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| **Joint Collaborative Team on 3D Video Coding Extension**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  12th Meeting: Warsaw, PL, 20–26 June 2015 | Document: JCT3V-L0003 |

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| *Title:* | **JCT-3V AHG Report: MV-HEVC and 3D-HEVC Software Integration (AHG3)** | | |
| *Status:* | AHG report input to JCT-3V | | |
| *Purpose:* | AHG report | | |
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| *Source:* | AHG | | |

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# Abstract

This report summarizes the activities of the AhG on MV-HEVC and 3D-HEVC Software Integration that have taken place between the 11th JCT-3V meeting in Geneva and the 12thJCT-3V meeting in Warsaw. Activities focused on the integration of proposals adopted at the 11th meeting into a common code base, the release of the MV-HEVC Software Draft 3, the release of the 3D-HEVC Software Draft 1, and the update of HTM to HM-16.5.

# Mandates

|  |  |  |
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| **Title** | **Chairs** | **Mtg** |
| **MV-HEVC / 3D-HEVC Software Integration (AHG4)**  ([jct-3v@lists.rwth-aachen.de](mailto:jct-3v@lists.rwth-aachen.de))   * Coordinate development of the HTM software and its distribution to JCT-3V members. * Produce documentation of software usage for distribution with the software. * Prepare and deliver HTM-14.0 software version and the reference configuration encodings according to JCT3V-G1100 based on common conditions suitable for in the core experiment (expected within four weeks after the meeting). * Start integrating HTM-15.0 aligned with HM16.3 or higher * Prepare and deliver the Draft 3 of MV-HEVC software JCT3V-K1009 and Draft 1 of 3D-HEVC software JCT3V-K1012. * Perform analysis and reconfirmation checks of the behaviour of technical changes adopted into the draft design, and report the results of such analysis. * Coordinate with 3D-HEVC Draft and MV-HEVC / 3D-HEVC Test Model editing to identify any mismatches between software and text. | G. Tech  H. Liu (co-chairs)  Y. W. Chen  K. Wegner (vice chairs) | N |

# HTM tool integration

Development of the software was coordinated with the parties needing to integrate changes.

The distribution of the software was announced on the JCT-3V e-mail reflector and the software was made available through the SVN server:

[https://hevc.hhi.fraunhofer.de/svn/svn\_3DVCSoftware/tags/](https://hevc.hhi.fraunhofer.de/svn/svn_3DVCSoftware/tags/HTM-4.0)

Anchor bitstreams have been created and uploaded to:

[ftp.hhi.fraunhofer.de](ftp://ftp.hhi.fraunhofer.de); login: mpeg3dv\_guest; path: /MPEG-3DV/HTM-Anchors/

Two version of the HTM software were produced and announced on the JCT-3V email reflector. The following sections give a brief summary of the integrated tools and achieved coding gains.

## Versions HTM-14.0

Starting point for development of HTM-14.0 was HTM-13.1. Development of HTM-14.0 was conducted in two parallel tracks each performing sequential integration. Development of each branch has been supervised by a software coordinator. Software of the two tracks was merged by the software coordinators.

### Integrated items

*Track 1: Various*

Coordinator: Hongbin Liu

* [JCT3V-K0033](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2445) Depth intra skip (DIS) mode
* [JCT3V-K0036](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2448) Position Derivation for Shifted-IVMC
* [JCT3V-K0035](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2447) Removal of Encoder Restriction of ARP Samsung
* [JCT3V-K0053](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2465) Bug fix of the 3D-HEVC specification text on the scaling of TMVP
* [JCT3V-K0028](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2440) Encoder optimization: Motion estimation for DBBP with masked SAD instead of SATD

*Track 2: Various*

Coordinator: Yi-Wen Chen

* [JCT3V-K0042](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2454) Simplification of DMM table derivation
* [JCT3V-K0044](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2456) Clean up of 3D-HEVC specification
* [JCT3V-K0048](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2460) Clean up on DBBP location derivation
* Vertical MV restriction
* [JCT3V-K0050](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2462) Proposed HLS Cleanup for 3D-HEVC
* [JCT3V-K0052](http://phenix.it-sudparis.eu/jct3v/doc_end_user/current_document.php?id=2464) Proposed TMVP Fix and CU syntax cleanup for 3D-HEVC
* Chroma 4:0:0 for depth

### Coding performance

***MV-HEVC:*** The coding results for MV-HEVC are identical to results obtained with version HTM-13.1.

***3D-HEVC: HTM-14.0 vs. HTM-13.1 (CTC, three view configuration)***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | video  video rate | video  total rate | synth  total rate | enc time | dec time | ren time |
| Balloons | -0,2% | -0,2% | -0,3% | 98,7% | 97,6% | 95,6% |
| Kendo | -0,1% | -0,4% | -0,4% | 98,1% | 88,7% | 91,8% |
| Newspaper\_CC | -0,2% | -0,3% | -0,3% | 97,9% | 91,4% | 91,1% |
| GT\_Fly | -0,3% | -0,3% | -0,2% | 98,5% | 91,8% | 94,6% |
| Poznan\_Hall2 | -0,2% | -0,9% | -1,2% | 99,2% | 97,7% | 95,7% |
| Poznan\_Street | -0,1% | -0,2% | -0,1% | 100,2% | 90,3% | 97,1% |
| Undo\_Dancer | -0,9% | -1,0% | -0,8% | 100,0% | 93,9% | 98,0% |
| Shark | -0,3% | -0,3% | -0,1% | 99,9% | 96,7% | 96,9% |
| 1024x768 | -0,2% | -0,3% | -0,3% | 98,2% | 92,5% | 92,8% |
| 1920x1088 | -0,4% | -0,5% | -0,5% | 99,6% | 94,1% | 96,5% |
| **average** | **-0,3%** | **-0,4%** | **-0,4%** | **99,0%** | **93,5%** | **95,1%** |

## Version HTM-14.1

Starting point for development of HTM-14.1 was HTM-14.0. Development of HTM-14.1 was conducted in a single track.

### Integrated items

Various clean-ups and bug fixes.

### Coding performance

The coding performance is identical to HTM-14.0.

# Update of HTM software to HM-16.5

Based on HTM-14.0 the update to HM-16.5 has been started according to the following plan. Completed items are marked green. Work in progress or in queue is marked blue.

1. Disabling of 3D-HEVC tools in HTM-14.1 and plain merge of HM-16.5.
2. Alignment and reactivation of MV-HEVC HLS, 3D-HEVC HLS and VSO.
3. Alignment and reactivation of 3D-HEVC parallel tracks:
   1. Parallel track *Intra Tools*
      1. DMMs
      2. Intra SDC
      3. DLT
      4. Single depth mode
   2. Parallel track *Inter tools I*
      1. TMVP ( Alt ref idx + IV MV scaling)
      2. Illumination compensation
      3. QTL
   3. Parallel track *Inter tools II*
      1. NBDV
      2. Depth Refinement
      3. Parallel track *Inter tools IIa*
         1. DBBP
         2. Residual prediction
      4. Parallel track *Inter tools IIb*
         1. Merge list construction
         2. VSP candidates
         3. IV MV, IV MV shift , DV, DV shift candidates
         4. MPI candidates
4. Merge of tracks *Inter tools IIa* + *Inter tool IIb*
5. Merge of tracks *Intra tools* + *Inter tools I* + *Inter tools II*
6. Integration of Inter SDC

# MV-HEVC Software Draft 3

The MV-HEVC software draft 3 (JCT3V-K1009) has been released. The software has been generated by removing 3D-HEVC related source code and configuration files from HTM-14.0. The software can also be accessed using the svn:

https://hevc.hhi.fraunhofer.de/svn/svn\_3DVCSoftware/branches/HTM-14.0-MV-draft-3

The related document has been submitted to the MPEG secretariat for DAM ballot.

# 3D-HEVC Software Draft 1

The 3D-HEVC software draft 1 (JCT3V-K1012) has been released. The software corresponds to HTM-14.0. The software can also be accessed using the svn:

https://hevc.hhi.fraunhofer.de/svn/svn\_3DVCSoftware/tags/HTM-14.0

The related document has been submitted to the MPEG secretariat for PDAM ballot.

# Open issues

* Most of MV-and 3D-HEVC SEI messages are not supported yet.
* Some items related to MV-HEVC decoding processes (e.g. hybrid scalability, correct bumping, POC reset) have not been integrated yet.
* Issues listed in the bug tracking system that have an impact on conformance:

#100 num\_extra\_slice\_header\_bits is set equal to 3 by the encoder, although only values in the range of 0 to 2 are allowed.

#101 Camera parameters are not present in slice headers of pictures in depth layers, but derived from texture. However, according to the specification, they should be.

* Other minor issues in the bug tracking system.

# Recommendations

The recommendations of the MV-HEVC and 3D-HEVC Software Integration AHG are:

* Continue development of HTM-15 based on HM-16.5.
* Continue to identify bugs and discrepancies with text and address them.
* Discuss on how to address open issues.