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| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  20th Meeting: Geneva, CH, 10–18 Feb. 2015 | Document: JCTVC-T0008 |

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| *Title:* | **JCT-VC AHG report: Screen content extensions software development (AHG 8)** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Report | | |
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| *Source:* | AHG8 | | |

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# Abstract

This report summarizes the activities of Ad Hoc Group 8 on screen content extensions software (SCM) development that have taken place between the JCT-VC 19th meeting in Strasbourg, France, and the 20th meeting in Geneva, Switzerland.

# Mandates

The ad hoc group was mandated to:

* Coordinate development of the HM SCM software and its distribution.
* Prepare and deliver HM 16.x-SCM-3.0 software version and the reference configuration encodings according to JCTVC-S1015.
* Prepare and deliver additional "dot" version software releases and software branches as appropriate.
* Perform analysis and reconfirmation checks of the behavior of the draft design, and report the results of such analysis.
* Suggest configuration files for additional testing of tools.
* Coordinate with AHG7 to address any identified issues regarding text and software relationship.

# Software revisions

Multiple versions of the HM SCM software were produced and SCM3.0 was announced on the JCT-VC email reflector. The integration details and performance summary of these revisions are provided in the next subsections. The performance results of software revisions were observed to be consistent with the adopted techniques.

## HM-16.2\_SCM-3.0

HM-16.2\_SCM-3.0 was tagged on the SVN HHI repository on November 17th 2014. This release includes following adoptions:

* JCTVC-S0067 - IBC encoder optimizations
* JCTVC-S0085 - Adaptive motion vector resolution
* JCTVC-S0086 - ACT enable flag from SPS to PPS and code ACT flag if all PU(s) are DM
* JCTVC-S0088/S0141 - Palette prediction alignment with CABAC (WPP based)
* JCTVC-S0089 - Hash based motion estimation improvements
* JCTVC-S0090 - Bug fix for temporal scalability
* JCTVC-S0096 - Disabling de-blocking for palette mode
* JCTVC-S0099/S0110/S0173 - Syntax optimization for palette size = 1
* JCTVC-S0100 - IBC early termination consistently regardless of ACT usage
* JCTVC-S0102 - Intra boundary filter control at SPS
* JCTVC-S0110 - Syntax optimization for palette\_transpose\_flag
* JCTVC-S0110/S0105/S0173 - Syntax optimization for palette size = 0
* JCTVC-S0144/S0086/S0140 - Clip ACT negative QPs to zero
* JCTVC-S0153 - Zero run-length coding for palette predictor
* JCTVC-S0156 - palette encoder optimizations
* JCTVC-S0179 - ACT operation on TU blocks
* JCTVC-S0180 - For different luma and chroma bit depth - Bit depth alignment of color components for ACT and disable the use of ACT for transquant-bypass
* JCTVC-S0186 - Remove one context for palette\_transpose\_flag
* JCTVC-S0220/S0088 - WPP shape based constraint for IBC prediction
* JCTVC-S0254 - Unification of ACT for lossy and lossless
* JCTVC-S0258/S0115/S0150/S0156/S0157/S0181 - Include escape sample into the INDEX and COPY\_ABOVE modes
* JCTVC-S0269 - Palette run coding improvements
* JCTVC-CE5 meeting notes - Add SPS flag for max palette and palette predictor size
* JCTVC-Integration issue - Non-normative bug fix for 4:2:0 chroma format

As per JCTVC-S1015, 4:2:0 was introduced to the common test conditions and this issue was observed during the integration process.

Following adoptions have not been integrated (These do not impact CTC)

* JCTVC-S0043 - palette delta QP coding

During integration proponents reported an underlying software issue in PLT mode when QP’s are changed across CU’s. A bug report # 1373 was raised by proponents on February 6th 2015. This will be fixed in the upcoming releases of SCM (SCM 4.0).

* JCTVC-S0197 - SCC WD, VUI codepoint for SMPTE ST 2085 (YDzDx)

Proponents claimed that it is not necessary to change the software

The release was announced on the email reflector. The software can be downloaded at   
<https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.2+SCM-3.0/>

The performance of this version against HM-16.2+SCM-2.0 was described according to the common test conditions in JCTVC-S1015. For the lossy 444 configuration, it is reported that this version provides BD-rate reduction of 4.2%, 3.5% and 3.8% for RGB 1080p & 720p text and graphics category in AI/RA/LB configurations respectively and BD-rate reduction of 2.6%, 3.0% and 3.7% for YUV 1080p & 720p text and graphics category in AI/RA/LB configuration, respectively. For the lossless 444configuration, it is reported that this version provides BD-rate reduction of 1.9%, 0.9% and 1.1% for RGB 1080p & 720p text and graphics category in AI/RA/LB configurations respectively and BD-rate reduction of 2.6%, 1.9% and 1.9% for YUV 1080p & 720p text and graphics category in AI/RA/LB configuration, respectively.

Table 1 and Table 2 summarize BD-rate change for lossy and lossless 444 configuration respectively.

Table 1. BD-Rate change in Lossy 444 configuration

|  |  |  |  |
| --- | --- | --- | --- |
|  | **All Intra** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p & 720p | -4.2% | -4.2% | -4.3% |
| RGB, mixed content, 1440p & 1080p | -3.5% | -3.2% | -3.2% |
| RGB, Animation, 720p | -0.2% | -0.2% | -0.3% |
| RGB, camera captured, 1080p | -0.1% | 0.0% | -0.1% |
| YUV, text & graphics with motion, 1080p & 720p | -2.6% | -3.5% | -3.9% |
| YUV, mixed content, 1440p & 1080p | -2.2% | -2.9% | -2.9% |
| YUV, Animation, 720p | 0.2% | -0.4% | -0.2% |
| YUV, camera captured, 1080p | 0.3% | 0.3% | 0.1% |
| Enc Time[%] | 72% | | |
| Dec Time[%] | 91% | | |
|  |  |  |  |
|  | **Random Access** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p & 720p | -3.5% | -3.6% | -3.7% |
| RGB, mixed content, 1440p & 1080p | -2.6% | -2.4% | -2.3% |
| RGB, Animation, 720p | -0.2% | -0.2% | -0.2% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | -0.1% |
| YUV, text & graphics with motion, 1080p & 720p | -3.0% | -3.6% | -3.9% |
| YUV, mixed content, 1440p & 1080p | -1.5% | -2.4% | -2.4% |
| YUV, Animation, 720p | 0.2% | -0.1% | -0.4% |
| YUV, camera captured, 1080p | 0.1% | 0.2% | 0.0% |
| Enc Time[%] | 78% | | |
| Dec Time[%] | 93% | | |
|  |  |  |  |
|  | **Low delay B** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p & 720p | -3.8% | -3.7% | -3.8% |
| RGB, mixed content, 1440p & 1080p | -1.4% | -1.2% | -0.9% |
| RGB, Animation, 720p | -0.1% | 0.0% | 0.2% |
| RGB, camera captured, 1080p | 0.0% | 0.1% | 0.1% |
| YUV, text & graphics with motion, 1080p & 720p | -3.7% | -3.9% | -4.1% |
| YUV, mixed content, 1440p & 1080p | -0.5% | -0.7% | -0.9% |
| YUV, Animation, 720p | 0.1% | -0.2% | 0.1% |
| YUV, camera captured, 1080p | 0.1% | -0.1% | 0.1% |
| Enc Time[%] | 82% | | |
| Dec Time[%] | 98% | | |

Table 2. BD-Rate change in Lossless 444 configuration

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **All Intra** | | | |
|  | Bit-rate change (Total) | Bit-rate change (Average) | Bit-rate change (Min) | Bit-rate change (Max) |
|  |
| RGB, text & graphics with motion, 1080p & 720p | -1.9% | -2.0% | -6.1% | -0.1% |
| RGB, mixed content, 1440p & 1080p | -1.4% | -1.3% | -1.6% | -0.9% |
| RGB, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p & 720p | -2.6% | -2.7% | -5.6% | -0.3% |
| YUV, mixed content, 1440p & 1080p | -1.6% | -1.6% | -1.8% | -1.2% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% |
| YUV, camera captured, 1080p | 0.0% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 68% | | | |
| Dec Time[%] | 82% | | | |
|  |  |  |  |  |
|  | **Random Access** | | | |
|  | Bit-rate change (Total) | Bit-rate change (Average) | Bit-rate change (Min) | Bit-rate change (Max) |
|  |
| RGB, text & graphics with motion, 1080p & 720p | -0.9% | -1.6% | -7.1% | 0.5% |
| RGB, mixed content, 1440p & 1080p | -0.1% | -0.1% | -0.6% | 0.3% |
| RGB, Animation, 720p | 0.2% | 0.2% | 0.2% | 0.2% |
| RGB, camera captured, 1080p | 0.2% | 0.2% | 0.1% | 0.2% |
| YUV, text & graphics with motion, 1080p & 720p | -1.9% | -2.3% | -7.1% | -0.1% |
| YUV, mixed content, 1440p & 1080p | -0.4% | -0.4% | -0.7% | -0.1% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% |
| YUV, camera captured, 1080p | 0.0% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 69% | | | |
| Dec Time[%] | 83% | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  | **Low Delay B** | | | |
|  | Bit-rate change (Total) | Bit-rate change (Average) | Bit-rate change (Min) | Bit-rate change (Max) |
|  |
| RGB, text & graphics with motion, 1080p & 720p | -1.1% | -1.8% | -7.7% | 0.4% |
| RGB, mixed content, 1440p & 1080p | 0.0% | 0.0% | -0.4% | 0.2% |
| RGB, Animation, 720p | 0.2% | 0.2% | 0.2% | 0.2% |
| RGB, camera captured, 1080p | 0.2% | 0.2% | 0.1% | 0.2% |
| YUV, text & graphics with motion, 1080p & 720p | -1.9% | -2.5% | -8.2% | -0.1% |
| YUV, mixed content, 1440p & 1080p | -0.2% | -0.2% | -0.5% | 0.0% |
| YUV, Animation, 720p | 0.0% | 0.0% | 0.0% | 0.0% |
| YUV, camera captured, 1080p | 0.0% | 0.0% | 0.0% | 0.0% |
| Enc Time[%] | 76% | | | |
| Dec Time[%] | 96% | | | |

## HM-16.2\_SCM-3.0rc1 and HM-16.2+SCM-2.1

HM-16.2\_SCM-3.0rc1 was tagged on the SVN HHI repository on November 15th 2014 before the release of HM-16.2\_SCM-3.0 to allow proponents to cross-check integrations and interactions with other adoptions. This version is same as HM-16.2\_SCM-3.0.

The release was announced on the email reflector. The software can be downloaded at <https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.2+SCM-3.0rc1/>

HM-16.2+SCM-2.1 has been tagged on HHI Server on October 29th 2014 and can be downloaded at <https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.2+SCM-2.1/>

The changes over RExt8.0\_SCM2.0 were:

* Migration of SCM2.0 HM 16.2.
* Removals of macros related to SCM 2.0.
* Fix for ticket #1344 (Instances of color changed to colour in SCM).
* Fix for ticket #1337 (incorrect address calculation in ACT).

The JCT-VC issue tracker at <https://hevc.hhi.fraunhofer.de/trac/hevc/> has been updated to allow bug reports to be entered for SCM, currently under milestone HM+SCC-4.0, version SCC-3.0.

# Recommendations

* Continue to develop reference software based on HM16.2\_SCM3.0 and improve its quality.
* Remove macros introduced in previous versions before starting integration towards SCM-3.0 such as to make the software more readable.
* Continue merging with later HM versions.