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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 21st meeting in Warsaw, Poland, and the 22nd 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-5.0 software version and the reference configuration encodings according to JCTVC-U1015.
* 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 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-16.6\_SCM-5.x releases

HM-16.6\_SCM-5.0rc1 release candidate was announced on the email reflector on July 21st 2015 before the release of HM-16.6\_SCM-5.0 to allow proponents to cross-check integrations and interactions with other adoptions. The software was tagged as <https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.6+SCM-5.0rc1/> .

HM-16.6\_SCM-5.0 was announced on the email reflector on July 24th, 2015. The software was tagged as <https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.6+SCM-5.0/> .This version incorporates two bug fixes related to palette predictor initialization (based on color component) and PLT de-blocking process over HM-16.6\_SCM-5.0rc1 release candidate.

HM-16.6\_SCM-5.1 was announced on the email reflector on August 05th, 2015. The software was tagged as <https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.6+SCM-5.1/> . This version incorporates a bug fix for JCTVC-U0087 on PLT escape coding in non-444 format and general cleanups. For the lossy 420 configuration under CTC as in JCTVC-U1015, it is reported that the bug fix provides BD-rate reduction of 0.1%, 0.2% and 0.1% for YUV 1080p & 720p text and graphics category in AI/RA/LB configurations respectively. No performance impact was observed for 444 CTC.

Further, HM-16.6\_SCM-5.2 was announced on the email reflector on September 16th, 2015. The software was tagged as <https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.6+SCM-5.2/> . A bug was reported in SCM 5.0 and SCM 5.1 resulting in different output when run on windows and Linux environment. A bug fix has been incorporated into SCM 5.2. For the lossy 444 configuration under CTC as in JCTVC-U1015, it is reported that this version provides BD-rate reduction of 0.1%, 0.0% and 0.0% for RGB 1080p & 720p text and graphics category in AI/RA/LB configurations respectively and BD-rate reduction of 0.2%, 0.1% and 0.1% for YUV 1080p & 720p text and graphics category in AI/RA/LB configuration, respectively.

AHG 8 and AHG 6 recommended to use HM-16.6\_SCM-5.2 as the basis software for 22nd JCT-VC meeting.

HM-16.6\_SCM-5.2 incorporates following adoptions/Bug fixes:

* JCTVC-U0036 :  Add bitstream conformance requirements when maximum palette size is 0
* JCTVC-U0052 :  Avoid QP dependence for coding the value of escape pixels
* JCTVC-U0078 :  Restrict 8x8 Bi-pred when IBC is enabled and use\_integer\_mv\_flag is disabled
* JCTVC-U0080/0077/0103 :  Enable IBC chroma interpolation
* JCTVC-U0081/U0107 :  Unification of adaptive motion vector resolution
* JCTVC-U0083/0079 :  Signal the use of current picture as reference picture at PPS
* JCTVC-U0084 :   Allow signal palette predictor initializers at SPS
* JCTVC-U0086 :   Simplification of mapping of numPLTIndices
* JCTVC-U0087 :  Swap the nesting of the the loops for sending the escape-coded entries
* JCTVC-U0090 :  last\_palette\_run\_type\_flag uses the same CABAC context that is used for palette\_run\_type\_flag
* JCTVC-U0095 :  Fast intra ACT search (default: macro OFF for CTC)
* JCTVC-U0096 :  Improved palette encoder
* JCTVC-U0104 :  Put current picture in both L0 and L1 when IBC is enabled (aspect #1)
* JCTVC-U0104 :  Disable weighted prediction for IBC (aspect #3)
* JCTVC-U0106 :  Control ACT at the TU level instead of CU level
* JCTVC-U0114 :  Generate the palette predictor initializer with low delay
* JCTVC-U0133 :  Change the positions of palette scanRotationModeFlag and palette delta qp and chroma qp offset
* JCTVC-U0176 :  Simplify the Rice parameter derivation of numIndices
* JCTVC-U0180 :  Add current picture into last position of reference picture list L0 by default, when RPLM is not used
* TICKET#1401 :  Fix for Ticket #1401 related to constraint intra prediction process
* New per-sequence configuration files are added for ChineseEditing sequence.
* Integration of JCTVC-U0181 was planned for future releases. (These do not impact CTC)
* Include palette predictor initialization also signaled by color component as per the meeting notes.
* Bug fix for PLT deblocking process (software mismatch w.r.t to spec).

The performance HM-16.6+SCM-5.2 compared to HM-16.4+SCM-4.0 was described according to the common test conditions in JCTVC-T1015 (without chineseEditing sequence). For the lossy 444 configuration, it is reported that this version provides BD-rate reduction of 1.0%, 0.6% and 0.4% for RGB 1080p & 720p text and graphics category in AI/RA/LB configurations respectively and BD-rate reduction of 1.9%, 1.0% and 0.4% for YUV 1080p & 720p text and graphics category in AI/RA/LB configuration, respectively.

For the lossy 420 configuration, it is reported that this version provides BD-rate reduction of 3.7%, 2.1% and 0.9% for YUV 1080p & 720p text and graphics category in AI/RA/LB configurations respectively.

Table 1 and Table 2 summarize BD-rate change for lossy 444 and lossy 420 configurations respectively.

Table 1. BD-Rate change in Lossy 444 configuration (SCM 5.2 Vs SCM 4.0)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **All Intra** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p & 720p | -1.0% | -1.9% | -1.8% |
| RGB, mixed content, 1440p & 1080p | -0.6% | -1.7% | -1.7% |
| RGB, Animation, 720p | -0.2% | -0.8% | -0.6% |
| RGB, camera captured, 1080p | 0.0% | 0.0% | 0.0% |
| YUV, text & graphics with motion, 1080p & 720p | -1.9% | -3.0% | -3.1% |
| YUV, mixed content, 1440p & 1080p | -1.7% | -3.8% | -3.8% |
| YUV, Animation, 720p | -1.1% | -4.7% | -4.2% |
| YUV, camera captured, 1080p | -0.3% | -1.2% | -1.5% |
| Enc Time[%] | 110% | | |
| Dec Time[%] | 84% | | |
|  |  |  |  |
|  | **Random Access** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p & 720p | -0.6% | -1.7% | -1.4% |
| RGB, mixed content, 1440p & 1080p | 0.1% | -1.1% | -1.2% |
| RGB, Animation, 720p | 0.7% | 0.2% | 0.5% |
| RGB, camera captured, 1080p | 0.8% | 0.9% | 1.2% |
| YUV, text & graphics with motion, 1080p & 720p | -1.0% | -2.2% | -2.6% |
| YUV, mixed content, 1440p & 1080p | -0.9% | -3.6% | -3.5% |
| YUV, Animation, 720p | 0.3% | -2.7% | -2.3% |
| YUV, camera captured, 1080p | 0.6% | -0.2% | -0.2% |
| Enc Time[%] | 104% | | |
| Dec Time[%] | 82% | | |
|  |  |  |  |
|  | **Low delay B** | | |
|  | G/Y | B/U | R/V |
| RGB, text & graphics with motion, 1080p & 720p | -0.4% | -1.0% | -0.8% |
| RGB, mixed content, 1440p & 1080p | 0.5% | 0.0% | -0.4% |
| RGB, Animation, 720p | 0.5% | 0.3% | 0.8% |
| RGB, camera captured, 1080p | 0.8% | 0.5% | 1.0% |
| YUV, text & graphics with motion, 1080p & 720p | -0.4% | -1.6% | -1.6% |
| YUV, mixed content, 1440p & 1080p | 0.2% | -1.5% | -1.5% |
| YUV, Animation, 720p | 0.6% | 0.0% | 0.2% |
| YUV, camera captured, 1080p | 0.4% | 0.0% | 0.5% |
| Enc Time[%] | 101% | | |
| Dec Time[%] | 85% | | |

Table 2. BD-Rate change in Lossy 420 configuration (SCM 5.2 Vs SCM 4.0)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **All Intra** | | |
|  | G/Y | B/U | R/V |
| YUV, text & graphics with motion, 1080p & 720p | -3.7% | -4.7% | -4.9% |
| YUV, mixed content, 1440p & 1080p | -1.7% | -3.0% | -3.8% |
| YUV, Animation, 720p & 768p | -0.9% | -1.8% | -1.0% |
| Enc Time[%] | 124% | | |
| Dec Time[%] | 98% | | |
|  |  |  |  |
|  | **Random Access** | | |
|  | G/Y | B/U | R/V |
| YUV, text & graphics with motion, 1080p & 720p | -2.1% | -3.0% | -3.4% |
| YUV, mixed content, 1440p & 1080p | -0.9% | -2.0% | -2.7% |
| YUV, Animation, 720p | -0.4% | -1.0% | -0.3% |
| Enc Time[%] | 111% | | |
| Dec Time[%] | 90% | | |
|  |  |  |  |
|  | **Low delay B** | | |
|  | G/Y | B/U | R/V |
| YUV, text & graphics with motion, 1080p & 720p | -0.9% | -2.0% | -2.5% |
| YUV, mixed content, 1440p & 1080p | -0.3% | -2.4% | -2.6% |
| YUV, Animation, 720p | -0.2% | -1.2% | -0.1% |
| Enc Time[%] | 105% | | |
| Dec Time[%] | 92% | | |

## HM-16.x\_SCM-4.1 releases

HM-16.4+SCM-4.1, HM-16.5+SCM-4.1, HM-16.6+SCM-4.1 were tagged on HHI Server and can be downloaded at <https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/>

Following adoptions, bug fixes and cleanup were integrated:-

* JCTVC-T0048 - Bug fix related to IBC restriction within the current slice
* JCTVC-T0056 - Bug fix related to IBC restriction within the current tile
* JCTVC-S0043 - Syntax for supporting deltaQP
* Removal of Macro's related to SCM4.0
* Other cleanups/bug fixes :
  + Bug Fix  : when IBC is turned off in test conditions
  + Bug Fix  : Related to IBC hash search for non-64x64 CTU sizes
  + Bug Fix  : Ticket#1311 on inconsistent cost calculation
  + Bug Fix  : When multiple-slices are used together with RPLM.
  + Clean-up: IBC functionality alignment with spec.
  + Clean-up : Removal of the code related to maintenance of LastIntraBCMv
  + Clean-up : Disable and removal of the macro SCM\_IBC\_CLEANUP\_IDENTICAL\_RDO
* Migration to HM 16.5 and HM 16.6

It is observed that there was no noticeable change in performance under common test configuration due to above integrations.

## Bug tracker

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-5.0, version SCC-6.0.

Following tickets were closed during the meeting cycle: #1373, #1401, #1411, #1417, #1418, #1419, #1420, #1421, and #1422.

# Recommendations

* Continue to develop reference software based on HM16.6\_SCM5.x and improve its quality and release HM16.6\_SCM5.x.
* Remove macros introduced in previous versions before starting integration towards SCM-6.0 such as to make the software more readable.
* Continue merging with later HM versions.