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| *Title:* | **SEI message for display orientation information** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes an SEI message for describing display orientation information, to be included in an amendment to H.264/MPEG-4 AVC, and in the HEVC design. The proposed SEI message indicates to the renderer to rotate and/or flip the decoded picture for proper display, after the normal decoding process. Because handheld video capturing devices allow changing the picture capture orientation dynamically, using an SEI message allows dynamic changes to the picture display orientation, temporally aligned with the compressed video data.

The same proposal is being made to MPEG as m21659, and to VCEG as T09-SG16-C-0690, for consideration as an amendment to H.264/MPEG-4 AVC. The concept was originally proposed in contribution JCTVC-E280.

# Introduction

Many modern video capturing devices (e.g., handheld devices) can capture pictures in an orientation different from the desired rendering/display orientation, and the orientation may change during the capture of a video. Many cameras are able to detect their orientation, but there is not a standardized method to send the desired display orientation in a time aligned manner with the compressed video data.

Additionally, it is advantageous to allow an end-to-end system to choose whether the rotation function be performed at the capturing end prior to the encoding process, or at the display end following the decoding process. Graphical Processing Units (GPUs) have become very common in computers and mobile phones. GPUs typically provide rotation operations that can be performed very efficiently. GPUs are frequently used to render video after it has been decoded, and to perform color conversion and image scaling functions. The figure below illustrates an example end-to-end system where the rotation function has been moved from the encoder-end to the decoder-end, where the rotation operation can be efficiently performed in the GPU, along with other functions.



The proposed SEI message provides a flag to indicate if the image should be flipped, and it provides the rotation angle, in degrees. While the message provides for rotation in single degree increments, the renderer may choose to round to the nearest 90 degrees, or otherwise simplify the suggested rotation rendering.

# Proposal

This contribution proposes an SEI message for describing the picture display orientation. The orientation information indicates the rotation and/or flipping needed to apply to the decoded picture. The following are proposed changes to the current H.264/AVC specification; changes are highlighted.

**D.1 SEI payload syntax**

|  |  |
| --- | --- |
| sei\_payload( payloadType, payloadSize ) { | Descriptor |
| **…** |  |
| else if( payloadType = = 46 ) |  |
| display\_orientation( payloadSize ) |  |
| else |  |
| reserved\_sei\_message( payloadSize ) |  |
| **…** |  |
| } |  |

**D.1.26 Decoded picture orientation for display SEI message syntax**

|  |  |
| --- | --- |
| display\_orientation\_ ( payloadSize ) { | Descriptor |
| **x\_flip** | u(1) |
| **rotate\_deg** | ue(v) |
| **display\_orientation\_repetition\_period** | ue(v) |
| } |  |

**D.1.27 Reserved SEI message syntax**

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**D.2.26 Display orientation SEI message semantics**

**x\_flip** equal to 1 specifies that the decoded picture shall be flipped horizontally for display. x\_flip equal to 0 specifies that the decoded picture shall not be flipped horizontally.

If x\_flip is equal to 1, then the decoded picture is flipped as follows:

For each color component Z = L, Cb, and Cr

* Let dZ be the final array of samples to be displayed for the component Z.
* For x = 0 .. PicWidthInSamplesZ and y = 0 .. PicHeightInSamplesZ

dZ[x, y] = s’Z[PicWidthInSamplesZ – x – 1, y]

**rotate\_deg** specifies the clockwise rotation of the decoded picture (after applying horizontal flipping when x\_flip is set) in degrees. rotate\_deg shall be in the range of 0 to 359, inclusive.

**display\_orientation\_repetition\_period** specifies the persistence of the display orientation characteristics SEI message and may specify a picture order count interval within which another display orientation characteristics SEI message or the end of the coded video sequence shall be present in the bitstream. The value of display\_orientation\_repetition\_period shall be in the range 0 to 16 384, inclusive.

display\_orientation\_repetition\_period equal to 0 specifies that the display orientation characteristics SEI message applies to the current decoded picture only.

display\_orientation\_repetition\_period equal to 1 specifies that the display orientation characteristics SEI message persists in output order until any of the following conditions are true:

* A new coded video sequence begins.
* A picture in an access unit containing a display orientation characteristics SEI message is output having PicOrderCnt( ) greater than PicOrderCnt( CurrPic ).

display\_orientation\_repetition\_period greater than 1 specifies that the display orientation characteristics SEI message persists until any of the following conditions are true:

* A new coded video sequence begins.
* A picture in an access unit containing a display orientation characteristics SEI message is output having PicOrderCnt( ) greater than PicOrderCnt( CurrPic ) and less than or equal to PicOrderCnt( CurrPic ) + display\_orientation\_repetition\_period.

display\_orientation\_repetition\_period greater than 1 indicates that another display orientation characteristics SEI message shall be present for a picture in an access unit that is output having PicOrderCnt( ) greater than PicOrderCnt( CurrPic ) and less than or equal to PicOrderCnt( CurrPic ) + display\_orientation\_repetition\_period; unless the bitstream ends or a new coded video sequence begins without output of such a picture.

**D.2.27 Reserved SEI message semantics**

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# Patent rights declaration(s)

**Vidyo may have IPR relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**