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Information technology — High efficiency coding and media delivery in heterogeneous environments —

Part 8: Conformance specification for HEVC

Technologies de l'information — Codage à haute efficacité et livraison des medias dans des environnements hétérogènes —

Partie 8: Spécification de conformité du codage video à haute efficacité

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*, in collaboration with ITU-T. A technically aligned twin text is published as ITU-T H.265.1.

This second edition cancels and replaces the first edition (ISO/IEC ISO/IEC 23008-8:2015), which has been technically revised.

The main changes compared to the previous edition are as follows:

— addition of conformance testing for Multiview Main and 3D Main profiles;

— addition of conformance testing for Format Range Extensions profiles;

— addition of conformance testing for Scalable profiles.

A list of all parts in the ISO/IEC 23008 series can be found on the ISO website.

Information technology — High efficiency coding and media delivery in heterogeneous environments —

Part 8: Conformance specification for HEVC

1 Scope

This document specifies a set of tests and procedures designed to indicate whether encoders or decoders meet the normative requirements specified in Rec. ITU-T H.265 | ISO/IEC 23008-2.

NOTE The conformance bitstreams identified within the text are available at http://standards.iso.org/iso-iec/23008/-8/ed-2/en.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, *Information technology — High efficiency video coding and media delivery in heterogeneous environment — Part 2: High Efficiency Video Coding*

Rec. ITU-T H.265.2 | ISO/IEC 23008-5, *Information technology — High efficiency video coding and media delivery in heterogeneous environment — Part 2: High Efficiency Video Coding Reference Software*

3 Terms, definitions, abbreviated terms and conventions

For the purposes of this document, the terms, definitions, abbreviated terms and conventions given in Rec. ITU-T H.265 | ISO/IEC 23008-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
bitstream
sequence of bits, in the form of a NAL unit stream or a byte stream, that forms the representation of coded pictures and associated data forming one or more CVSs

Note 1 to entry: In this document, this refers specifically to video bitstream according to ISO/IEC 23008-2.

[SOURCE: Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, 3.12, modified – Note 1 to entry added]

3.2
decoder
embodiment of a decoding process

Note 1 to entry: In this document, this refers specifically to a video decoder as specified in ISO/IEC 23008-2.

Note 2 to entry: The decoder does not include the display process, which is outside the scope of this document.

[SOURCE: Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, 3.40, modified – Notes 1 and 2 to entry added]

3.3
encoder
embodiment of an encoding process

Note 1 to entry: The process, not specified in this document (except in regard to identification of the reference software encoder), produces a bitstream.

[SOURCE: Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, 3.49, modified – Note 1 to entry added]

3.4
reference software decoder
decoding software required for this document

Note 1 to entry: For this document, the reference software decoder is provided in Rec. ITU-T H.265.2 | ISO/IEC 23008-5.

3.5
reference software encoder
encoding software required for this document

Note 1 to entry: For this document, the reference software encoder is provided in Rec. ITU-T H.265.2 | ISO/IEC 23008-5.

4 Conformance testing for Rec. ITU-T H.265 | ISO/IEC 23008-2

4.1 General

The following clauses specify normative tests for verifying conformance of video bitstreams as well as decoders. Those normative tests make use of test data (bitstream test suites) provided at http://standards.iso.org/iso-iec/23008/-8/ed-2/en and the reference software decoder specified in Rec. ITU-T H.265.2 | ISO/IEC 23008-5.

4.2 Bitstream conformance

Bitstream conformance for Rec. ITU-T H.265 | ISO/IEC 23008-2 is specified by ISO/IEC 23008-2:2017, C.4.

4.3 Decoder conformance

Decoder conformance for Rec. ITU-T H.265 | ISO/IEC 23008-2 is specified by ISO/IEC 23008-2:2017, C.5.

4.4 Procedure to test bitstreams

A bitstream that claims conformance with Rec. ITU-T H.265 | ISO/IEC 23008-2 shall pass the following normative test.

The bitstream shall be decoded by processing it with the reference software decoder. When processed by the reference software decoder, the bitstream shall not cause any error or non-conformance messages to be reported by the reference software decoder. This test should not be applied to bitstreams that are known to contain errors introduced by transmission, as such errors are highly likely to result in bitstreams that lack conformance to Rec. ITU-T H.265 | ISO/IEC 23008-2.

Successfully passing the reference software decoder test provides only a strong presumption that the bitstream under test is conforming to the video layer, i.e., that it does indeed meet all the requirements for the video layer (except Annexes C, D and E) specified in Rec. ITU-T H.265 | ISO/IEC 23008-2 that are tested by the reference software decoder.

Additional tests may be necessary to more thoroughly check that the bitstream properly meets all the requirements specified in Rec. ITU-T H.265 | ISO/IEC 23008-2 including the hypothetical reference decoder (HRD) conformance (based on Annexes C, D and E). These complementary tests may be performed using other video bitstream verifiers that perform more complete tests than those implemented by the reference software decoder.

Rec. ITU-T H.265 | ISO/IEC 23008-2 contains several informative recommendations that are not an integral part of that Document. When testing a bitstream for conformance, it may also be useful to test whether or not the bitstream follows those recommendations.

To check correctness of a bitstream, it is necessary to parse the entire bitstream and to extract all the syntax elements and other values derived from those syntactic elements and used by the decoding process specified in Rec. ITU-T H.265 | ISO/IEC 23008-2.

A verifier may not necessarily perform all stages of the decoding process specified in Rec. ITU-T H.265 | ISO/IEC 23008-2 in order to verify bitstream correctness. Many tests can be performed on syntax elements in a state prior to their use in some processing stages.

4.5 Procedure to test decoder conformance

4.5.1 Conformance bitstreams

A bitstream has values of general_profile_idc, general_tier_flag, and general_level_idc corresponding to a set of specified constraints on a bitstream for which a decoder conforming to a specified profile, tier, and level is required in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Annex A to properly perform the decoding process.

4.5.2 Contents of the bitstream file

The conformance bitstreams are provided at http://standards.iso.org/iso-iec/23008/-8/ed-2/en. The following information is included in a single zipped file for each such bitstream.

— bitstream;

— decoded pictures or hashes of decoded pictures (may not be present);

— short description of the bitstream;

— trace file (results while decoding the bitstream, in ASCII format).

In cases where the decoded pictures or hashes of decoded pictures are not available, the reference software decoder shall be used to generate the necessary reference decoded pictures from the bitstream.

4.5.3 Requirements on output of the decoding process and timing

Two classes of decoder conformance are specified:

— output order conformance;

— output timing conformance.

The output of the decoding process is specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Clause 8 and Annex C.

For output order conformance, it is a requirement that all of the decoded pictures specified for output in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Annex C shall be output by a conforming decoder in the specified order and that the values of the decoded samples in all of the pictures that are output shall be (exactly equal to) the values specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Clause 8.

For output timing conformance, it is a requirement that a conforming decoder shall also output the decoded samples at the rates and times specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Annex C.

The display process, which ordinarily follows the output of the decoding process, is outside the scope of this document.

4.5.4 Recommendations (informative)

In addition to the requirements, it is desirable that conforming decoders implement various informative recommendations specified in Rec. ITU-T H.265 | ISO/IEC 23008-2 that are not an integral part of that document. This clause discusses some of these recommendations.

It is recommended that a conforming decoder be able to resume the decoding process as soon as possible after the loss or corruption of part of a bitstream. In most cases it is possible to resume decoding at the next start code or slice header. It is recommended that a conforming decoder be able to perform concealment for the coding tree blocks or video packets for which all the coded data has not been received.

4.5.5 Static tests for output order conformance

Static tests of a video decoder require testing of the decoded samples. This clause explains how this test can be accomplished when the decoded samples at the output of the decoding process are available. It may not be possible to perform this type of test with a production decoder (due to the lack of an appropriate accessible interface in the design at which to perform the test). In that case this test should be performed by the manufacturer during the design and development phase. Static tests are used for testing the decoding process. The test will check that the values of the samples decoded by the decoder under test shall be identical to the values of the samples decoded by the reference decoder. When a hash of the values of the samples of the decoded pictures is attached to the bitstream file, a corresponding hash operation performed on the values of the samples of the decoded pictures produced by the decoder under test shall produce the same results.

4.5.6 Dynamic tests for output timing conformance

Dynamic tests are applied to check that all the decoded samples are output and that the timing of the output of the decoder's decoded samples conforms to the specification of Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Clause 8 and Annex C, and to verify that the HRD models (as specified by the CPB and DPB specification in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Annex C) are not violated when the bits of the bitstream are delivered at the proper rate.

The dynamic test is often easier to perform on a complete decoding system, which may include a systems decoder, a video decoder and a display process. It may be possible to record the output of the display process and to check that display order and timing of decoded pictures are correct at the output of the display process. However, since the display process is not within the normative scope of Rec. ITU-T H.265 | ISO/IEC 23008-2, there may be cases where the output of the display process differs in timing or value even though the video decoder is conforming. In this case, the output of the video decoder itself (before the display process) would need to be captured in order to perform the dynamic tests on the video decoder. In particular the output order and timing of the decoded pictures shall be correct.

If buffering period and picture timing SEI messages are included in the test bitstream, HRD conformance shall be verified using the values of nal_initial_cpb_removal_delay, nal_initial_cpb_removal_offset, au_cpb_removal_delay_minus1 and pic_dpb_output_delay that are included in the bitstream.

If buffering period and picture timing SEI messages are not included in the bitstream, the following inferences shall be made to generate the missing parameters:

— fixed_pic_rate_within_cvs_flag shall be inferred to be equal to 1;

— low_delay_hrd_flag shall be inferred to be equal to 0;

— cbr_flag shall be inferred to be equal to 0;

— The frame rate of the bitstream shall be inferred to be equal to the frame rate value specified in the corresponding table of subclause 6.7, where the bitstream is listed. If this is missing, then a frame rate of either 25 or 30 000 ÷ 1 001 can be inferred;

— vui_time_scale shall be set equal to 90 000 and the value of vui_num_units_in_tick shall be computed based on frame rate;

— The bit rate of the bitstream shall be inferred to be equal to the maximum value for the level specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Table A-1;

— CPB and DPB sizes shall be inferred to be equal to the maximum value for the level specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Table A-1.

With the above inferences, the HRD shall be operated as follows.

— The CPB is filled starting at time t = 0, until it is full, before removal of the first access unit. This means that the nal_initial_cpb_removal_delay shall be inferred to be equal to the total CPB buffer size divided by the bit rate divided by 90 000 (rounded downwards) and nal_initial_cpb_removal_offset shall be inferred to be equal to zero.

— The first access unit is removed at time t = nal_initial_cpb_removal_delay ÷ 90 000 and subsequent access units are removed at intervals based on the frame distance, i.e. (90 000 ÷ vui_num_units_in_tick).

— Using these inferences, the CPB will not overflow or underflow and the DPB will not overflow.

4.5.7 Decoder conformance test of a particular profile, tier, and level

In order for a decoder of a particular profile, tier, and level to claim output order conformance to Rec. ITU-T H.265 | ISO/IEC 23008-2 as specified by this document, the decoder shall successfully pass the static test specified in subclause 6.5.5 with all the bitstreams of the normative test suite specified for testing decoders of this particular profile, tier, and level combination.

In order for a decoder of a particular profile, tier, and level to claim output timing conformance to Rec. ITU-T H.265 | ISO/IEC 23008-2 as specified by this document, the decoder shall successfully pass both the static test specified in subclause 6.5.5 and the dynamic test specified in subclause 6.5.6 with all the bitstreams of the normative test suite specified for testing decoders of this particular profile, tier, and level. Tables 1 through 6 specify the normative test suites for each profile, tier, and level combination. The test suite for a particular profile, tier, and level combination is the list of bitstreams that are marked with an 'X' in the column corresponding to that profile, tier, and level combination. In the column 'Main tier', 'X' indicate the bitstream is for Main tier. A decoder conformed to Main tier shall be capable of decoding the specified bitstreams, among the testing profile-level combination, indicated by 'X' at 'Main tier' column in Table 1. A decoder conformed to High tier shall be capable of decoding all the specified bitstreams, among the testing profile-level combination, in Table 1.

'X' indicates that the bitstream is designed to test both the dynamic and static conformance of the decoder.

The bitstream column specifies the bitstream used for each test.

A decoder that conforms to the Main profile, Main Still Picture profile, or Main 10 profile at a specific level shall be capable of decoding the specified bitstreams in Table 1.

A decoder that conforms to the Multiview Main profile at specific level shall be capable of decoding the specified bitstreams in Table 2. In addition to the bitstreams defined in Table 3, a decoder that conforms to the Multiview Main profile shall be capable of decoding the Main profile bitstreams specified in Table 1.

A decoder that conforms to the 3D Main profile (as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, Clause I.11) at specific level shall be capable of decoding the specified bitstreams in Table 3. In addition to the bitstreams defined in Table 3, a decoder that conforms to the 3D Main profile shall be capable of decoding the Multiview Main profile bitstreams specified in Table 2.

A decoder that conforms to the Monochrome, Monochrome 12, Monochrome 16, Main 12, Main 4:2:2 10, Main 4:2:2 12, Main 4:4:4, Main 4:4:4 10, Main 4:4:4 12, Main Intra, Main 10 Intra, Main 12 Intra, Main 4:2:2 10 Intra, Main 4:2:2 12 Intra, Main 4:4:4 Intra, Main 4:4:4 10 Intra, Main 4:4:4 12 Intra, Main 4:4:4 16 Intra, Main 4:4:4 Still Picture, or Main 4:4:4 16 Still Picture profile (as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, A.3.5), which are collectively referred to as the format range extensions profiles, shall be capable of decoding the specified bitstreams in Table 4. A decoder that conforms to some format range extensions profiles is also required to be capable of decoding bitstreams that conform to particular other profiles. Thus, in addition to the specified bitstreams in Table 4, a decoder that conforms to a format range extensions profile shall also be capable of decoding the bitstreams specified in Table 1 that conform to the decoding requirements specified for the format range extensions profile in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, A.3.5.

A decoder that conforms to the High Throughput 4:4:4 16 Intra profile (as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, A.3.6) at specific level shall be capable of decoding the specified bitstreams in Table 4.

A decoder that conforms to a list of profile, tier, level, INBLD capability quadruplets such that one of the quadruplets corresponds to a profile indication of Scalable Main or Scalable Main 10 profile (as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, H.11.1.1) at specific level, shall be capable of decoding the specified bitstreams in Table 5. A decoder that conforms to a list of profile, tier, level, INBLD capability quadruplets such that one of the quadruplets corresponds to a profile indication of Scalable Main or Scalable Main 10 profile at specific level shall also be capable of decoding the specified bitstreams in Table 1.

A decoder that conforms to a list of profile, tier, level, INBLD capability quadruplets such that one of the quadruplets corresponds to a profile indication of Scalable Monochrome, Scalable Monochrome 12, Scalable Monochrome 16 or Scalable Main 4:4:4 (as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, H.11.1.2, collectively referred to as scalable format range extension profiles) at specific level, shall be capable of decoding the specified bitstreams in Table 6. A decoder that conforms to a list of profile, tier, level, INBLD capability quadruplets such that one of the quadruplets corresponds to a scalable format range extension profile is also required to be capable of decoding bitstreams that conform to particular other profiles. Thus, in addition to the specified bitstreams in Table 6, a decoder that conforms to a list of profile, tier, level, INBLD capability quadruplets such that one of the quadruplets corresponds to a scalable format range extension profile shall also be capable of decoding the bitstreams specified in Table 1 and Table 5 that conform to the decoding requirements specified for the scalable format range extensions profile in Rec. ITU-T H.265 | ISO/IEC 23008-2:2017, H.11.1.2.

4.6 Specification of the test bitstreams

4.6.1 General

Some characteristics of each bitstream listed in Table 1 are specified in this clause. In Table 1, the value "29.97" shall be interpreted as an approximation of an exact value of 30 000 ÷ 1 001 and the value "59.94" shall be interpreted as an approximation of an exact value of 60 000 ÷ 1 001.

4.6.2 Test bitstreams — Block structure

4.6.2.1 Test bitstreams #STRUCT_A

Specification: All slices are coded as I, P or B slices. Each picture contains one slice. Various CTU and maximum CU sizes are used.

Functional stage: Test the reconstruction process of slices.

Purpose: Check that the decoder can properly decode I, P and B slices with various CTU and maximum CU sizes.

4.6.2.2 Test bitstreams #STRUCT_B

Specification: All slices are coded as I, P or B slices. Each picture contains one slice. Various CTU and minimum CU sizes are used.

Functional stage: Test the reconstruction process of slices.

Purpose: Check that the decoder can properly decode I, P and B slices with various CTU and minimum CU sizes.

4.6.3 Test bitstreams — Intra coding

4.6.3.1 Test bitstreams #IPRED_A, #IPRED_B, and #IPRED_C

Specification: All slices are coded as I slices. Each picture contains one slice. All intra prediction modes (35 modes for each of luma 32x32, luma 16x16, luma 8x8, luma 4x4, chroma 16x16, chroma 8x8 and chroma 4x4, for a total 245 modes) are used. The IPRED_B bitstream contains only one picture, and conforms to the Main Still Picture profile.

Functional stage: Test the reconstruction process of I slices.

Purpose: Check that the decoder can properly decode I slices with all intra prediction modes.

4.6.3.2 Test bitstreams #CIP_A

Specification: The bitstream contains one I slice and one B slice, using one slice per picture. Both SAO and the deblocking filter are disabled.

Functional stage: Test the reference sample substitution process for intra sample prediction.

Purpose: Check that the decoder can properly decode slices of coded pictures containing intra TUs with unavailable samples for intra prediction.

4.6.3.3 Test bitstreams #CIP_B

Specification: The bitstream contains an I-picture and 4 P-pictures. Each picture contains only one slice. constrained_intra_pred_flag is equal to 1.

Functional stage: Test the reference sample substitution process for intra sample prediction.

Purpose: Check that the decoder can properly decode slices of coded pictures containing intra TUs with unavailable samples for intra prediction.

4.6.3.4 Test bitstreams #CIP_C

Specification: The bitstream contains one I slice and one B slice, using more than one slice per picture. Both SAO and the deblocking filter are disabled.

Functional stage: Test the reference sample substitution process for intra sample prediction.

Purpose: Check that the decoder can properly decode slices of coded pictures containing intra TUs with unavailable samples for intra prediction.

4.6.4 Test bitstreams — Inter frame coding

4.6.4.1 Test bitstreams #MERGE_A

Specification: All slices are coded as I or B slices. Each picture contains only one slice. five_minus_max_num_merge_cand is set equal to 4.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode with the maximum number of merging candidates equal to any value permitted by the standard (i.e. 1, 2, 3, 4, 5).

4.6.4.2 Test bitstreams #MERGE_B

Specification: All slices are coded as I or B slices. Each picture contains only one slice. five_minus_max_num_merge_cand is set equal to 3.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode with the maximum number of merging candidates equal to any value permitted by the standard (i.e. 1, 2, 3, 4, 5).

4.6.4.3 Test bitstreams #MERGE_C

Specification: All slices are coded as I or B slices. Each picture contains only one slice. five_minus_max_num_merge_cand is set equal to 2.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode with the maximum number of merging candidates equal to any value permitted by the standard (i.e. 1, 2, 3, 4, 5).

4.6.4.4 Test bitstreams #MERGE_D

Specification: All slices are coded as I or B slices. Each picture contains only one slice. five_minus_max_num_merge_cand is set equal to 1.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode with the maximum number of merging candidates equal to any value permitted by the standard (i.e. 1, 2, 3, 4, 5).

4.6.4.5 Test bitstreams #MERGE_E

Specification: All slices are coded as I or B slices. Each picture contains only one slice. five_minus_max_num_merge_cand is set equal to 0.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode with the maximum number of merging candidates equal to any value permitted by the standard (i.e. 1, 2, 3, 4, 5).

4.6.4.6 Test bitstreams #MERGE_F

Specification: All slices are coded as I or B slices. Each picture contains only one slice. sps_temporal_mvp_enabled_flag is equal to 0 and five_minus_max_num_merge_cand is equal to 0.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode when the temporal merging candidate is not included in the merge candidate set.

4.6.4.7 Test bitstreams #MERGE_G

Specification: All slices are coded as I or B slices. Each picture contains only one slice. five_minus_max_num_merge_cand is set equal to 0.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode with merge index ranging from 0 to 4.

4.6.4.8 Test bitstreams #PMERGE_A

Specification: All slices are coded as I or B slices. Each picture contains only one slice. log2_parallel_merge_level_minus2 is set equal to 0.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode parallel merge level values permitted by the standard (i.e. 2, 3, 4, 5, 6 for luma CTB size 64x64).

4.6.4.9 Test bitstreams #PMERGE_B

Specification: All slices are coded as I or B slices. Each picture contains only one slice. log2_parallel_merge_level_minus2 is set equal to 1.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode parallel merge level values permitted by the standard (i.e. 2, 3, 4, 5, 6 for luma CTB size 64x64).

4.6.4.10 Test bitstreams #PMERGE_C

Specification: All slices are coded as I or B slices. Each picture contains only one slice. log2_parallel_merge_level_minus2 is set equal to 2.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode the parallel merge level values permitted by the standard (i.e. 2, 3, 4, 5, 6 for luma CTB size 64x64).

4.6.4.11 Test bitstreams #PMERGE_D

Specification: All slices are coded as I or B slices. Each picture contains only one slice. log2_parallel_merge_level_minus2 is set equal to 3.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode the parallel merge level values permitted by the standard (i.e. 2, 3, 4, 5, 6 for luma CTB size 64x64).

4.6.4.12 Test bitstreams #PMERGE_E

Specification: All slices are coded as I or B slices. Each picture contains only one slice. log2_parallel_merge_level_minus2 is set equal to 4.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode the parallel merge level values permitted by the standard (i.e. 2, 3, 4, 5, 6 for luma CTB size 64x64).

4.6.4.13 Test bitstreams #AMVP_A

Specification: All slices are coded as I or P slices. Each picture contains only one slice. num_ref_idx_l0_default_active_minus1 is equal to 0, num_ref_idx_l1_default_active_minus1 is equal to 0 and num_ref_idx_active_override_flag is equal to 0.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode when motion vector scaling is not needed for spatial motion vector prediction candidate generation (all inter-coded PUs within the same slice have the same inter_pred_idc and ref_idx_l0).

4.6.4.14 Test bitstreams #AMVP_B

Specification: All slices are coded as I or B slices. Each picture contains only one slice. Multiple reference pictures are used. For some slices, num_ref_idx_l0_default_active_minus1 is equal to 3 and num_ref_idx_active_override_flag is equal to 0. For other B slices, num_ref_idx_l0_default_active_minus1 is equal to 1, num_ref_idx_l1_default_active_minus1 is equal to 1 and num_ref_idx_active_override_flag is equal to 0.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode when motion vector scaling is not needed for spatial motion vector prediction candidate generation.

4.6.4.15 Test bitstreams #AMVP_C

Specification: All slices are coded as I or P slices. Each picture contains only one slice.

Functional stage: Test the reconstruction process of motion vector prediction, specifically, motion vector prediction during the low delay condition.

Purpose: Check that the decoder can properly decode when motion vector scaling is not needed for spatial motion vector prediction candidate generation.

4.6.4.16 Test bitstreams #TMVP_A

Specification: Each picture contains only one slice. slice_temporal_mvp_enabled_flag is set equal to 0 for pictures 0 to 8 and 1 for pictures 9 to 16.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode for different slice_temporal_mvp_enabled_flag values.

4.6.4.17 Test bitstreams #MVDL1ZERO_A

Specification: The bitstream contains multiple B slices per picture. Randomized on and off switching of the mvd_l1_zero_flag is included for multiple B slices.

Functional stage: Test the reconstruction process of motion vector prediction.

Purpose: Check that the decoder can properly decode when the parsing of list 1 motion vector difference for bi-prediction varies according to values of mvd_l1_zero_flag.

4.6.4.18 Test bitstreams #MVCLIP_A

Specification: Each picture contains only one slice. Motion vector prediction and merge candidate motion vectors are clipped to 16-bit values. Clipped motion vector prediction and merge candidates are selected.

Functional stage: Test the reconstruction process of motion vector prediction.

