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| **ITU - Telecommunications Standardization Sector**  STUDY GROUP 16 Question 6  **Video Coding Experts Group (VCEG)**  44th Meeting: San Jose, CA, USA, 03-10 February 2012 | Document VCEG-AR12  Filename: VCEG-AR12.docx |

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| Question: | Q.6/SG16 (VCEG) | | |
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| Title: | **Display Orientation Information SEI message** | | |
| Purpose: | Proposal | | |

# 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 m23499.

Small modifications were made to the syntax previously proposed in SG16 COM16-C.690.

# 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 flags to indicate if the image should be flipped horizontally or vertically, and it provides the rotation angle to a 16 bit precision. While the message provides for very precise rotation increments, the renderer may choose to round to the nearest 90 degrees, or otherwise simplify the suggested rotation rendering.

The operations are performed in the following order:

1. horizontal flipping, if hor\_flip equal to 1
2. vertical flipping, if ver\_flip equal to 1
3. rotation, if clockwise\_rotation not equal to 0

# 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 |
| **display\_orientation\_cancel\_flag** | u(1) |
| if ( !display\_orientation\_cancel\_flag) { |  |
| **hor\_flip** | u(1) |
| **ver\_flip** | u(1) |
| **clockwise\_rotation** | u(16) |
| **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**

**display\_orientation\_cancel\_flag** equal to 1 indicates that the SEI message cancels the persistence of any previous display orientation SEI message in output order. display\_orientation\_cancel\_flag equal to 0 indicates that display orientation information follows.

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

If hor\_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]

**ver\_flip** equal to 1 specifies that the decoded picture should be flipped vertically (after applying horizontal flipping when hor\_flip set) for display. ver\_flip equal to 0 specifies that the decoded picture should not be flipped vertically.

If ver\_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[x, PicHeightInSamplesZ – y – 1]

**clockwise\_rotation** specifies the recommended clockwise rotation of the decoded picture (after applying horizontal or vertical flipping when hor\_flip or ver\_flip is set). The decoded picture should be rotated by 360 \* clockwise\_rotation / 0x10000 degrees or 2 \* pi \* clockwise\_rotation / 0x10000 radians in the clockwise direction. For example, clockwise\_rotation equal to 0 indicates no rotation and clockwise\_rotation equal to 0x4000 indicates 90 degrees (pi/2 radians) rotation in clockwise direction. clockwise\_rotation shall be in the range of 0 to 0xFFFF, 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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