

**Title:** JCT-3V AHG Report: 3D-HEVC Software Integration (AHG5)

**Status:** AHG report input to JCT-3V

**Purpose:** AHG report

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**Source:** AHG

## Abstract

This report summarizes the activities of the AhG on 3D-HEVC Software Integration that have taken place between the 5<sup>th</sup> JCT-3V meeting in Vienna and the 6<sup>th</sup> JCT-3V meeting in Geneva. Activities focused on the integration of tools adopted at the 5<sup>th</sup> meeting into a common code base.

## 1 Mandates

Title	Chairs	Mtg
<p><b>3D-HEVC Software Integration (AHG5)</b></p> <ul style="list-style-type: none"> <li>• Coordinate development of the HTM software and its distribution to JCT-3V members</li> <li>• Produce documentation of software usage for distribution with the software</li> <li>• Prepare and deliver HTM 8.0 software version and the reference configuration encodings according to JCT3V-E1100 based on common conditions suitable for use in most core experiments (expected within four weeks after the meeting).</li> <li>• Prepare and deliver HTM 8.1 software that include additional items not integrated into the 8.0 version (expected within three weeks after the 8.0 software release).</li> <li>• Perform analysis and reconfirmation checks of the behaviour of technical changes adopted into the draft design, and report the results of such analysis.</li> <li>• Suggest configuration files for additional testing of tools.</li> <li>• Coordinate with MV-HEVC Draft and 3D-HEVC Test Model editing AhG to identify any mismatches between software and text.</li> </ul>	<p>G. Tech L. Zhang (co-chairs) Y. Chang K. Wegner (vice chairs)</p>	<p>N</p>

## 2 HTM tool integration

Development of the software was co-ordinated with the parties needing to integrate changes. Development of HTM-8.0 was conducted in three parallel tracks each performing sequential integration. Development of each branch has been supervised by one software coordinator. Software of all three tracks was merged by the software coordinators.

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\\_3DVCSsoftware/tags/](https://hevc.hhi.fraunhofer.de/svn/svn_3DVCSsoftware/tags/)

Anchor bitstreams have been created and uploaded to:

<ftp.hhi.fraunhofer.de>; login: mpeg3dv\_guest; path: /MPEG-3DV/HTM-Anchors/

Multiple versions 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.

### 2.1 Version HTM-8.0

Starting point for development of HTM-8.0 was HTM-DEV-2.0.

#### 2.1.1 Integrated items

***Track 1 (VSP, disparity derivation, coordinated by Yulin Chang):***

[JCT3V-E0172](#) CE2: Bug fix for issues caused by reference view

[JCT3V-E0182](#) CE3: A bug-fix for the texture merging candidate in 3D-HEVC

[JCT3V-E0207](#) CE1: Adaptive block partitioning for VSP

[JCT3V-E0208](#) CE1: Clipping operations in VSP

[JCT3V-E0141](#) CE2: Clipping in depth-based disparity vector derivation

[JCT3V-E0126](#) CE3: Merge candidates derivation from vector shifting

[JCT3V-E0142](#) CE2: Simplified NBDV and improved disparity vector derivation

***Track 2 (Misc, coordinated by Li Zhang):***

[JCT3V-E0046](#) CE4: Resampling in IC parameter derivation and 4x4 Chroma removal

[JCT3V-E0173](#) CE3: Fast encoder decision for texture coding

[JCT3V-E0168](#) CE4: Results on complexity reduction of bi-prediction for illumination compensation

[JCT3V-E0170](#) CE3: motion data buffer reduction for 3D-HEVC

[JCT3V-E0156](#) CE6: Results on Simplified Inter Mode Coding of Depth

***Track 3 (Depth Intra, coordinated by Gerhard Tech):***

[JCT3V-E0146](#) CE5: DMM simplification and signalling

[JCT3V-E0158](#) CE6: Results on Removal of DC from SDC Mode

[JCT3V-E0159](#) CE5: Results on Removal of Overlap between DMM1 and DMM3

[JCT3V-E0204](#) CE5: Results on Simplified Binarization for depth\_intra\_mode

[JCT3V-E0238](#) CE5: Fast Intra Prediction Mode Selection for Intra Depth Map Coding

[JCT3V-E0242](#) CE5: On DMM simplification

[JCT3V-E0117](#) CE6: Simplified DC calculation for SDC

## **Fixes**

Bug fix of renderer

Other minor fixes.

## **2.1.2 Coding performance**

**MV-HEVC:** The coding results for MV-HEVC are identical to results obtained from version HTM-DEV-2.0.

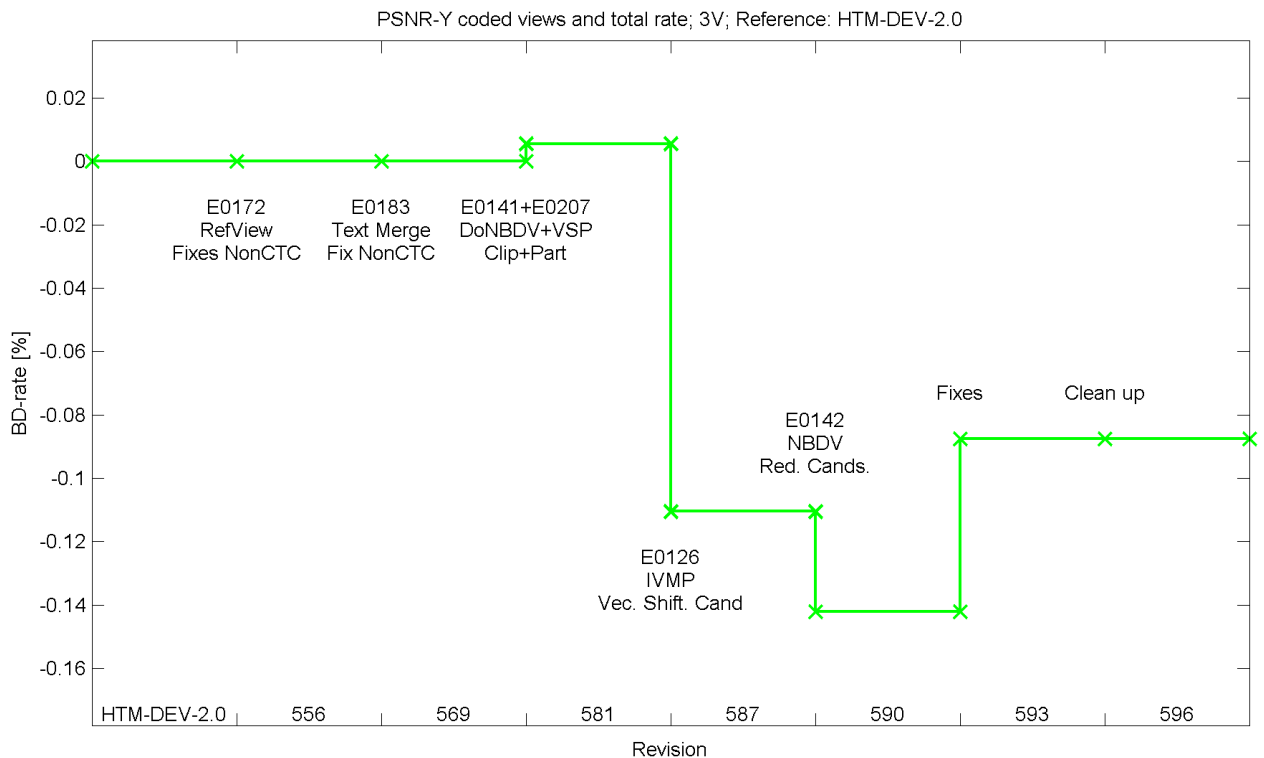
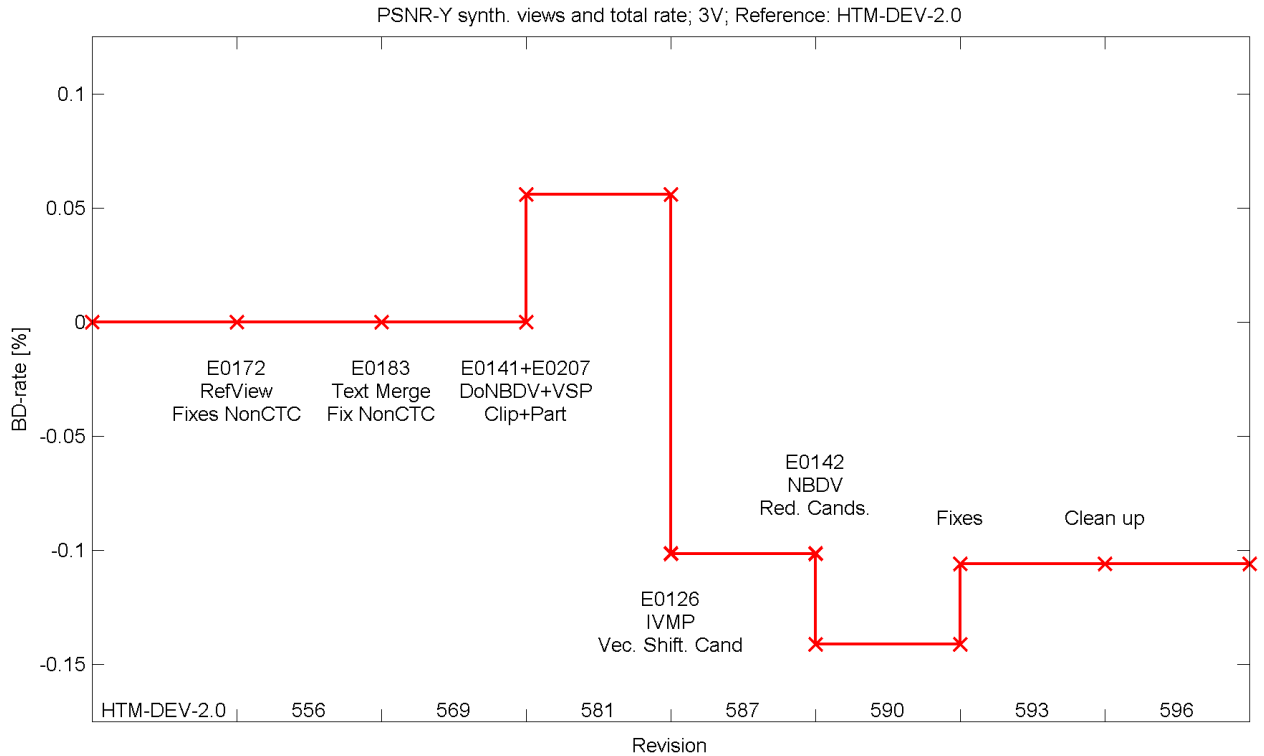
**3D-HEVC: HTM-8.0 vs. HTM-DEV-2.0 (CTC, three view configuration, fixed renderer)**

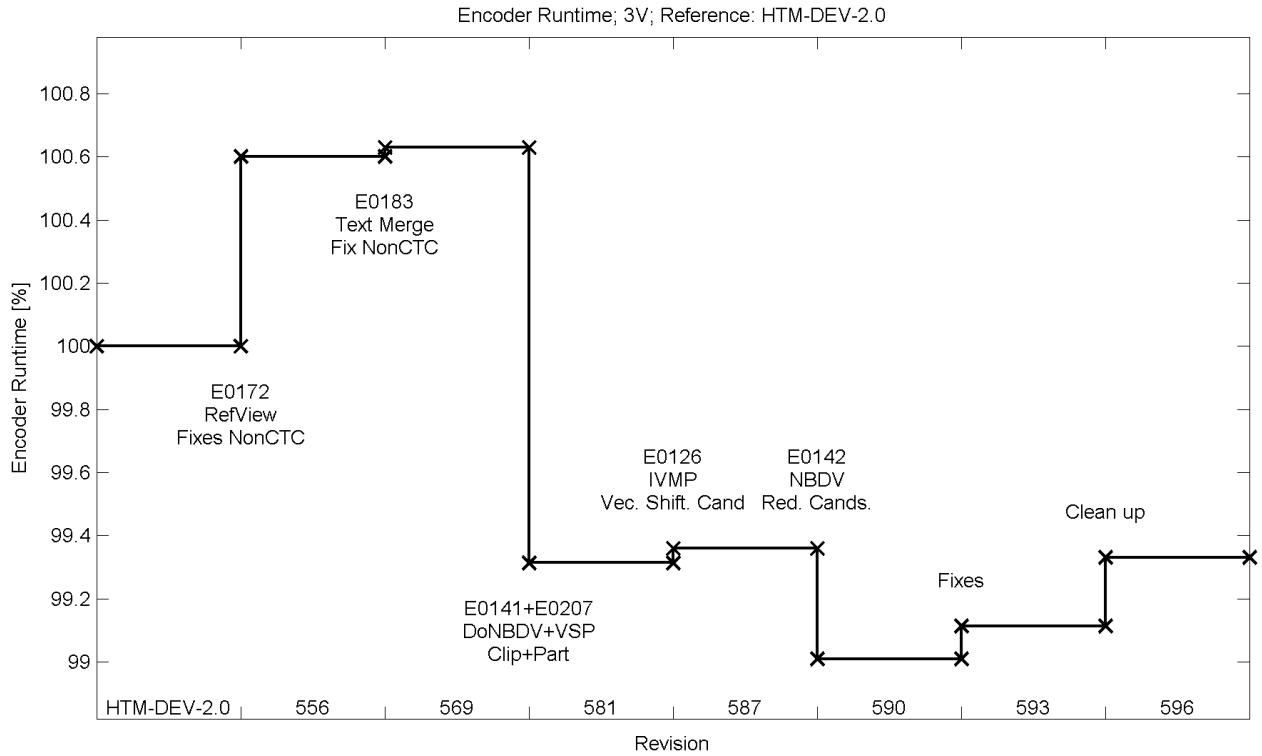
	video video rate	video total rate	synth total rate	enc time	dec time	ren time
Balloons	-0,1%	0,0%	-0,7%	53,7%	103,0%	100,3%
Kendo	-0,1%	0,2%	-0,7%	57,0%	105,1%	101,0%
Newspaper_CC	-0,2%	0,2%	-0,7%	50,9%	102,5%	100,2%
GT_Fly	-0,3%	0,0%	-1,5%	61,4%	91,1%	101,8%
Poznan_Hall2	-0,4%	0,1%	-1,8%	42,9%	105,0%	100,3%
Poznan_Street	-0,1%	0,1%	-0,4%	46,2%	106,3%	99,8%
Undo_Dancer	0,2%	0,4%	-1,1%	52,6%	102,0%	99,8%
1024x768	-0,1%	0,1%	-0,7%	53,9%	103,5%	100,5%
1920x1088	-0,1%	0,1%	-1,2%	50,8%	101,1%	100,4%
<b>average</b>	-0,1%	0,1%	-1,0%	52,1%	102,1%	100,5%

### 2.1.3 History of revisions

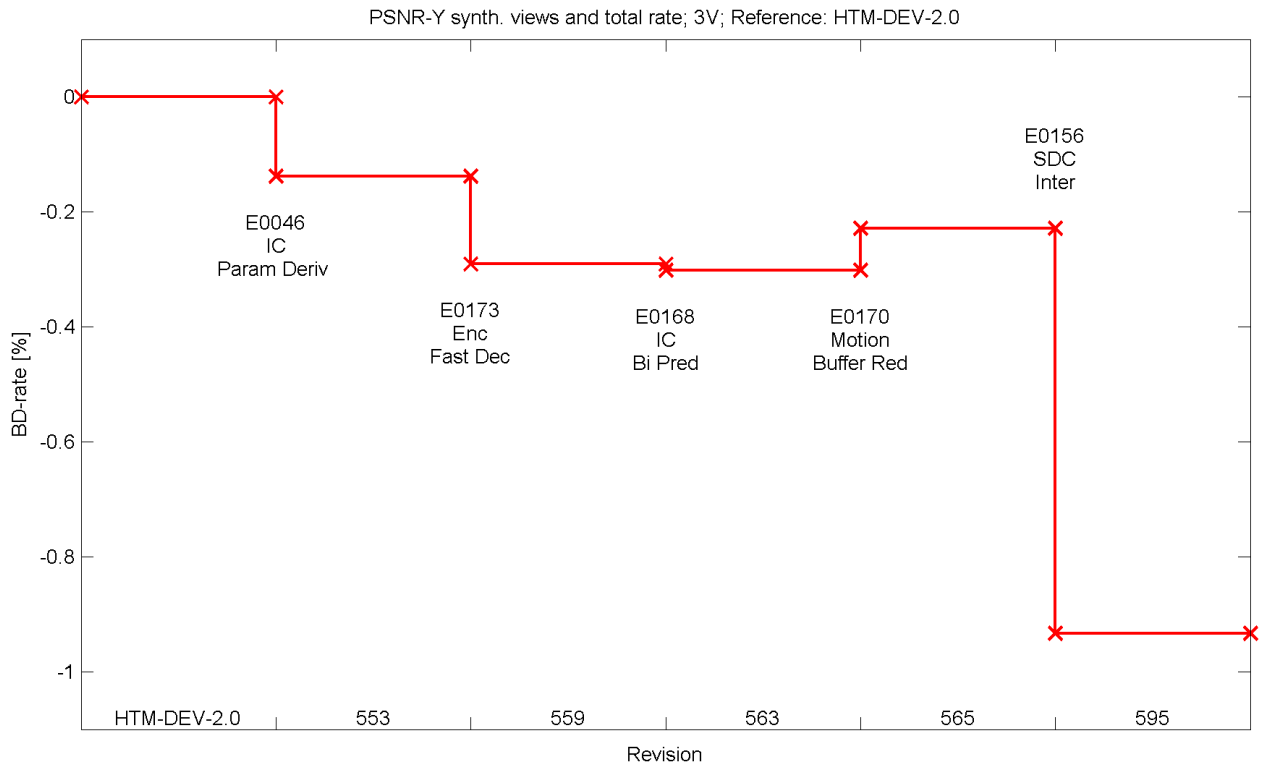
The following sections give a brief summary of average rate savings and runtimes of the different software revisions produced during the integration the period. Results are not cross verified. Simulations were performed using CTC for the three view case.

#### 2.1.3.1 Track 1 (VSP, Disparity Derivation)

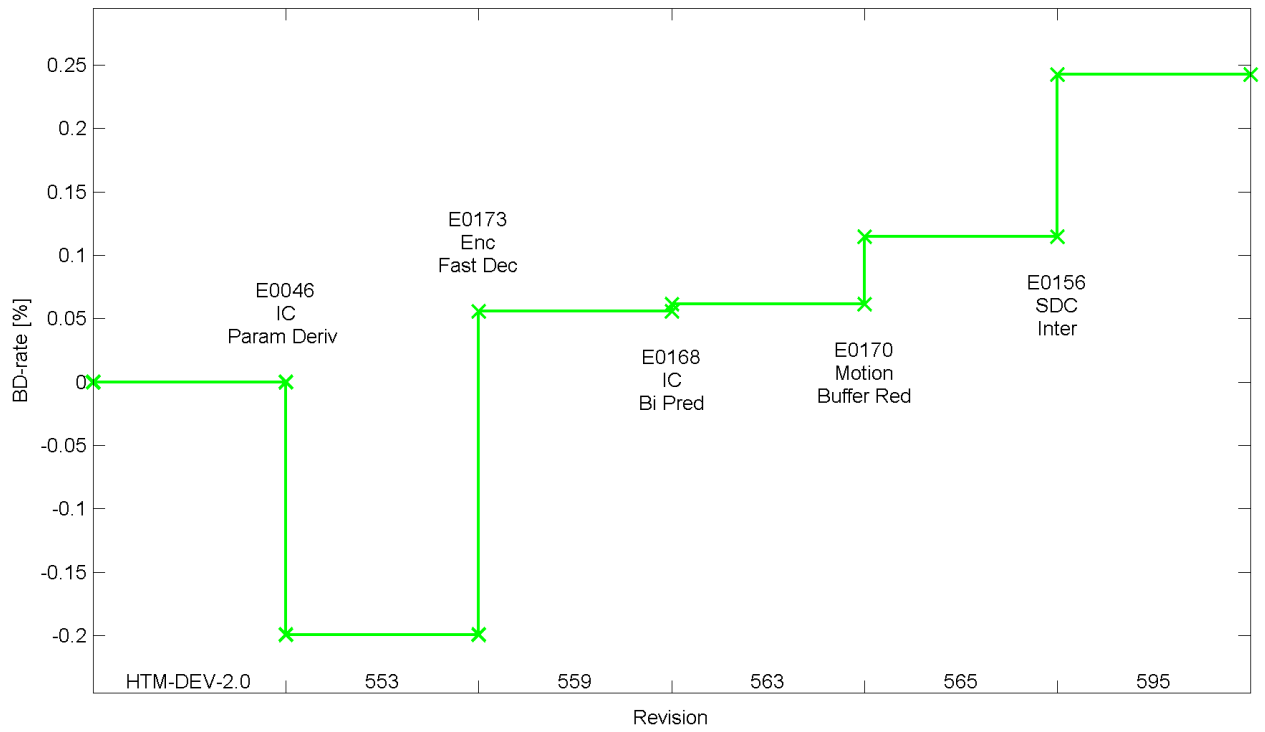




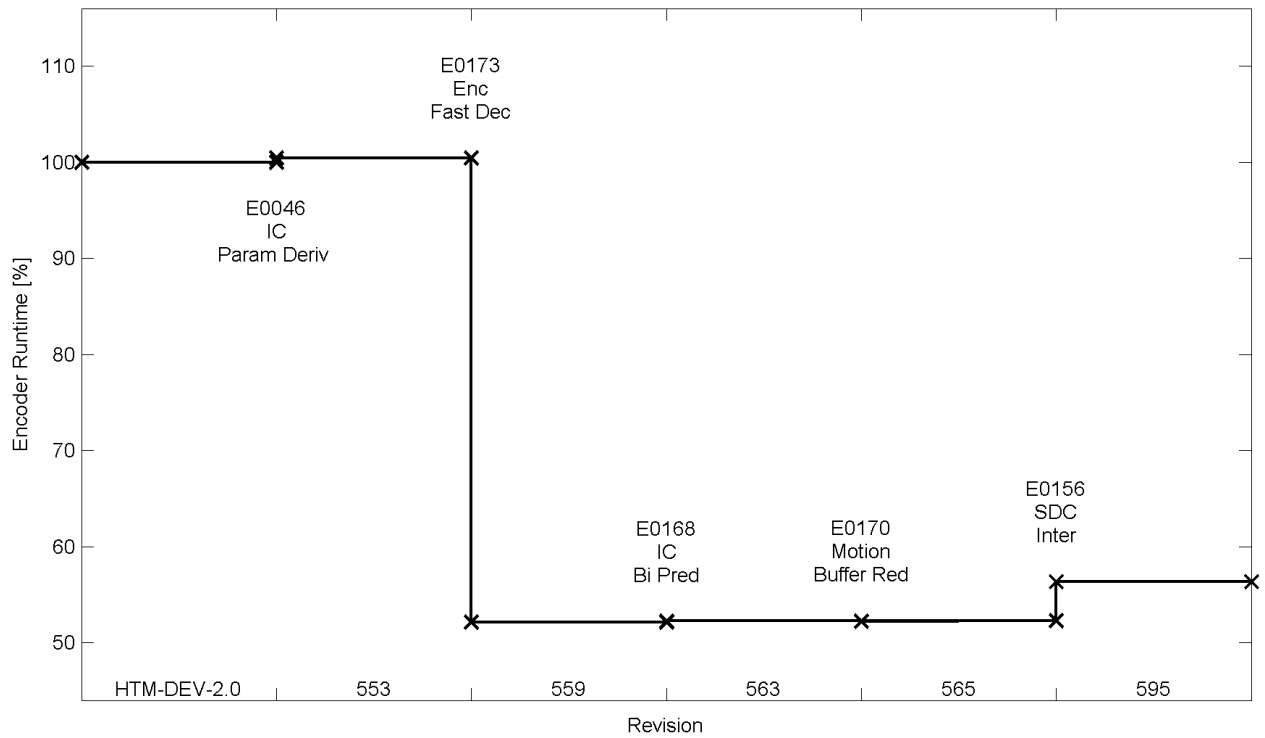
### 2.1.3.2 Track 2 (Miscellaneous)



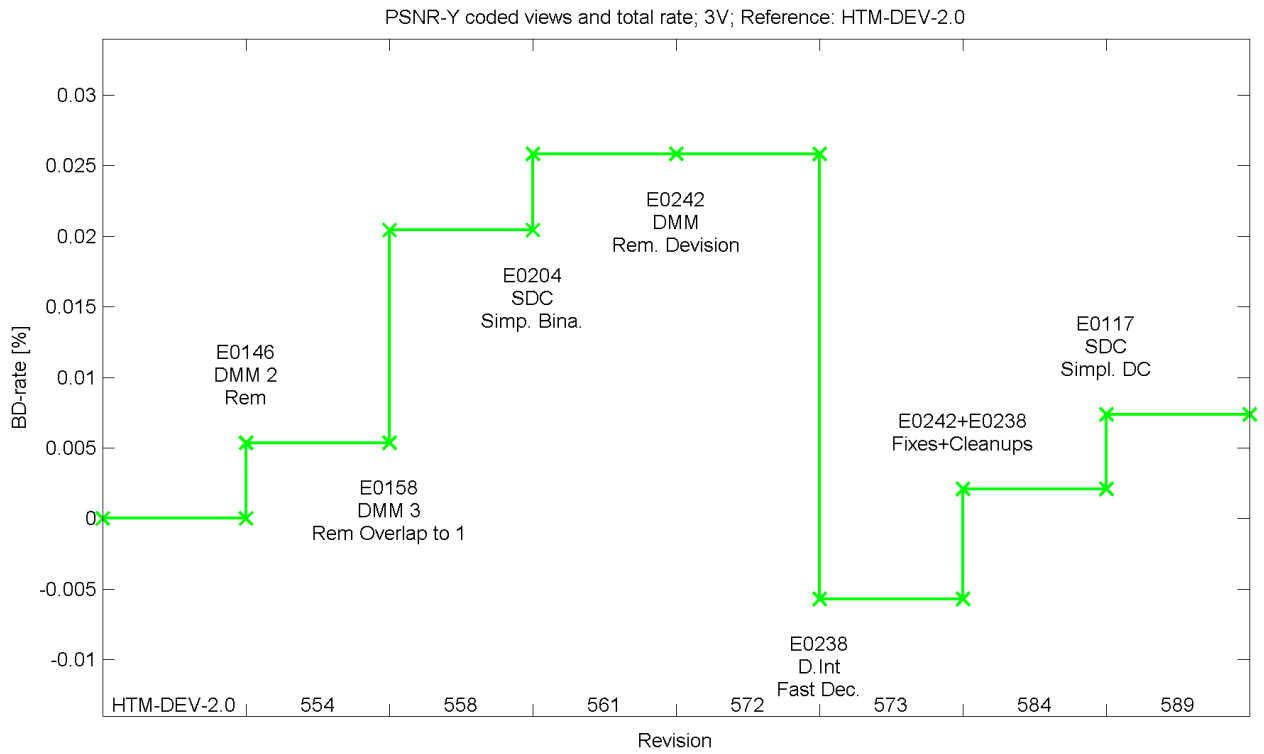
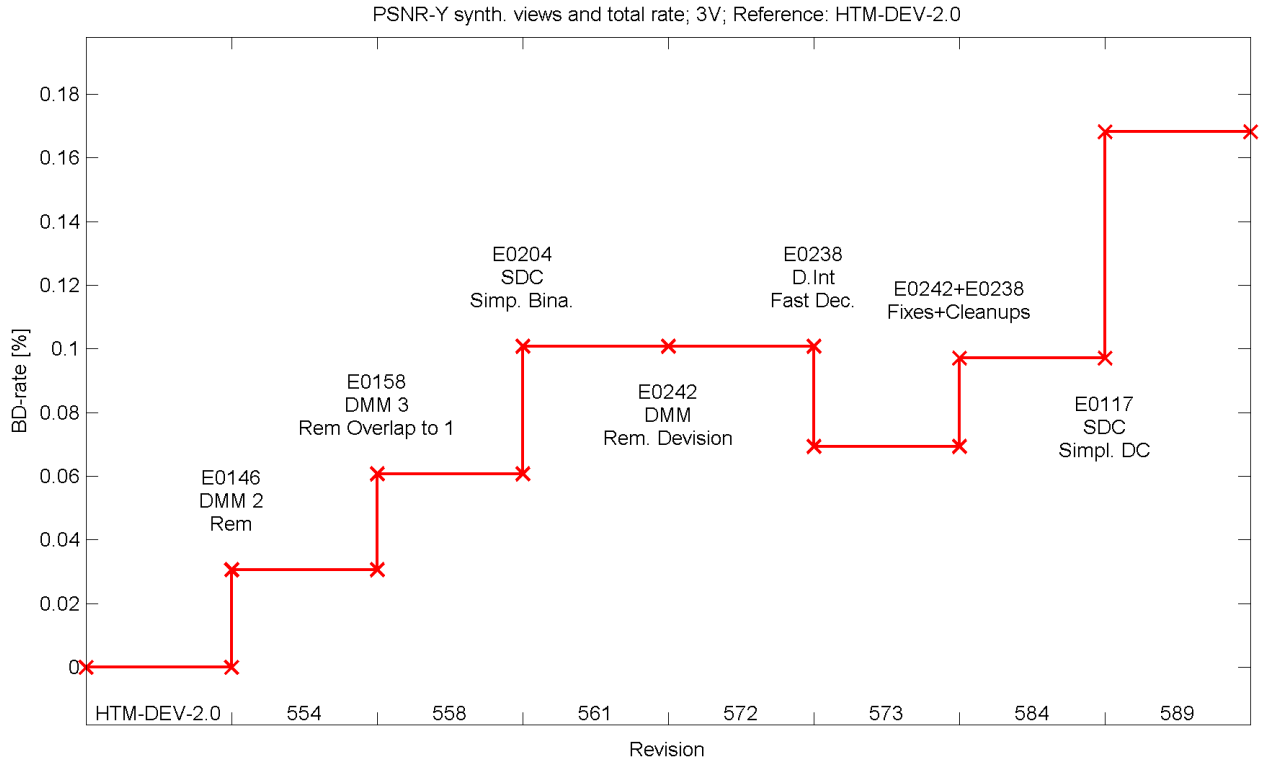
PSNR-Y coded views and total rate; 3V; Reference: HTM-DEV-2.0

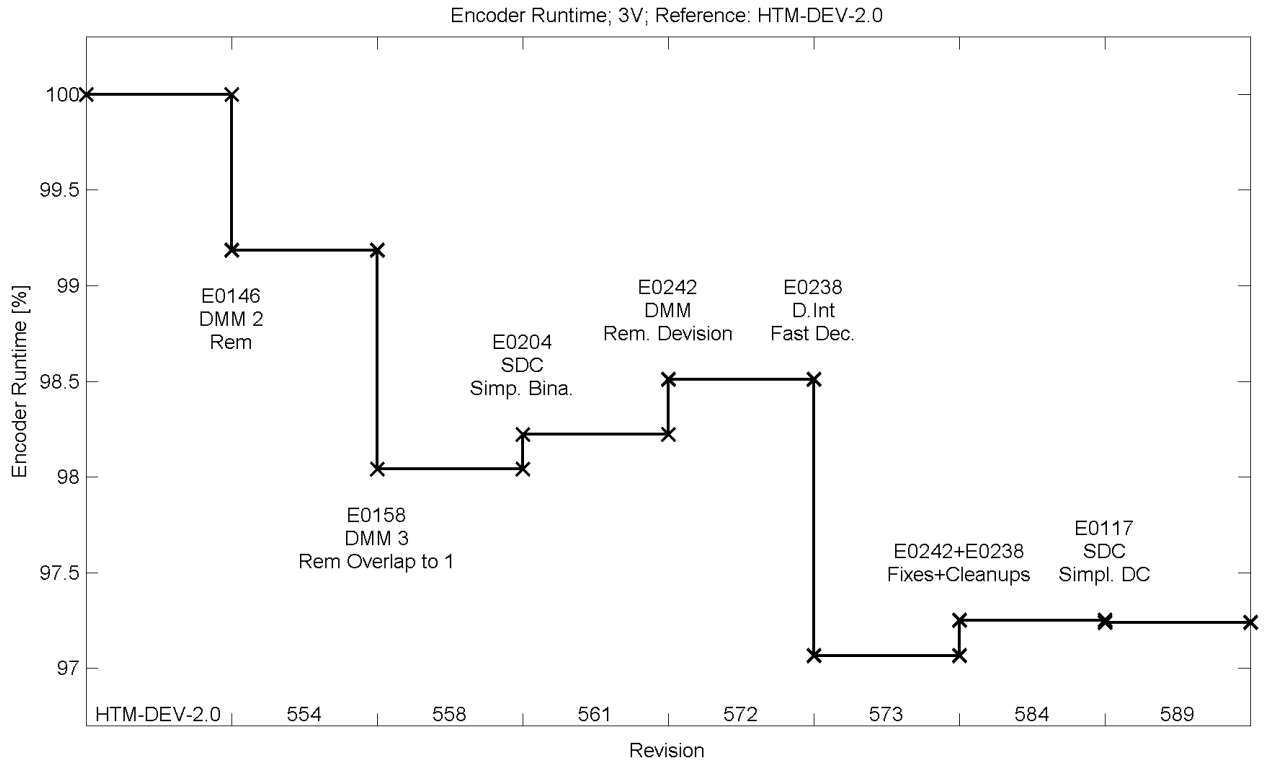


Encoder Runtime; 3V; Reference: HTM-DEV-2.0

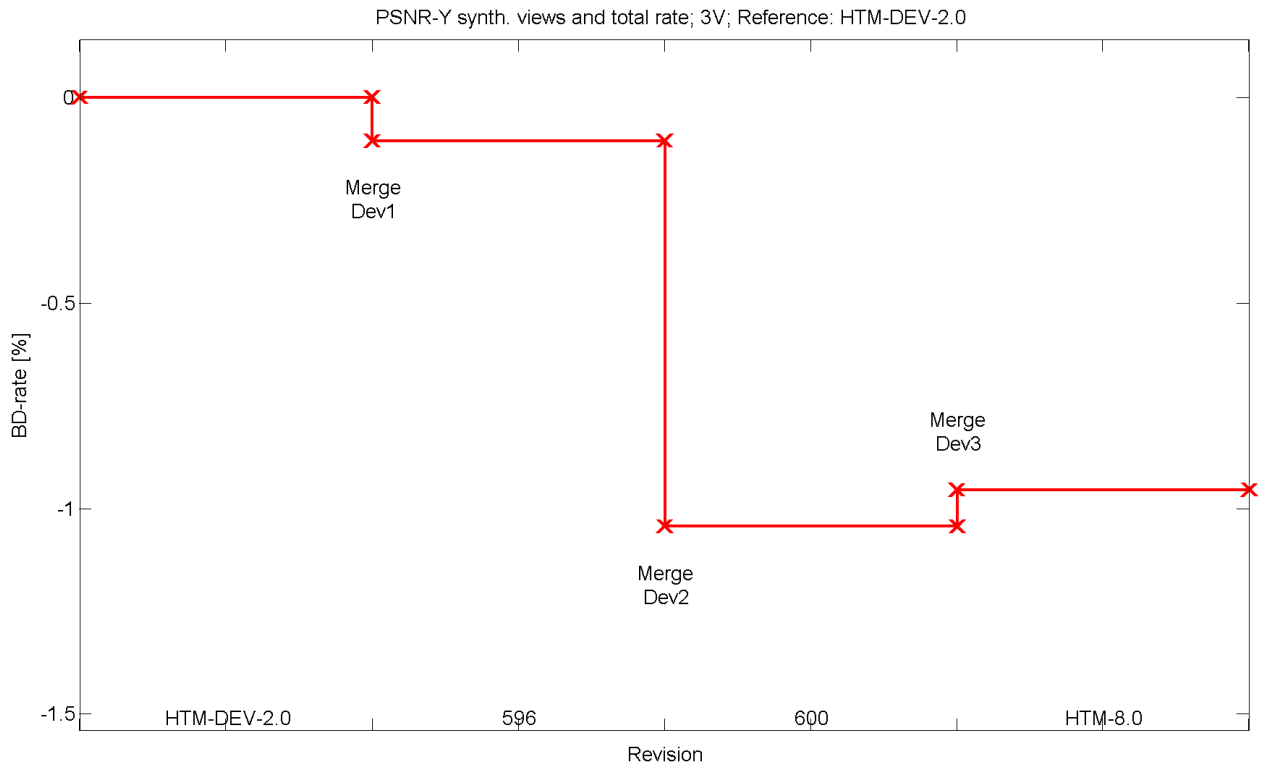


### 2.1.3.3 Track 3 (Depth Intra)

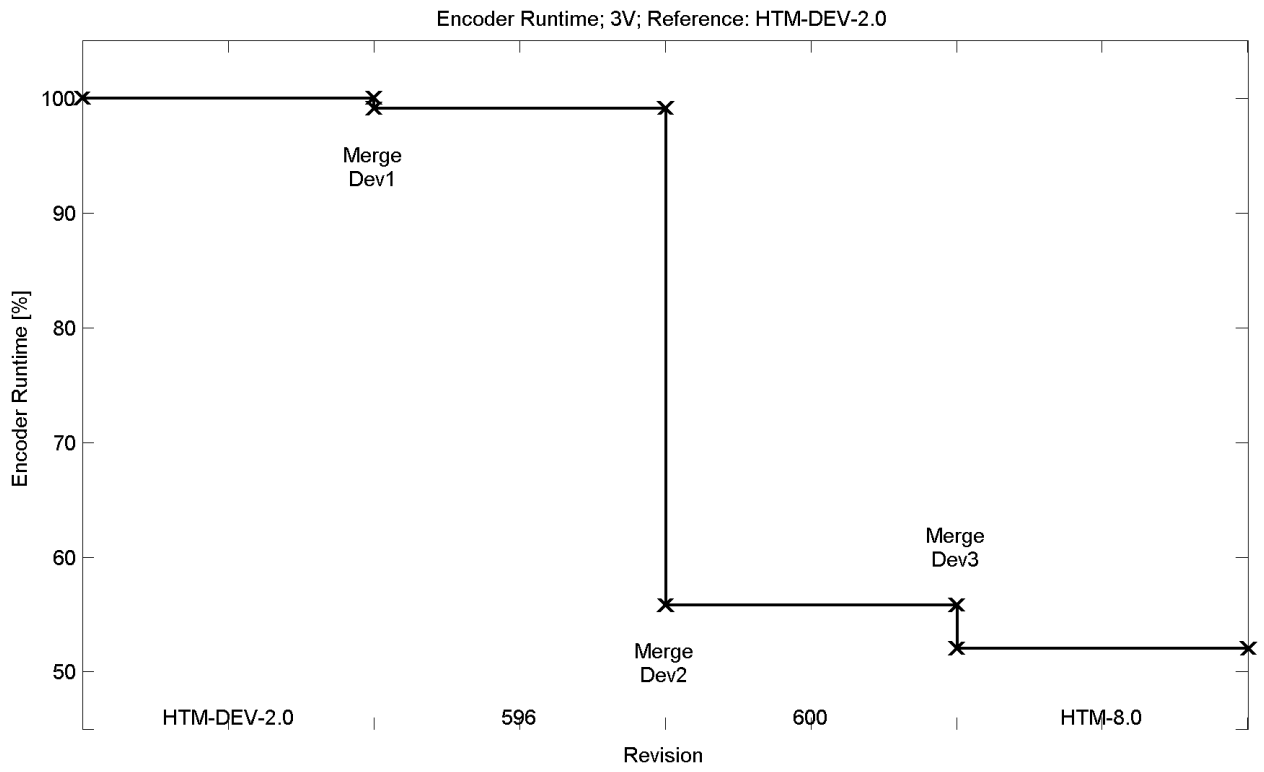
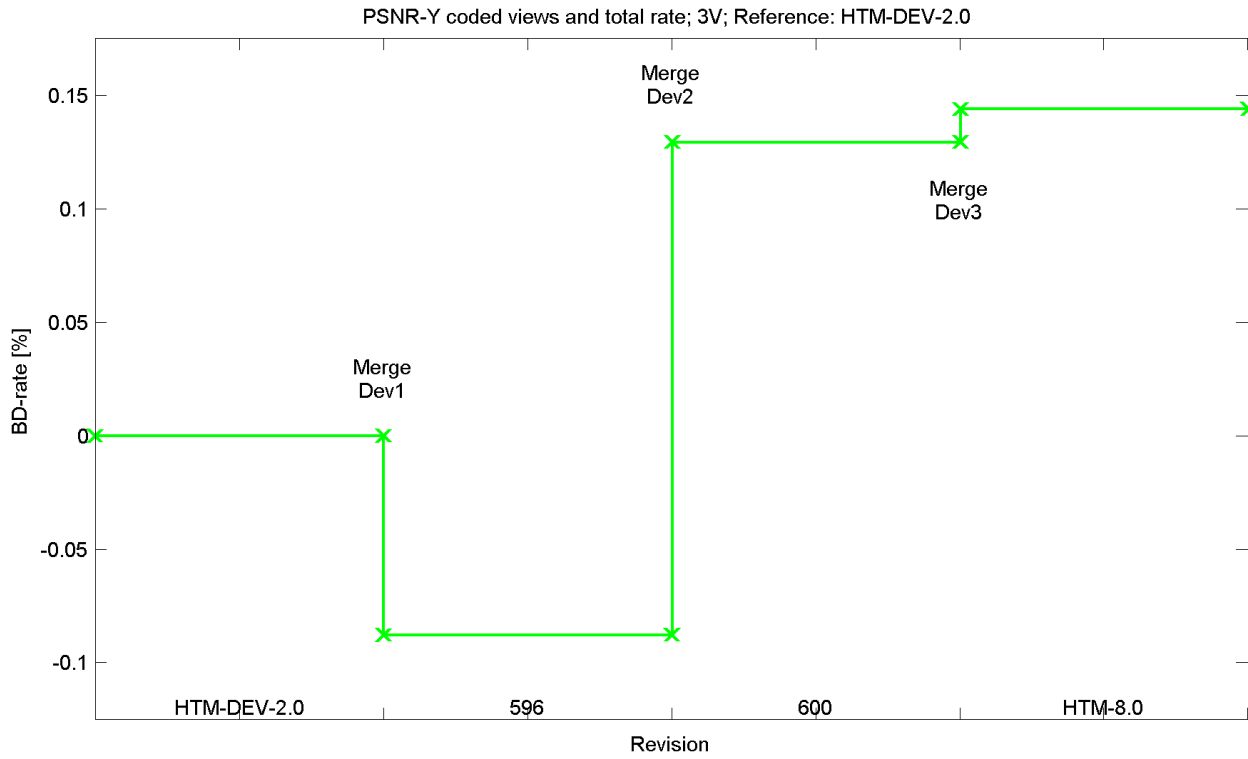




### 2.1.3.4 Merge of tracks







## 2.2 Version HTM-8.1

### 2.2.1 Integrated items

- MV-HEVC 5 HLS

### 2.2.2 Coding performance

*MV-HEVC:HTM-8.1 vs. HTM-8.0 (CTC, three view configuration)*

	video PSNR / video bitrate
Balloons	-0,1%
Kendo	-0,1%
Newspaper_CC	-0,1%
GT_Fly	0,0%
Poznan_Hall2	-0,1%
Poznan_Street	-0,1%
Undo_Dancer	0,0%
1024x768	-0,1%
1920x1088	-0,1%
<b>average</b>	<b>-0,1%</b>

*3D-HEVC: HTM-8.1 vs. HTM-8.0 (CTC, three view configuration)*

	video video rate	video total rate	synth total rate	enc time	dec time	ren time
Balloons	-0,1%	-0,1%	-0,1%	98,9%	98,7%	98,8%
Kendo	-0,1%	-0,1%	-0,1%	100,3%	104,5%	99,1%
Newspaper_CC	-0,1%	-0,1%	-0,1%	100,5%	100,4%	100,7%
GT_Fly	0,0%	0,0%	0,0%	98,9%	98,0%	88,5%
Poznan_Hall2	-0,1%	-0,2%	-0,2%	100,3%	113,4%	100,6%
Poznan_Street	0,0%	-0,1%	-0,1%	99,0%	97,2%	97,8%
Undo_Dancer	0,0%	0,0%	0,0%	99,5%	93,4%	95,6%
1024x768	-0,1%	-0,1%	-0,1%	99,9%	101,2%	99,5%
1920x1088	0,0%	-0,1%	-0,1%	99,4%	100,5%	95,6%
<b>average</b>	<b>0,0%</b>	<b>-0,1%</b>	<b>-0,1%</b>	<b>99,6%</b>	<b>100,8%</b>	<b>97,3%</b>

## 2.3 *Version HTM-8.2*

### 2.3.1 Integrated items

- FCO
- Rate control
- Macro Cleanup
- Update to HM-12.0 (Field coding and Multiview coding need further harmonization)

### 2.3.2 Coding performance

*MV-HEVC*: Insignificant increase of bitrate.

*3D-HEVC*: Insignificant increase of bitrate.

## 3 Open issues

- On integration of fast encoder decisions ([JCT3V-E0238](#), [JCT3V-E0173](#)) cfg-file parameters for enabling/disabling have not been integrated.
- Some minor mismatches related to 3D-HEVC HLS.
- MV-HEVC / 3D-HEVC SEI messages missing.
- Other minor issues are listed in the bug tracking system.

## 4 Recommendations

The recommendations of the 3D-HEVC Software integration group are:

- Develop reference software HTM version 9 based on HTM-8.2 and improve its quality
- When a proposal is adopted to discuss how to enable it in the HTM software (e.g. encoder parameter / parameter set flag, or always on).
- Continue to identify bugs and discrepancies with text, and address them.
- Fix open issues.
- Discuss on how to address open issues.