

*Title:* **Temporal MCTS Coding Constraints Implementation**

*Status:* Input document to JCT-VC

*Purpose:* Information

*Author(s) or* Robert Skupin

Email: [robert.skupin@hhi.fraunhofer.de](mailto:robert.skupin@hhi.fraunhofer.de)

*Contact(s):* Yago Sanchez  
Karsten Sühning  
Thomas Schierl

Eun-Seok Ryu  
Jangwoo Son

[esryu@gachon.ac.kr](mailto:esryu@gachon.ac.kr)

*Source:* Fraunhofer HHI, Gachon University

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## Abstract

This contribution presents a software implementation of encoding constraints required for Temporal motion-constrained tile sets SEI with `mc_all_tiles_exact_sample_value_match_flag` equal to 1, as well as decoder-side checks to verify that a decoded bitstream follows these constraints. The modifications are implemented based on the HM 16.16 reference software.

## 1 Introduction

This document accompanies a software contribution for HEVC encoding with Temporal motion-constraint tile sets (TMCTS) as specified in JCTVC-AB1005.

On the encoder side, if TMCTS encoding is enabled, each tile is considered one TMCTS. With `mc_all_tiles_exact_sample_value_match_flag` enabled, tiles belonging to a TMCTS do not rely on data of tiles not belonging to the same TMCTS for decoding of the TMCTS, where data refers to decoded sample values as well as syntax values such as spatial or temporal motion vector candidates. As clarified in development of HEVC DAM3, cases such as using border extensions sample values or using a bottom right spatial candidate that would turn into collocated temporal candidates upon TMCTS extraction using the TMCTS sub-bitstream extraction process are forbidden.

Currently TMCTS is gaining some interest. For instance, TMCTS play an important role in applications based on the HEVC viewport-dependent baseline profile of MPEG OMAF and is being considered as well in VR-IF for guidelines for VR experiences. Herein, tiles that were encoded using the above-mentioned constraints are recombined into a common bitstream on client side using the ISO base media file format. By depicting regions within an omnidirectional video at varying fidelity, this technique allows to create a client dependent HEVC bitstream with a preferred viewing direction. Such bitstreams allow better utilization of decoder and network resources for video samples that are actually presented to the user in typical VR video applications.

## 1.1 Software Changes

The software builds on top of the HEVC reference software HM 16.16 and the encoder additions are marked with the MCTS\_ENC macro. Decoder changes are marked with the MCTS\_CHECK macro, which requires MCTS\_ENC to be enabled.

The main part of the software contribution can be found in the classes TComPrediction, where

```
Bool TComPrediction::CheckMCTSMVP(TComDataCU* pcCU, Int iPartIdx)
```

checks for motion vector predictors whether they are forbidden following the MCTS constraints, amongst other, by checking the reference PU part position using

```
Void TComPrediction::getRefPUPartPos(TComDataCU* pcCU, TComMv& cMv, Int uiPartIdx, Int& ruiPredXLeft, Int& ruiPredYTop, Int& ruiPredXRight, Int& ruiPredYBottom, Int iWidth, Int iHeight)
```

Also, TComDataCU is extended to account for the number of spatial MV candidates in either TComDataCU::getInterMergeCandidates or TComDataCU::fillMvpCand, so that the constraints described in JCTVC-AB1005 regarding allowed MV predictors are fulfilled.

## 1.2 Usage

For the HM encoder, the configuration parameter SEITMCTSTileConstraint controls the motion vector constraint for each tile boundary within the picture.

While the already present configuration parameter SEITempMotionConstrainedTileSets equal to 1 enables writing of the Temporal Motion Constrained Tile Set (TMCTS) SEI message to the bitstream, when SEITMCTSTileConstraint is set equal to 1, the TMCTS SEI message is written to the bitstream with the syntax elements mc\_all\_tiles\_exact\_sample\_value\_match\_flag and each\_tile\_one\_tile\_set\_flag equal to 1 as enabled by this software contribution.

For the HM decoder, the check can be enabled with the "--MCTSCheck=1" parameter. The TMCTS constraints are checked only on occurrence of an TMCTS SEI message with mc\_all\_tiles\_exact\_sample\_value\_match\_flag and each\_tile\_one\_tile\_set\_flag equal to 1. A message is printed in the decoder output whenever the checks are enabled. Also, warnings are printed to the output, if bitstream conformance violations are detected.

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