

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

Status: AHG report input to JCT-3V

Purpose: AHG report

Author(s) or Contact(s): Gerhard Tech (Fraunhofer HHI) Email: gerhard.tech@hhi.fraunhofer.de
Li Zhang (Qualcomm) lizhang@qti.qualcomm.com
YuLin Chang (Mediatek) yulin.chang@mediatek.com
Krzysztof Wegner (Poznan Univ. of Tech.) kwegner@multimedia.edu.pl

Source: AHG

Abstract

This report summarizes the activities of the AhG on 3D-HEVC Software Integration that have taken place between the 3rd meeting in Geneva (17-23 January 2013) and the 4th JCT-3V meeting in Incheon (20–26 April 2013). Activities focused on the integration of tools adopted at the 3rd meeting into a common code base, the setup of a bug tracking system and the update of HTM software to HM 10.0.

1 Mandates

Title	Chairs	Mtg
<p>3D-HEVC Software Integration (AHG5)</p> <ul style="list-style-type: none"> • 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 6.0 software version and the reference configuration encodings according to JCT3V-C1100 based on common conditions suitable for use in most core experiments (expected within 4 weeks after the meeting). • Prepare and deliver HTM 6.1 software that include additional items not integrated into the 6.0 version (expected within 2 weeks after the 6.0 software release). • Prepare the migration of high-level syntax part corresponding to JCT3V-C1004 into HM10 (basic functionalities for multiview coding). • Perform analysis and reconfirmation checks of the behaviour of technical changes adopted into the draft design, and report the results of such analysis. • Suggest configuration files for additional testing of tools. • Coordinate with MV-HEVC Draft and 3D-HEVC Test Model editing AhG to identify any mismatches between software and text. • Set up a bug tracking system. 	<p>G. Tech L. Zhang (co-chairs) Y. Chang K. Wegner (vice chairs)</p>	<p>N</p>

2 Tool integration to HTM

Development of the software was co-ordinated with the parties needing to integrate changes. Development of HTM-6.0 was conducted in three parallel tracks each performing sequential integration. Software of all three tracks was merged by the software coordinators. HTM-6.1 was developed using a single track.

Prior to each integration source code to be integrated has been reviewed by the software coordinator and suggestions for improvement have been made to the integrators when necessary.

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/

Anchor bitstreams have been created and uploaded to:

<ftp.hhi.fraunhofer.de>; login: mpeg3dv_guest; path: /MPEG-3DV/HTM-Anchors/

2.1 History of software tags

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.

2.1.1 Version HTM-6.0

2.1.1.1 Integrated items

Track 1 (most tools related to Depth Intra):

[JCT3V-C0034](#) CE6.h Modified deltaDC processing for DMM

[JCT3V-C0160](#) CE6.h Modified depth coding in random access units

[JCT3V-C0154](#) CE6.h Reference samples sub-sampling for SDC and DMM

[JCT3V-C0044](#) CE6.h Simplification of Depth Modeling Mode 3 adopt JCT3V-C0044, solution 3

[JCT3V-C0046](#) CE5.h related: Bug Fix and Extension of Illumination Compensation Adopt(SW): first and second fixes, enabling IC on depth

[JCT3V-C0096](#) CE6.h Results on Improved Simple Depth, removal of DMM2

[JCT3V-C0143](#) CE6.h Simplification of Simplified Depth Coding SW bug fix (identical to C0068 and C0155)

Track 2 (most tools related to Merge):

[JCT3V-C0051](#) CE5.h Unification of inter-view candidate derivation for 3D-HEVC

[JCT3V-C0047](#) CE5.h Improved temporal motion vector prediction for merge

[JCT3V-C0138](#) CE4.h results on removal of parsing dependency for inter-view residual prediction Part that removes the parsing dependency. No action on removing interpolation of residual

[JCT3V-C0137](#) 3D-CE3.h results on removal of parsing dependency and picture buffers for motion parameter inheritance

[JCT3V-C0115](#) Alignment of inter-view vector scaling. Flag in VPS

[JCT3V-C0116](#) Inter-view vector scaling for AMVP

Track 3 (most tools related to Disparity Derivation):

[JCT3V-C0152](#) CE1.h: Backward View Synthesis Prediction using Neighbouring Blocks

[JCT3V-C0131](#) CE1.h: Depth-oriented neighbouring block disparity vector (DoNBDV) with virtual depth retrieval

[JCT3V-C0097/JCT3V-C0141](#) CE2.h related results on disparity vector derivation. Part 1 Adopt (priority order, identical to C0141)

[JCT3V-C0135](#) CE2.h related: Restriction on the temporal blocks for memory bandwidth reduction in DV derivation (All 3 Parts)

[JCT3V-C0129](#) Constrained DV for inter-view Adopt remove the constraint from the decoder, but not as suggested in JCT3V-C0129, but unconditionally (without flag).

[JCT3V-C0112](#) CE1.h related: Adaptive method for Depth Oriented Neighbouring Block Disparity Vector Method 4

[JCT3V-C0055](#) Bug fix for disparity vector derivation in 3D-HEVC (SW)

2.1.1.2 Coding performance

HTM-6.0 vs. HTM-5.1 (CTC, three view configuration)

	video video rate	video total rate	synth total rate	enc time	dec time	ren time
Balloons	-0,7%	-0,5%	-1,8%	94,9%	107,2%	101,9%
Kendo	-1,2%	-0,9%	-1,8%	93,2%	101,2%	100,9%
Newspaper_CC	-0,5%	0,3%	-3,6%	98,9%	109,6%	102,1%
GT_Fly	-2,5%	-2,1%	-2,1%	95,6%	106,3%	98,9%
Poznan_Hall2	-0,7%	-0,8%	-1,8%	96,7%	104,2%	101,3%
Poznan_Street	-1,2%	-0,5%	-2,6%	99,7%	110,3%	100,7%
Undo_Dancer	-2,4%	-2,0%	-1,8%	96,3%	102,7%	100,5%
1024x768	-0,8%	-0,4%	-2,4%	95,7%	106,0%	101,6%
1920x1088	-1,7%	-1,3%	-2,1%	97,1%	105,9%	100,4%
average	-1,3%	-0,9%	-2,2%	96,5%	105,9%	100,9%

2.1.2 Version HTM-6.1

2.1.2.1 Integrated Items

[JCT3V-C0170/JCT3V-C0132](#) CE2.h-related: Flexible Coding Order (FCO) and depth-first-based disparity derivation, DDV for FCO (non-cte) (SW only)

[JCT3V-C0223](#) Fixed to Weighted Prediction for 3D-HEVC

2.1.2.2 Coding performance

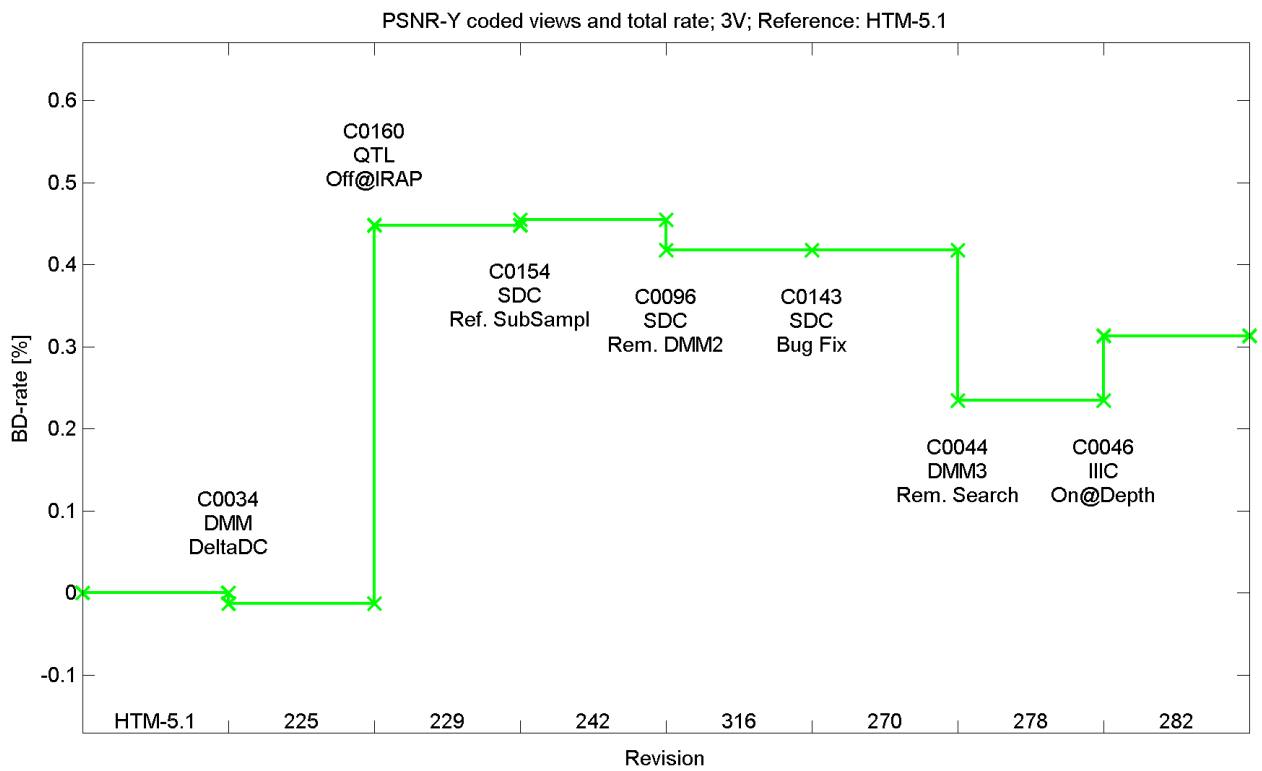
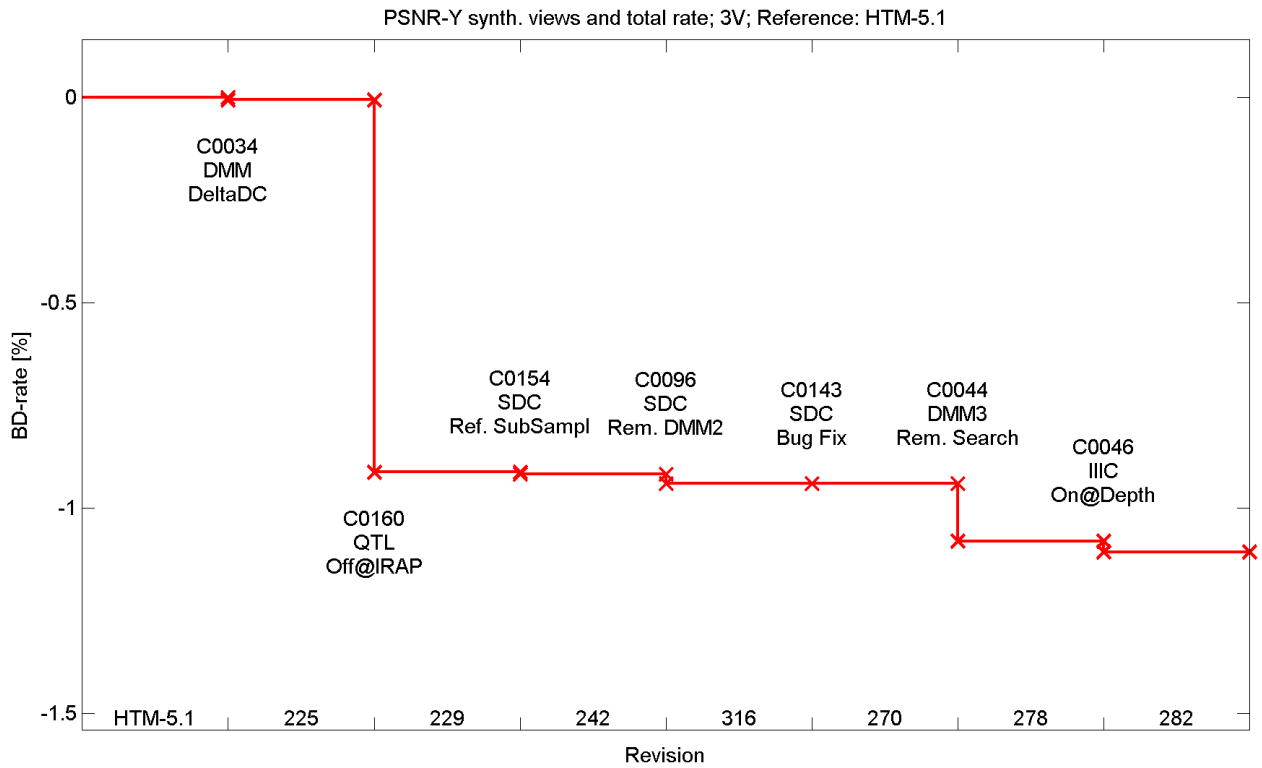
HTM-6.1 vs. HTM-6.0 (CTC, three view configuration)

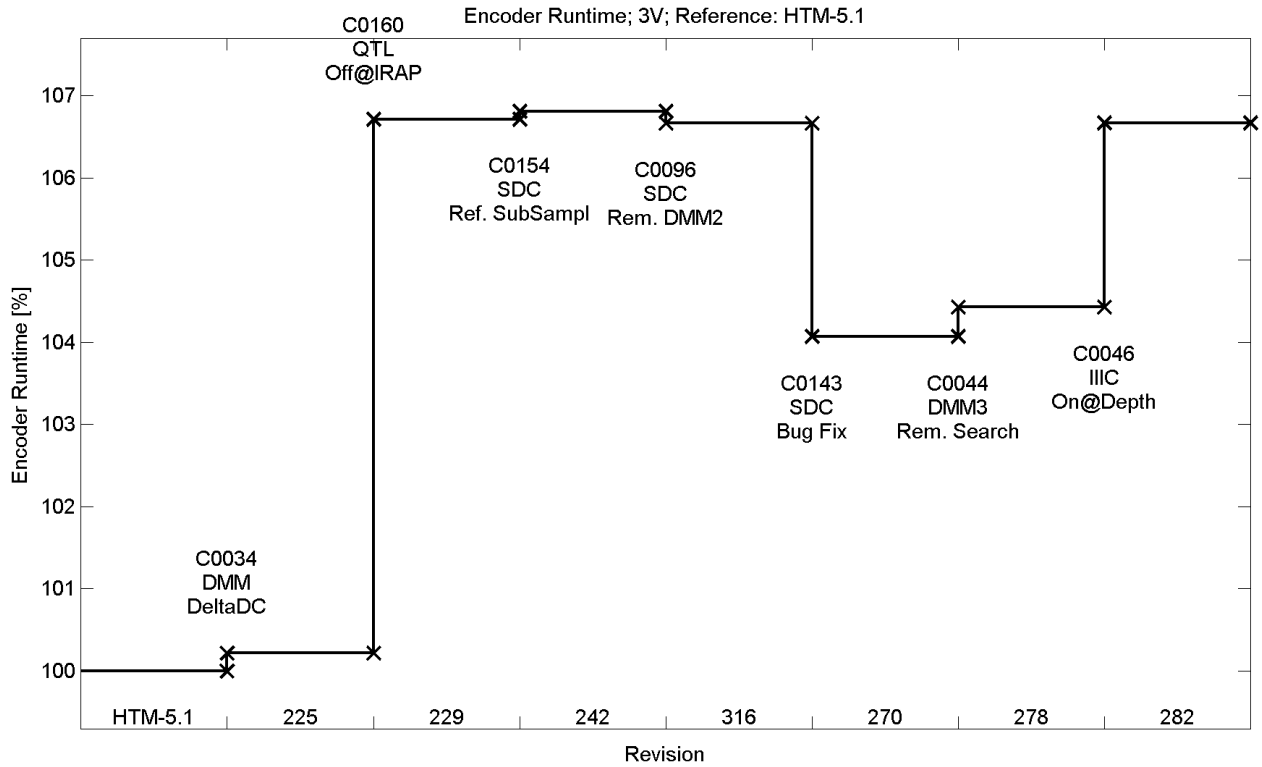
	video video rate	video total rate	synth total rate	enc time	dec time	ren time
Balloons	-0,3%	-0,2%	-0,3%	99,2%	97,3%	100,6%
Kendo	-0,1%	-0,1%	0,0%	100,3%	101,1%	100,0%
Newspaper_CC	-0,1%	0,0%	-0,1%	99,4%	95,2%	100,3%
GT_Fly	0,1%	0,1%	0,0%	100,2%	104,0%	103,1%
Poznan_Hall2	-0,1%	-0,1%	0,0%	99,7%	101,1%	100,3%
Poznan_Street	0,0%	0,0%	0,0%	99,8%	95,1%	104,9%
Undo_Dancer	0,0%	0,0%	0,0%	100,0%	102,8%	101,3%
1024x768	-0,1%	-0,1%	-0,1%	99,7%	97,8%	100,3%
1920x1088	0,0%	0,0%	0,0%	99,9%	100,8%	102,4%
average	-0,1%	-0,1%	-0,1%	99,8%	99,5%	101,5%

2.2 History of revisions

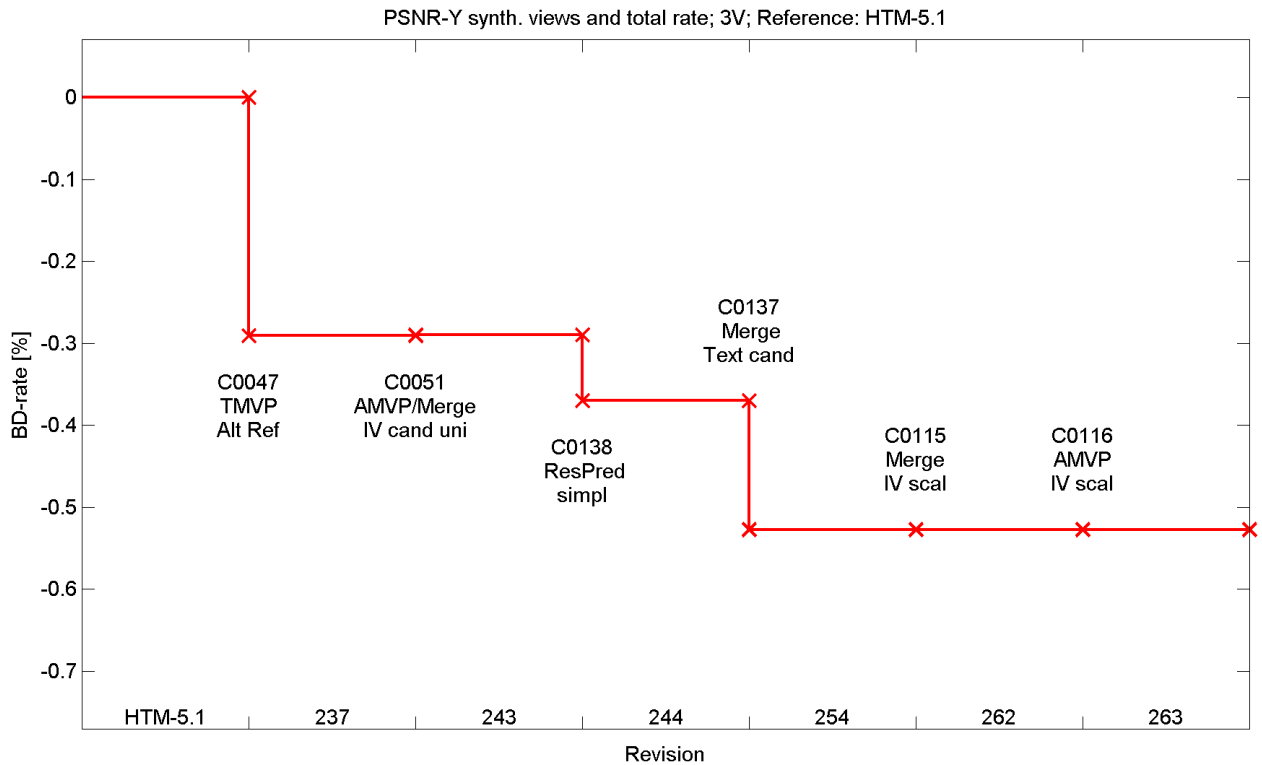
The following sections give a brief summary of average rate savings and runtimes of the different software revisions produced during the integration the period. Results are not cross verified.

2.2.1 Track 1

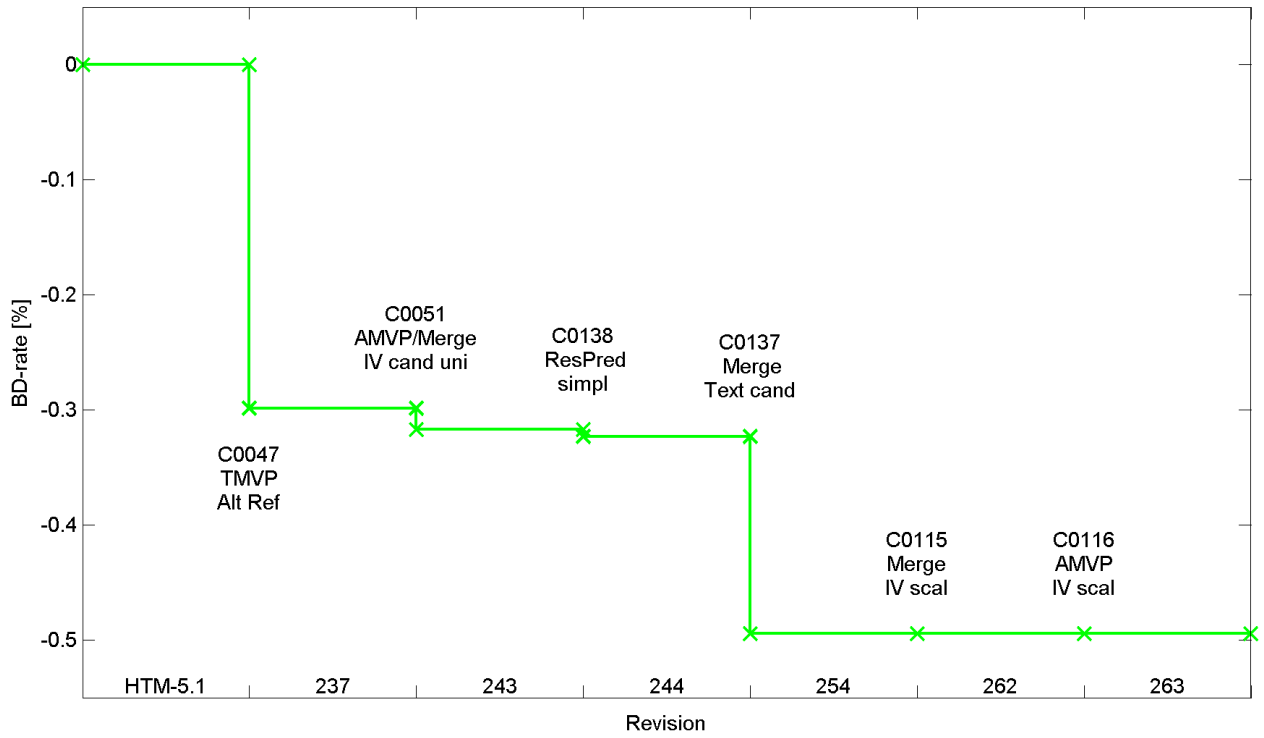




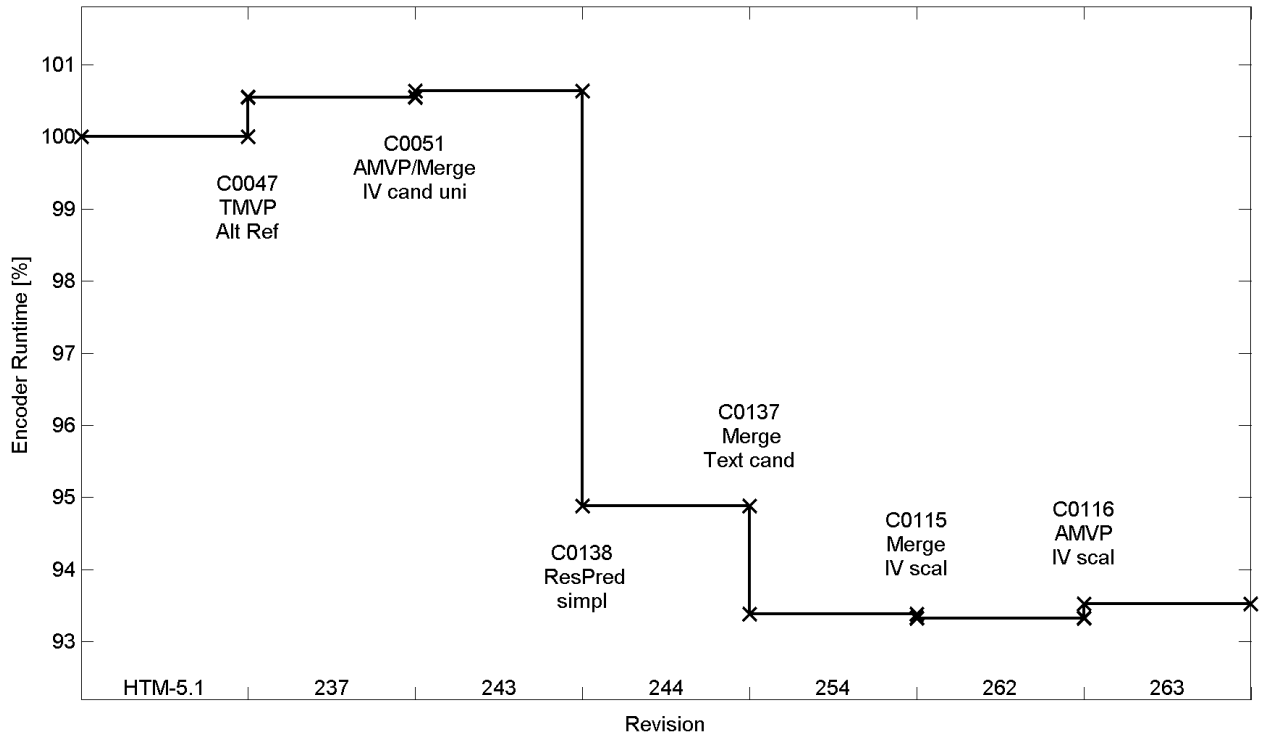
2.2.2 Track 2



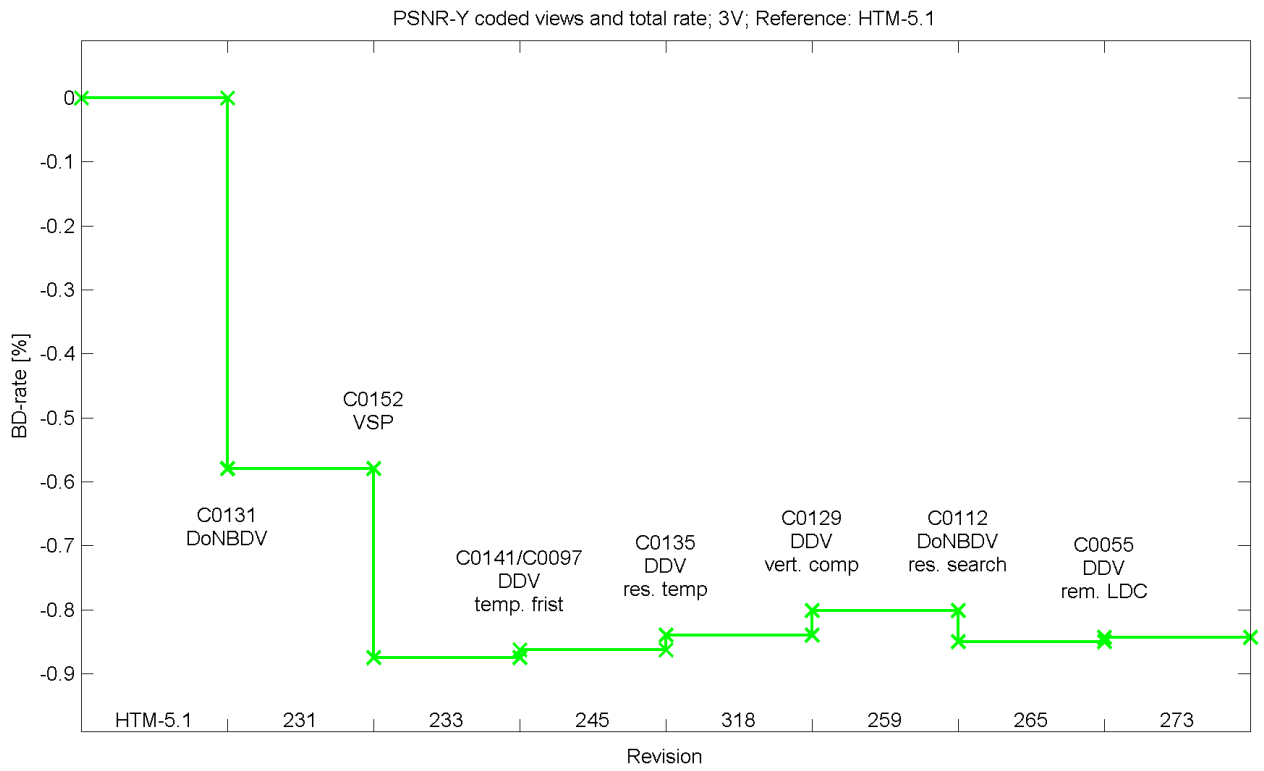
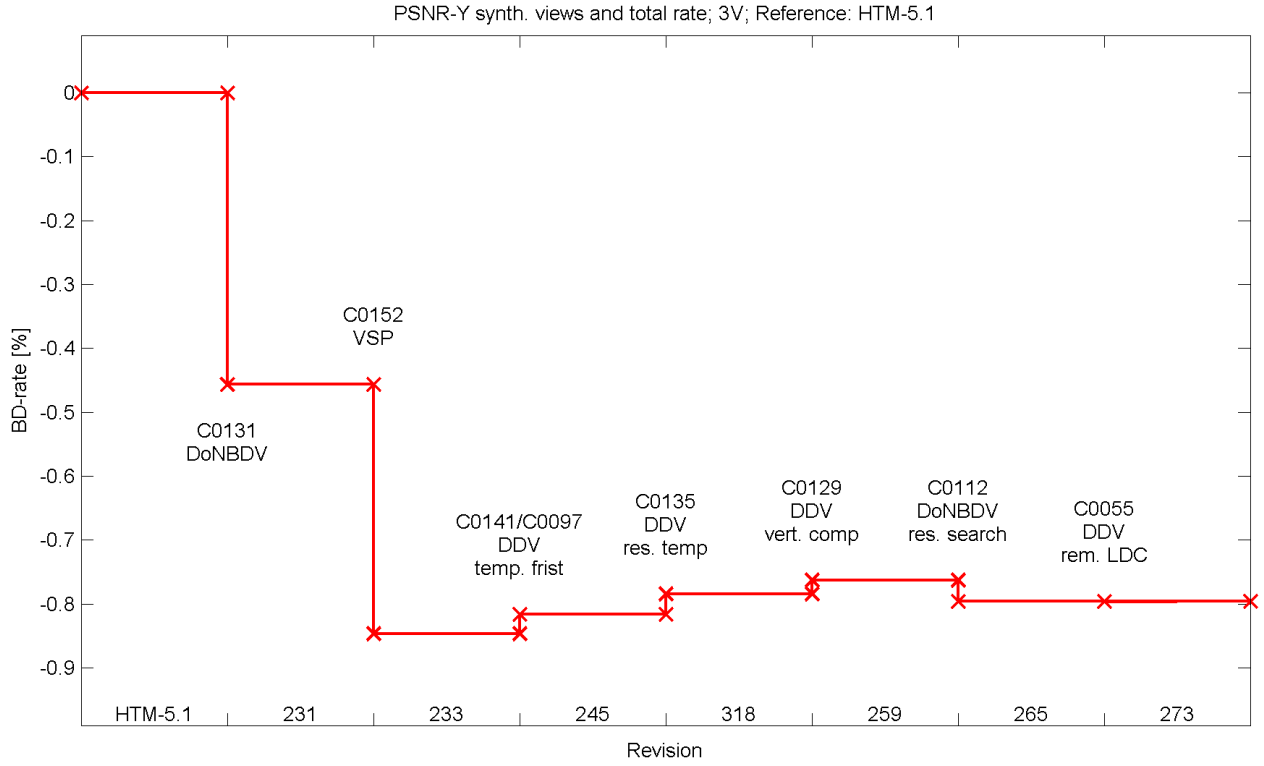
PSNR-Y coded views and total rate; 3V; Reference: HTM-5.1

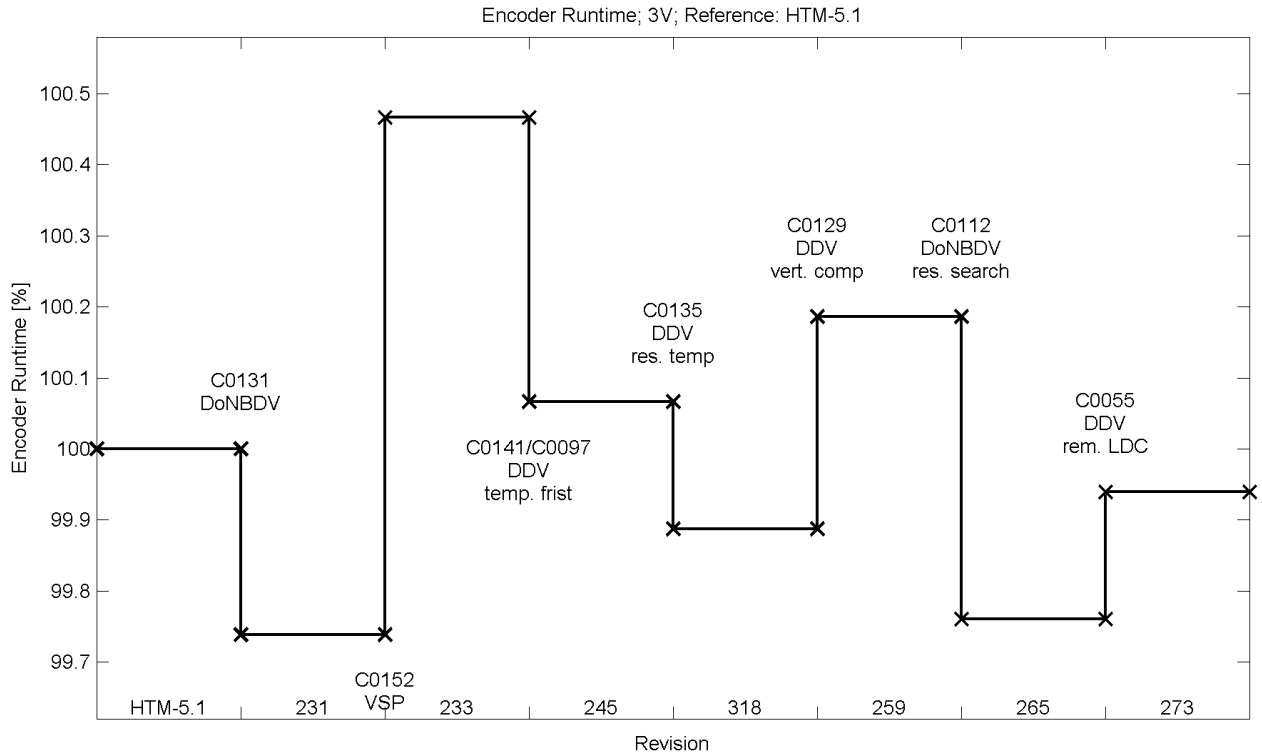


Encoder Runtime; 3V; Reference: HTM-5.1

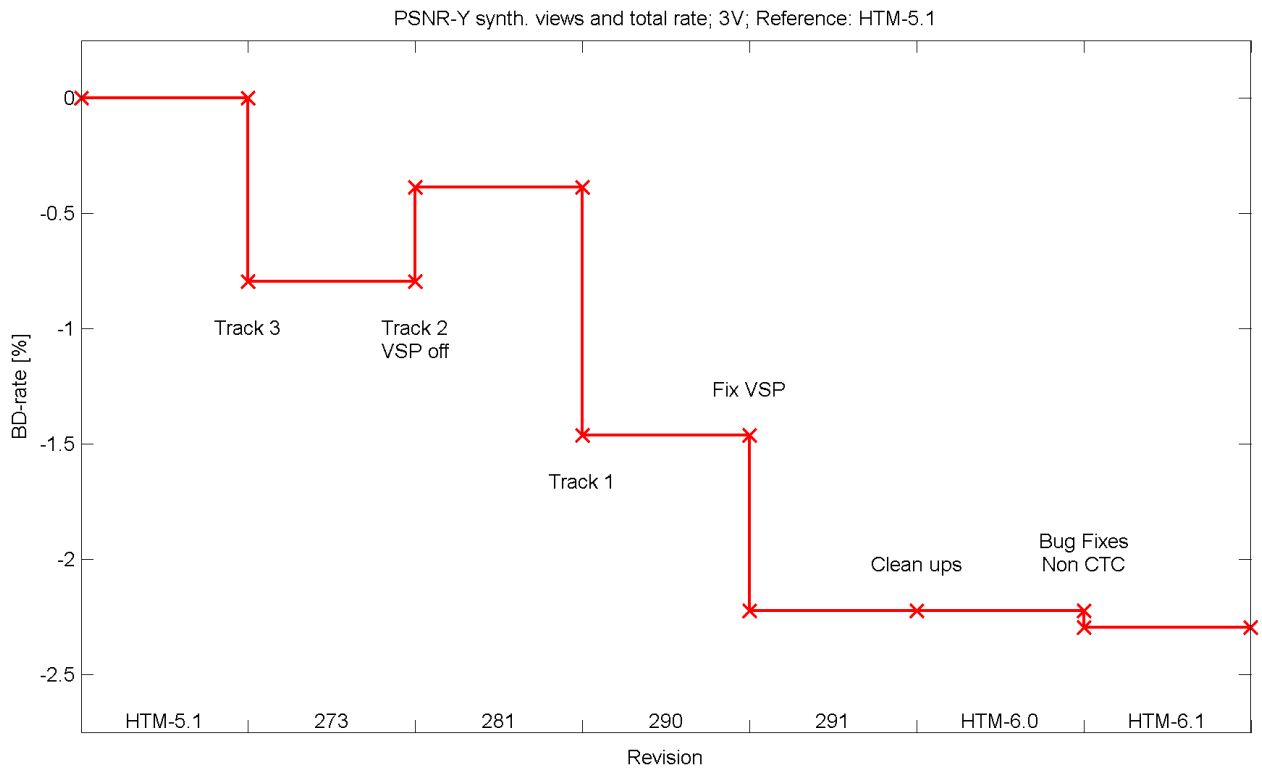


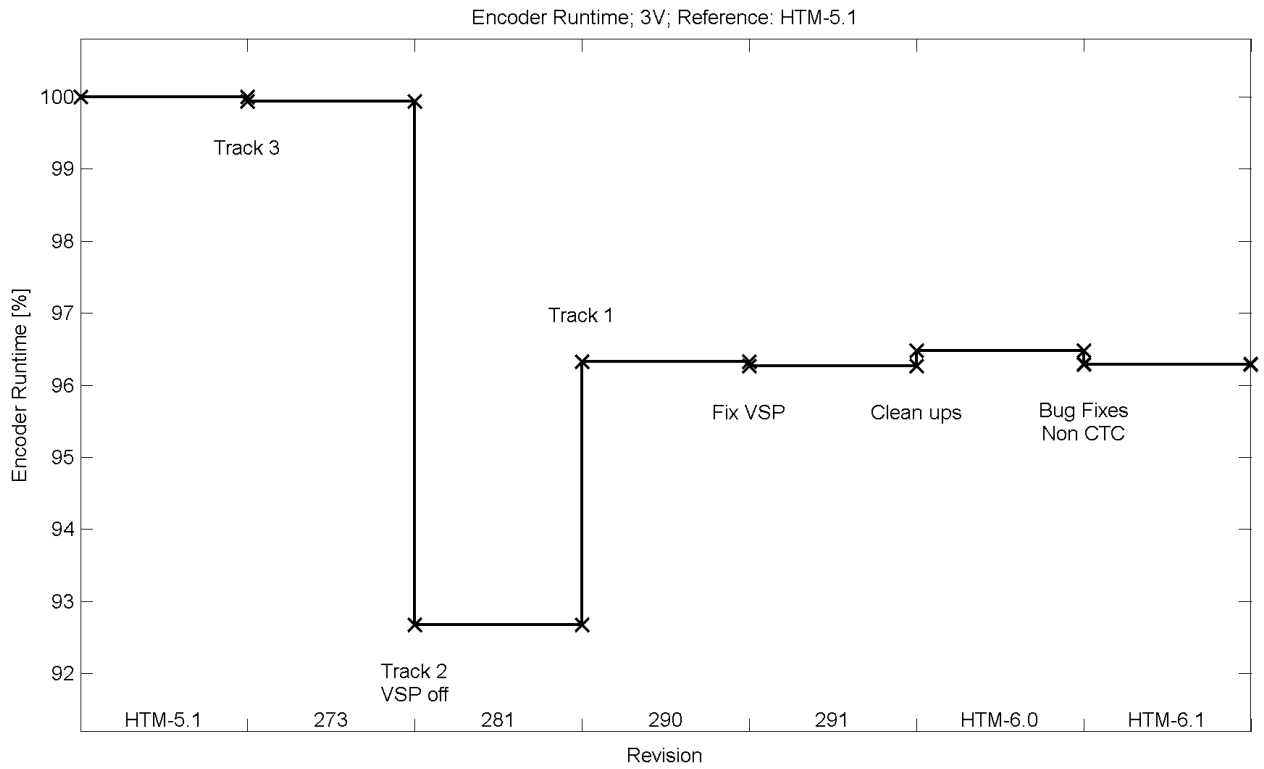
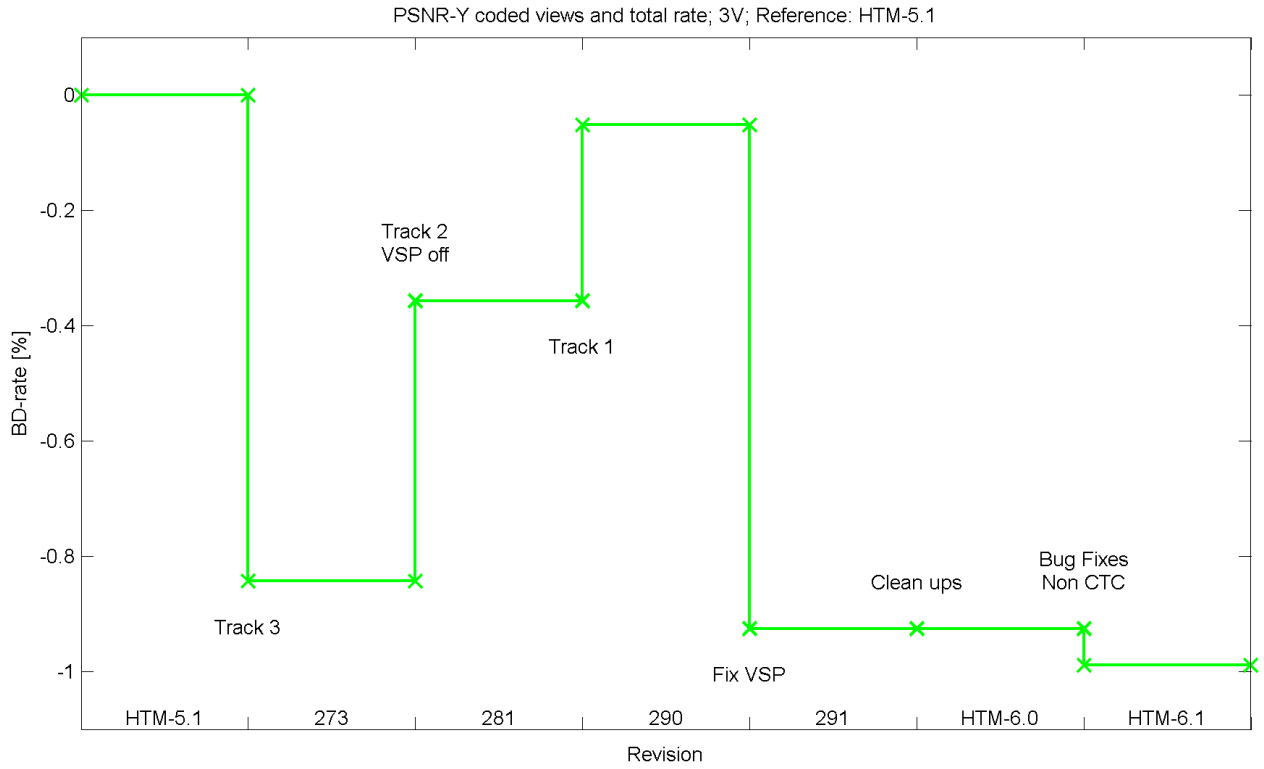
2.2.3 Track 3





2.2.4 Merge on tracks and HTM-6.1





2.3 *Open issues in HTM-6.1*

- Since the 3D-HEVC Test Model [2] is based on HEVC text specification draft 8 [3] and HTM-6.1 is based on HM-6.1 there are mismatches between draft text and HTM-software.
- With the integration of tools related to inter-view motion prediction the issue arose that inter-view motion prediction only works properly under CTC. Moreover there are mismatches with the provided text.
- Some tools are not switchable by encoder configuration, although this would be desirable.
- Other minor issues are listed in the bug tracking system.

3 HTM Update

An initial version software version for HTM update has been released. The provided software package is conforming to the current MV-HEVC specification and can thus be used as reference software for MV-HEVC. For 3D-HEVC compliance the integration of 3D-HEVC tools is required.

Other features of the software are:

- clean software design from HM-10.0 as starting point
- strict separation of MV- and 3D-HEVC parts by macros
- multiple VPS features switchable by the encoder
- basic support of depth maps
- software architecture in sense of general extendibility, hence other scalability types can be added easily

Related input document:

[JCT3V-D0287](#) AHG5 Report on update of HTM: MV-HEVC Software based on HM10.0, (H. Brust, G. Tech, K. Mueller (HHI), Y. Chen, L. Zhang (Qualcomm))

4 Setup of bug tracking system

The setup of the bug tracking has been carried out by Karsten Sühning and David Flynn. AHG5 wants to thank Karsten and David for their support. The bug tracking system has been announced on the reflector can be accessed at:

<https://hevc.hhi.fraunhofer.de/trac/3d-hevc/>

For HTM a component in the bug tracking system has been created:

Issues reported by the software coordinators often require additional inputs or clarification by the proponents. So it is recommended that proponents of adopted tools check the tracking system, whether there is an issue with their proposal and suggest to the editors how to fix it.

5 Recommendations

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

- Continue to develop reference software based on HTM version 6.1 and improve its quality
- Remove bug fix related macros introduced in previous HTM versions before starting integration towards HTM 7.0.

- 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.
- Discuss how to continue the update of HTM to the most recent version of HM.
- Discuss on how to address open issues.
- Discuss AHG5 related input documents.

6 References

- [1] JCT-3V, “MV-HEVC Draft 3”, JCT3V-C1004, JCT-3V Meeting, Geneva, January 2013
- [2] JCT-3V, “3D-HEVC Test Model 3”, JCT3V-C1005, JCT-3V Meeting, Geneva, January 2013
- [3] JCT-VC, “High Efficiency Video Coding (HEVC) text specification draft 8”, JCTVC-J1003, JCT-VC Meeting, Stockholm, July 2012