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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**  29th Meeting: Macao, CN, 19–25 Oct. 2017 | Document: JCTVC-AC0033 |

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| *Title:* | **MCTS extraction with implicit slice reordering** | | |
| *Status:* | Input document | | |
| *Purpose:* | Proposal | | |
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# Abstract

With regard to the motion-constrained tile set (MCTS) extraction information set SEI message described in JCTVC-AB1005, the implicit slice reordering approach without additional syntax element is proposed. Instead of signaling the slice segment address of all slice segments included in the output picture, the ordering of MCTS indexes signaled in the SEI message and given parameters are used to induce the slice segment address of each MCTS in the output bitstream. Since the proposed method do not require any additional syntax elements in the derivation process, the slice reordering in the wrap-around position could be supported efficiently.

# Problem Statement

Motion-constrained tile set (MCTS) extraction information set SEI message provides supplemental information that can be used in the MCTS sub-bitstream extraction to generate a conforming bitstream for an MCTS set [1]. One of the issues with regard to MCTS extraction is the arrangement of MCTSs in the output picture of the sub-bitstream extraction when the MCTSs are on the wrap-around position of the original picture. In the previous JCT-VC meetings, two difference approaches were proposed to provide solutions: explicit signaling of slice addresses [2][3] and the implicit signaling of MCTS order [4]. In the first approach, the carriage of the replacement slice addresses through the MCTS extraction information set SEI message was proposed. In the second solution, it is proposed to use the order of MCTS indexes in a MCTS set to identify the position of MCTSs in the output picture of the sub-bitstream. Since this approach does not need any additional signaling, such as replacement address, this could be considered as an efficient approach to support the slice reordering function.

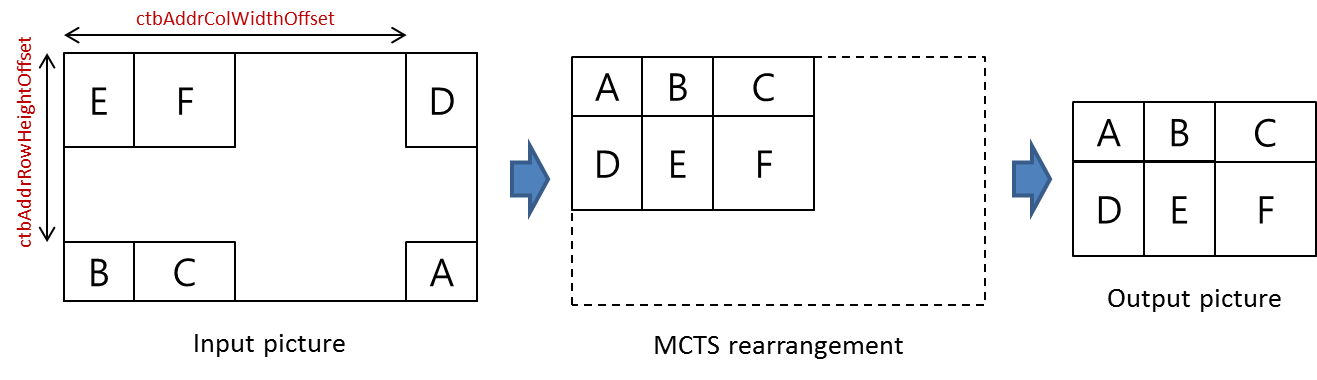


Figure 1. Reordering of MCTS with regard to the order of MCTS identifier. Alphabets in each MCTS (A-F) represent the order of MCTS identifier in the syntax element of MCTS EIS SEI message.

In Figure 1, an example of the MCTS sub-picture reordering process by using the orders of MCTS indexes is described. When the target MCTSs are determined, the horizontal and the vertical offsets of the first MCTS in the MCTS index order, which will be the top left MCTS in the output picture, are induced by using the information of the MCTS structure signalled in the temporal motion-constraint tile sets SEI message and the SPS parameters of the input image. By using the offset values, the MCTSs are rearranged where the first MCTS A is moved to top left position of the image, the MCTS B and C are wrapped and moved horizontally, MCTS D is wrapped and moved vertically, and MCTS E and F are wrapped and moved both horizontally and vertically. After the rearrangement of MCTSs, the output picture could be produced.

Similar to the MCTS sub-picture reordering, the slice addresses of the output picture could be derived by using the given parameters. The key of the derivation is the horizontal and the vertical offset values of the top left MCTS. As the first MCTS will be the top left position in the output picture, the offset values are derived by using the first CTB address of the slice segments in the first MCTS. With the offset values, the relative positions of other MCTSs are derived by shifting all the MCTSs, and then the slice address of each slice segment is calculated with respect to the shifted position in the rectangular region of the output picture.

In this proposal, we proposed to add this approach to the MCTS extraction information set SEI message as an implicit approach to support slice reordering process. As it is performed without any additional signaling, this could provide an efficient way of slice segment address replacement where the lengthy syntax element is burden to some use cases.

# Proposal

Based on the issues with regard to MCTS extraction information set SEI message, we propose to edit the slice segment address calculation process as follows.

In the semantics, add descriptions as highlighted.

**idx\_of\_mcts\_in\_set**[ i ][ j ][ k ] specifies the MCTS index of the k-th MCTS in the j-th MCTS set that is associated with the i-th extraction information set. The order index k represents the raster scan order of the k-th MCTSs in the j-th MCTS set where the width and the height of the output picture produced by the j-th MCTS set is provided by the associated SPS in the i-th extraction information set. The value of idx\_of\_mcts\_in\_set[ i ][ j ][ k ] shall be in the range of 0 to 511, inclusive.

In the sub-bitstream extraction process, replace the slice segment calculation process with the proposed text.

Instead of the current text :

– If slice\_reordering\_enabled\_flag[ mctsEISIdTarget ] is equal to 0, the coding tree block raster and tile scanning conversion process as specified in clause 6.5.1 is invoked with the syntax element values of the replacement SPS and PPS as inputs. The output CtbAddrRsToTs[ ctbAddrRs ] is assigned to extCtbAddrRsToTs[ ctbAddrRs ] and CtbAddrTsToRs[ ctbAddrTs ] is assigned to extCtbAddrTsToRs[ ctbAddrTs ]. For each remaining VCL NAL units in outBitstream, adjust the slice segment header as follows:

– For the first VCL NAL unit within each access unit, set the value of first\_slice\_segment\_in\_pic\_flag equal to 1, and set the value of slice\_segment\_address to be equal to 0.

– For each remaining VCL NAL units in outBitstream, let ctbAddrRs be the value of the raster scan address of the last CTB in the previous VCL NAL unit in bitstream order within a coded picture of outBitstream, set the value of first\_slice\_segment\_in\_pic\_flag equal to 0, and set the value of slice\_segment\_address equal to extCtbAddrTsToRs[ extCtbAddrRsToTs [ ctbAddrRs ] + 1 ].

Replace it with the following text :

* If slice\_reordering\_enabled\_flag[ mctsEISIdTarget ] is equal to 0, calculate the replacement slice segment address as follows.
* If each\_tile\_one\_tile\_set\_flag equal to 0, for MCTSs whose mcts\_id[ i ] equal to idx\_of\_mcts\_in\_set[ mctsEisIdTarget ][ mctsSetIdxTarget ][ 0 ], set colWidthOffsetInTiles and rowHeightOffsetInTiles equal to top\_left\_tile\_index[ i ][ 0 ] % ( num\_tile\_columns\_minus1 + 1 ) and top\_left\_tile\_index[ i ][ 0 ] / ( num\_tile\_columns\_minus1 + 1 ), respectively.
* Else if each\_tile\_one\_tile\_set\_flag\_equal to 1, set colWidthOffsetInTiles and rowHeightOffsetInTiles equal to idx\_of\_mcts\_in\_set[ mctsEisIdTarget ][ mctsSetIdxTarget ] [ 0 ] % ( num\_tile\_columns\_minus1 + 1 ) and idx\_of\_mcts\_in\_set[ mctsEisIdTarget ] [ mctsSetIdxTarget ][ 0 ] / ( num\_tile\_columns\_minus1 + 1 ), respectively.
* Calculate ctbAddrColWidthOffset and ctbAddrRowHeightOffset which are the sum of colWidth[ j ] for j ranges from 0 to colWidthOffsetInTiles and rowHeight[ j ] for j ranges from 0 to rowHeightOffsetInTiles, respectively, with the functions colWidth[ j ] and rowHeight[ j ] are evoked from defined in 6.5.1 given the SPS and PPS of the input video stream.
* For each VCL NAL units in outBitstream, the following applies.
  + Set inCtbAddrColWidth and inCtbAddrRowHeight equal to slice\_segment\_address % PicWidthInCtbsY and slice\_segment\_address / PicWidthInCtbsY, respectively, given the SPS of the input video stream.
  + Set outCtbAddrColWidth and outCtbAddrRowHeight equal to ( inCtbAddrColWidth − ctbAddrColWidthOffset + PicWidthInCtbsY ) % PicWidthInCtbsY and ( inCtbAddrRowHeight − ctbAddrRowHeightOffset + PicHeightInCtbsY ) % PicHeightInCtbsY, respectively, given the SPS of the input video stream.
  + Set the value of slice\_segment\_address equal to outCtbAddrColWidth + outCtbAddrRowHeight \* PicWidthInCtbsY, given the replacement SPS of the output video stream.
* Reorder the VCL NAL units within each access unit for ascending values of slice\_segment\_address.
* For the first VCL NAL unit within each access unit, set the value of first\_slice\_segment\_in\_pic\_flag equal to 1.

1. **References**
2. JCTVC-AB-1005, “HEVC Additional Supplemental Enhancement Information (Draft 3)”, J. Boyce, A. Ramasubramanian, R. Skupin, G. J. Sullivan, A. Tourapis, Y. –K. Wang, July 2017, Torino.
3. JCTVC-AA0029, “MCTS extraction with slice reordering”, R. Skupin, Y. Sanchez, April 2017, Hobart.
4. JCTVC-AB0028, “MCTS extraction with optional slice reordering”, R. Skupin, Y. Sanchez, July 2017, Torino.
5. JCTVC-AB0037, “On MCTS extraction information set SEI message”, H. -M. Oh, S. Oh, July 2017, Torino.

# Patent rights declaration(s)

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