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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, 10–17 Feb. 2015 | Document: JCTVC-T1015-r1 |

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| *Title:* | **Common test conditions for screen content coding** | | |
| *Status:* | Output document | | |
| *Purpose:* | Information | | |
| *Author(s) or Contact(s):* | Haoping Yu Robert Cohen Krishna Rapaka Jizheng Xu | Email: | [haoping.yu@huawei.com](mailto:haoping.yu@huawei.com) [cohen@merl.com](mailto:cohen@merl.com) [krapaka@qti.qualcomm.com](mailto:krapaka@qti.qualcomm.com) [jzxu@microsoft.com](mailto:jzxu@microsoft.com) |
| *Source:* | JCT-VC | | |

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# Abstract

This document defines common test conditions and software reference configurations to be used in the development of HEVC screen content coding (SCC) extension conducted between the 20th and the 21st JCT-VC meetings. These common test conditions are also recommended for use in technical contributions to the 21st JCT-VC meeting, if applicable.

# Introduction

Common test conditions are defined for conducting experiments in an environment where outcome of the experiments can be compared.

This document defines two coding modes, three configurations, three encoding formats and four quantization parameter (QP) values, as shown in Table 1.

Table 1. Coding modes, configurations, encoding formats and QP values.

|  |  |
| --- | --- |
| Coding modes: | Lossy  Mathematically lossless |
| Configurations: | All intra (AI)  Random access (RA)  Low-delay B (LB) |
| Encoding formats: | R’G’B’ 4:4:4  Y’CbCr 4:4:4  Y’CbCr 4:2:0 |
| QP values: | Lossy: 22, 27, 32, 37  Lossless: 0 |

Four categories of test sequences are used in the tests, namely ‘text and graphics with motion (TGM)’, ‘mixed content (M)’, ‘animation (A)’, and ‘camera-captured content (CC)’ category. A list of these sequences is given in Section 2.5.

Excel templates are provided for reporting the results of experiments. These templates contain anchor results that were generated by running SCM with the SCC specific encoder settings given in Section 2.6.

The reference software SCM-4.0 is expected to be used for the experiments. It is available at:

<https://hevc.hhi.fraunhofer.de/svn/svn_HEVCSoftware/tags/HM-16.x+SCM-4.0>

**Notes:**

Experiments investigating R’G’B’ coding tools should also provide results using Y’CbCr 4:4:4.

# Descriptions

## Coding modes

**Lossy**: The decoded compressed content is not necessarily numerically identical to the uncompressed content.

**Mathematically lossless**: The decoded compressed content is numerically identical to the uncompressed content.

## Configurations

Configuration files are provided in the cfg/ folder of the reference software package. There are three encoder configurations files provided as follows:

* All intra (AI): encoder\_intra\_main\_scc.cfg
* Random access (RA): encoder\_randomaccess\_main\_scc.cfg
* Low-delay B (LB): encoder\_lowdelay\_main\_scc.cfg

When the random access configuration is used, the period for intra random access frames for each test sequence needs to be specified, as follows:

* IntraPeriod: Specifies the intra refresh period in the random access configuration. The intra refresh period is dependent on the frame rate of the test sequence. A value 16 shall be used for test sequences with a frame rate equal to 20fps, 24 for 24fps, 32 for 30fps, 48 for 50fps, and 64 for 60fps.

To ensure decoded frame checking, the following setting must be applied to the encoder and the decoder for all configurations:

* SEIDecodedPictureHash: Must be set to 1.

For the lossless case, the following settings must be applied to the encoder:

* QP=0
* TransquantBypassEnableFlag=1
* CUTransquantBypassFlagForce=1
* IntraReferenceSmoothing=0
* CostMode=lossless
* TransquantBypassInferTUSplit=1

For each sequence, the corresponding ‘per-sequence’ configuration file is to be used. Configuration files for every sequence including these test conditions will be available from the per-sequence/ subfolder of the cfg/ folder.

To facilitate the evaluation of the test results, sequence MSE results and MSE-based PSNR values are added to the test results reporting templates. Therefore, the following settings must be applied to the encoder:

* MSEBasedSequencePSNR=1
* PrintClippedPSNR=1
* PrintFrameMSE=1
* PrintSequenceMSE=1

## Encoding formats

The encoding format is the chroma format of a test sequence and the colour space (only RGB and YCbCr are considered). The following setting is applied to the encoder for each encoding format:

* InputChromaFormat: Specifies the chroma format of the test sequence. SCC related tests use either ‘444’ or ‘420’ format.

For test sequences using the RGB colour space, the following settings are applied to the encoder:

* InputColourSpaceConvert: Must be set to ‘RGBtoGBR’.
* SNRInternalColourSpace: Should be set to 1.
* OutputInternalColourSpace: Should be set to 0.

For test sequences using the RGB colour space, the decoder should be configured with:

* OutputColourSpaceConvert: Should be set to ‘GBRtoRGB’.

**Notes:**

The settings for SNRInternalColourSpace and OutputInternalColourSpace are optional since they will not affect the coding performance. Note, however, that the spreadsheet template expects PSNRs to be reported in the GBR order for RGB material.

## QP values

The following four QP values shall be used in the SCC related tests for the lossy configurations:

* 22, 27, 32, and 37

## Test sequences

Test sequences are available from the following locations (please contact JCT-VC chairs for login information):

* <ftp://hevc@ftp.tnt.uni-hannover.de/testsequences>
* <ftp://hevc@ftp.tnt.uni-hannover.de/testsequences/FrExt-candidate-sequences/screen_content/ScExt-TestSequences>.

Note that test sequences from the EBU (i.e. with the string ‘EBU’ included in the test sequence name) are password protected. The password can be obtained by registering at the following location:

* <http://tech.ebu.ch/testsequences/uhd-1_public_form>

The test sequences that are part of these common conditions are listed in Table 2 and Table 3.

**Table 2 - 4:4:4 Test Sequences**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Resolution** | **Sequence name** | **Category** | **fps** | **Frames to be encoded** |
| 1920x1080 | sc\_flyingGraphics\_1920x1080\_60\_8bit\*  sc\_desktop\_1920x1080\_60\_8bit  sc\_console\_1920x1080\_60\_8bit  MissionControlClip3\_1920x1080\_60p\_8b444  EBURainFruits\_1920x1080\_50\_10bit\*\*  Kimono1\_1920x1080\_24\_10bit\*\*\* | TGM  TGM  TGM  M  CC  CC | 60  60  60  60  50  24 | 0-299\*  0-599  0-599  0-599  0-249\*\*  0-119\*\*\* |
| 1280x720 | sc\_web\_browsing\_1280x720\_30\_8bit  sc\_map\_1280x720\_60\_8bit  sc\_programming\_1280x720\_60\_8bit  sc\_SlideShow\_1280x720\_20\_8bit  sc\_robot\_1280x720\_30\_8bit | TGM  TGM  TGM  TGM  A | 30  60  60  20  30 | 0-299  0-599  0-599  0-499  0-299 |
| 2560x1440 | Basketball\_Screen\_2560x1440\_60p\_8b444  MissionControlClip2\_2560x1440\_60p\_8444 | M  M | 60  60 | 322-621  120-419 |
| \*Note that only the first 300 frames of this sequence are used.  \*\*Note that only the first 250 frames of this 10-bit sequence are used, and InternalBitDepth is set to 8.  \*\*\*Note that only the first 120 frames of this 10-bit sequence are used, and InternalBitDepth is set to 8  TGM: Text and graphics with motion; M: mixed content; A: animation; CC: camera-captured content | | | | |

**Table 3 - 4:2:0 Test Sequences**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Resolution | Sequence name | Category | fps | Frames to be encoded |
| 1920x1080 | sc\_flyingGraphics\_1920x1080\_60\_8bit\_420\*  sc\_desktop\_1920x1080\_60\_8bit\_420  sc\_console\_1920x1080\_60\_8bit\_420  MissionControlClip3\_1920x1080\_60p\_8b420 | 4:2:0 TGM  4:2:0 TGM  4:2:0 TGM  4:2:0 M | 60  60  60  60 | 0-299\*  0-599  0-599  0-599 |
| 1280x720 | sc\_web\_browsing\_1280x720\_30\_8bit\_420\_r1  sc\_map\_1280x720\_60\_8bit\_420  sc\_programming\_1280x720\_60\_8bit\_420  SlideShow\_1280x720\_20  sc\_robot\_1280x720\_30\_8bit\_420 | 4:2:0 TGM  4:2:0 TGM  4:2: 0TGM  4:2:0 TGM  4:2:0 A | 30  60  60  20  30 | 0-299  0-599  0-599  0-499  0-299 |
| 2560x1440 | Basketball\_Screen\_2560x1440\_60p\_8b420  MissionControlClip2\_2560x1440\_60p\_8420 | 4:2:0 M  4:2:0 M | 60  60 | 322-621  120-419 |
| 1024x768 | ChinaSpeed\_1024x768\_30 | 4:2:0 A | 30 | 0-499 |
| \*Note that only the first 300 frames of this sequence are used.  TGM: Text and graphics with motion; M: mixed content; A: animation; CC: camera-captured content | | | | |

Annex A includes md5sums for the test sequences in the common test conditions.

The following parameters are used to configure the encoder for a given test sequence:

* InputFile: Specifies the file name and path of a given test sequence.
* FrameRate: Specifies the frame rate of a given test sequence.
* SourceWidth: Specifies the width of a given test sequence.
* SourceHeight: Specifies the height of a given test sequence.
* FramesToBeEncoded: Specifies the encoded frame count for a given sequence.
* InputBitDepth: Specifies the bit-depth of a given test sequence.
* InternalBitDepth: Specifies the internal bit-depth of operation for the encoder for a given test sequence.

## Encoder settings for anchors

The following SCC specific encoder settings were used in generating the anchors:

* IntraBlockCopyEnabled = 1
* HashBasedIntraBlockCopySearchEnabled = 1
* IntraBlockCopySearchWidthInCTUs = -1
* IntraBlockCopyNonHashSearchWidthInCTUs = 1
* ColorTransform = 1
* PaletteMode = 1
* IntraBoundaryFilterDisabled = 1
* UseAdaptiveMvResolution = 1 (RA and LB)
* SelectiveRDOQ = 1

## In addition, lossy coding anchors with constrained IBC search area are also generated using the following IBC related encoder settings for 4:4:4 sequences:

* HashBasedIntraBlockCopySearchEnabled = 1
* IntraBlockCopySearchWidthInCTUs = 3
* IntraBlockCopyNonHashSearchWidthInCTUs = 1

## Annex A. Test sequence md5sums

For each sequence included in the common test conditions, the ‘md5sum’ value is provided in Table 4.

**Table 4 - Test Sequences with md5sum**

|  |  |  |
| --- | --- | --- |
| format | file name | MD5 |
| 4:4:4 RGB | sc\_flyingGraphics\_1920x1080\_60\_8bit\_rgb.zip | 5ec2977e16da42a2d4373b893d7bd636 |
| sc\_desktop\_1920x1080\_60\_8bit\_rgb.zip | 45d2d0ad013a5cb1313c5b542c98ec5f |
| sc\_console\_1920x1080\_60\_8bit\_rgb.zip | 6181644352dc7194146fca0c4daf54ee |
| MissionControlClip3\_1920x1080\_60p\_8b444.zip | 81dbb94053a737a203236c888808a9ae |
| EBURainFruits\_1920x1080\_50\_10bit\_444\_rgb\_ebu.zip | 6086e46bc8337b1f6752c51e25b9d0f7 |
| Kimono1\_1920x1080\_24\_10bit\_444\_rgb.zip | 682e252e549a64d2e3f4676e3bf9ffab |
| sc\_web\_browsing\_1280x720\_30\_8bit\_300\_rgb.zip | 04d5451b34bb601e4e83e3688643ecb3 |
| sc\_map\_1280x720\_60\_8bit\_rgb.zip | fbb45233360302e115e2c331c16e534a |
| sc\_programming\_1280x720\_60\_8bit\_rgb.zip | 8cef6e8149bef2903dc1f6cb4c7c46b0 |
| sc\_SlideShow\_1280x720\_20\_8bit\_500.zip (RGB&YUV) | 2c73107851bc237be07d51297b526a0e |
| sc\_robot\_1280x720\_30\_8bit\_300\_rgb.zip | 36d3ef423954ee8d98deabb1b6a82477 |
| Basketball\_Screen\_2560x1440\_60p\_8b444.zip | 215784fd2cab1ade97dc740883c24c93 |
| MissionControlClip2\_2560x1440\_60p\_8b444.zip | f535830c4ed233a9e998426c3b593294 |
| 4:4:4 Y’CbCr | sc\_flyingGraphics\_1920x1080\_60\_8bit\_yuv.zip | d1ef8f76e0d0e025401b3cc03bde8986 |
| sc\_desktop\_1920x1080\_60\_8bit\_yuv.zip | cf94582dc37dc62f8c0b3ac36894c8b5 |
| sc\_console\_1920x1080\_60\_8bit\_yuv.zip | ad9fee7d7e32c891cf183b7ea43b325a |
| MissionControlClip3\_1920x1080\_60p\_8b444YUV.zip | 4b441b49f8c7fb7ae4031b266f330671 |
| EBURainFruits\_1920x1080\_50\_10bit\_444\_ebu.zip | 7a73333b9e63938b5b194fc86718d30a |
| Kimono1\_1920x1080\_24\_10bit\_444.zip | 29490eccf2742c6e9fcaeb3165de4847 |
| sc\_web\_browsing\_1280x720\_30\_8bit\_300\_444\_r1.zip | 6d88218a4585f3e88e1c01cfcc3026ac |
| sc\_map\_1280x720\_60\_8bit\_444.zip | 5bf31c2c90ca5e8baa30d6e90372b5e7 |
| sc\_programming\_1280x720\_60\_8bit\_444.zip | cbea3b976a60aa69acbd48eb6a7ffdf7 |
| sc\_SlideShow\_1280x720\_20\_8bit\_500.zip (RGB&YUV) | 2c73107851bc237be07d51297b526a0e |
| sc\_robot\_1280x720\_30\_8bit\_300\_444.zip | 0a03b4c5e508a4a7c00bd8331d926922 |
| Basketball\_Screen\_2560x1440\_60p\_8b444YUV.zip | 367bc916228f52a4c4ab66d19f0c406b |
| MissionControlClip2\_2560x1440\_60p\_8b444YUV.zip | 3d71ecafc94a9b919eac3f0ef1270dae |
| 4:2:0 Y’CbCr | SlideShow\_1280x720\_20.zip | 34fbaf67d600a5d8bf06b3064934bb88 |
| ChinaSpeed\_1024x768\_30.zip | 2ce970e611113b249f0365cfb6e2ca5c |
| sc\_flyingGraphics\_1920x1080\_60\_8bit\_420.zip | 8296308afe0421796a901d6f191f8a2a |
| sc\_desktop\_1920x1080\_60\_8bit\_420.zip | 9d2de5da7982fbc2fd2d42437b3d9b6f |
| sc\_console\_1920x1080\_60\_8bit\_420.zip | f946f37a415cf15ef0d6773b2a6e39fd |
| sc\_web\_browsing\_1280x720\_30\_8bit\_300\_420\_r1.zip | d1f20953a1fe477ab7ff77d0d833b812 |
| sc\_map\_1280x720\_60\_8bit\_420.zip | 8d4f15bd463d156ea9032dc4bb356fed |
| MissionControlClip2\_2560x1440\_60p\_8b420.zip | 6a3f7ebdb2e66ac7914a327f428caca0 |
| MissionControlClip3\_1920x1080\_60p\_8b420.zip | f3df660027bc1cb71a9336f98c066ddb |
| sc\_robot\_1280x720\_30\_8bit\_300\_420.zip | 4e822bc43b49a3c64809cc54dbd8065f |
| sc\_programming\_1280x720\_60\_8bit\_420.zip | c81a7dff676e8edcd4f58fd7a82c4369 |
| Basketball\_Screen\_2560x1440\_60p\_8b420.zip | 11e047d398f42a627ca5158dad20516e |