test conditions

Software:

* Anchor: HM12.0-RExt4.1
* Modified Scheme 1: HM12.0-RExt4.1 + Proposal-1 [3].
  + For Proposal-1 [3], we are using the Level 3 configuration with dictionary size equal to 16Kbytes.
* Modified Scheme 2: HM12.0-RExt4.1 + constrained Proposal-1.
  + For the constrained Proposal 1, we modified the dictionary definition and reduced its size close to a CU so that the complexity of this particular tool is significantly reduced while maintaining its coding efficiency at the same level.

Encoding settings:

* AI-Main, RA-Main,
* QP=17, 22, 27, 32 (High-tier setting of RExt common test condition), lossless.

Video format:

* RGB 444 8 bits per component (the G component was treated as Y inside the code).
* YUV 444 8 bit per component

# Test results and discussions

The complete coding simulation results for both lossless and lossy compression are given in the attached Excel file. Relative gains are measured in comparison to the anchor (i.e., HM12.0-RExt4.1).

## Lossless scenario

The bit rate savings over the anchors are reported for both Modified Scheme 1 and Modified Scheme 2 in Table 1(a)(b) and Table 2(a)(b), for AI-main and RA-main encoding settings, respectively.

Table 1 Bit rate saving of “Modified Schemes 1” over anchor for lossless AI and RA settings.





Table 2 Bit rate saving of “Modified Schemes 2” over anchor for lossless AI and RA settings.





Note, we added a column “Compression Ratio Gain (Average)” in the above tables. This is mainly due to the fact that, in the current RCE2&3 results template, “Bit-rate saving” is calculated as the bit-rate reduction of approach A relative to approach B on sequence basis, i.e.

Bit-rate Saving = (bit-rate\_A - bit-rate\_B) / bit-rate\_A.

Therefore, including a relative compression ratio gain for each sequence will help make a consistent and correct assessment on compression efficiency for the compression technologies under test. Here,

Compression Ratio Gain = (Compression-Ratio\_A – Compression-Ratio\_B) / Compression-Ratio\_B.

We suggest that this “Compression Ratio Gain” can be included in the future results report template for lossless coding.

## Lossy scenarios

As shown in Section 2.1, the Modified Scheme 2 delivers better results in the lossless case. In this section, additional results using the Modified Scheme 2 in lossy coding are given in Table 3 and Table 4, to further demonstrate the benefit of the Modified Scheme 2 (i.e., HM12.0-RExt4.1+constrained Proposal-1).

Table 3 Lossy coding gains of Modified scheme 2 vs. anchor for AI-main using High-tier configuration



Table 2 Lossy coding gains of Modified Scheme 2 vs. anchor for RA-main using High-tier configuration



## Discussions

As indicated in the previous sections, our test results clearly showed that HM12.0-RExt4.1 could be further improved significantly for coding the typical screen content that is commonly seen in our daily desktop applications.

# Conclusions

The investigation results reported in this contribution show that the current design of HEVC range extensions could indeed be further improved significantly for coding screen content. Therefore, we would like to suggest detailed study of all SCC tools together in further development of future HEVC extensions.

We would also like to suggest that the “Compression Ratio Gain”, described in Section 2.1, can be included in the future results report template for lossless coding.

# References

[1] H. Yu, W. Gao, J. Ye, Y. Cao, X. Wang, “AhG8: results from lossless coding of the 4:4:4 screen content sequences”, JCT-VC Document, JCTVC-L0302, Geneva, CH, Jan. 2013.

[2] H. Yu, W. Wang, X. Wang, J. Ye, Z. Ma, “AHG8: New 4:4:4 test sequences with screen content”, JCTVC Document, JCTVC-O0256, Geneva, CH, Oct. 2013.

[3] T. Lin, S. Wang, P. Zhang, K. Zhou, “AHG7: Full-chroma (YUV444) dictionary+hybrid dual-coder extension of HEVC”, JCT-VC Document, JCTVC-K0133, Shanghai, China, October 2012.