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| *Title:* | **On signalling of recommended viewport** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes a new SEI message, named omnidirectional viewport static information SEI message, to signal information on recommended viewports that is static, as opposed to the usually dynamic position and size of the viewport regions across time. Such static information includes priority and source of each recommended viewport. In addition, the omni\_viewport\_id syntax element is proposed to be removed from the omnidirectional viewport SEI message syntax, as the source information is asserted to be basically the same as the purpose of a viewport that may be indicated by omni\_viewport\_id.

MPEG document m40922 contains a proposal to OMAF for signalling of the same information in timed metadata file tracks. It is suggested that the decisions on the SEI message proposal in this document (JCTVC-AB034) and the OMAF proposal in MPEG document m40922 be made in a consistent manner, e.g., the decisions by the respectively groups could be aligned at a joint meeting session between JCT-VC and MPEG Systems (including at least experts of the OMAF AHG).

# Background

Clauses D.2.42 and D.3.42 of JCTVC-AA1005 specify the omnidirectional viewport SEI message for signalling of recommended viewport information.

When the value of omni\_viewport\_cnt\_minus1 is greater than 0, multiple viewports are signalled. However, in this case, between any two of the signalled viewports, which one is more recommended?

A recommended viewport may be generated per the director's cut, view frequency, a celebrity's preference, and so on. It'd be useful to provide such source information of recommended viewports such that the user can choose one based on his/her preference.

For other sources of recommended viewport than the director's cut or viewing statistics, identifying and specifying all of them is neither possible nor necessary. Instead, it should be sufficient to use a simple approach similar that applies to them all, similarly as for signalling of priority ID allocation methods in the scalability information SEI message in the AVC specification. The approach there was to signal a URI of the description of a priority ID allocation method.

Therefore, this contribution proposes a new SEI message, named omnidirectional viewport static information SEI message, to signal the information on recommended viewports that is static as opposed to the usually dynamic position and size of the sphere region across time. Such static information includes priority and source of each recommended viewport. In addition, the omni\_viewport\_id syntax element is proposed to be removed from the omnidirectional viewport SEI message syntax, as the source information is asserted to be basically the same as the purpose that may be indicated by omni\_viewport\_id. The omni\_viewport\_cnt\_minus1 syntax element is signalled in both the omnidirectional viewport SEI message and the new SEI message (with a different syntax element name in the new SEI message), to avoid syntax parsing dependency of the omnidirectional viewport SEI message on the new SEI message.

# Proposal

## The proposed omnidirectional viewport static information SEI message

The syntax and semantics of the proposed omnidirectional viewport static information SEI message are as follows:

|  |  |
| --- | --- |
| omni\_static\_info\_viewport( payloadSize ) { | **Descriptor** |
| **osv\_reserved\_zero\_4bits** | u(4) |
| **omni\_static\_viewport\_cnt\_minus1** | u(4) |
| for( i = 0; i  <=  omni\_static\_viewport\_cnt\_minus1; i++ ) { |  |
| **omni\_static\_viewport\_priority**[ i ] | u(8) |
| **omni\_static\_viewport\_source**[ i ] | u(8) |
| if(omni\_static\_viewport\_source[ i ] = = 2 ) { |  |
| ViewportGeneratingUriIdx[ i ] = 0 |  |
| do |  |
| **viewport\_generating\_uri**[ i ][ ViewportGeneratingUriIdx ] | b(8) |
| while( viewport\_generating\_uri[ i ][ ViewportGeneratingUriIdx++ ] != 0 ) |  |
| } |  |
| } |  |
| } |  |

The omnidirectional viewport static information SEI message specifies information that applies to all viewports specified by the omnidirectional viewport SEI messages in the CLVS.

When an omnidirectional projection indication SEI message with omni\_projection\_information\_cancel\_flag equal to 0 is not present in the CLVS that applies to the current picture and precedes the omnidirectional viewport static information SEI message in decoding order, an omnidirectional viewport static information SEI message shall not be present in the CLVS that applies to the current picture. Decoders shall ignore omnidirectional viewport static information SEI messages that do not follow, in decoding order, an omnidirectional projection indication SEI message with omni\_projection\_information\_cancel\_flag equal to 0 in the CLVS that applies to the current picture.

Let the current omnidirectional projection indication SEI message be the omnidirectional projection indication SEI message with omni\_projection\_information\_cancel\_flag equal to 0 in the CLVS that applies to the current picture. The information in an omnidirectional viewport static information SEI message persists from the current picture until the last picture in the CLVS, in decoding order, to which the current omnidirectional projection indication SEI message applies.

**osv\_reserved\_zero\_4bits** shall be equal to 0 in bitstreams conforming to this version of this Specification. Other values for osv\_reserved\_zero\_4bits are reserved for future use by ITU-T | ISO/IEC. Decoders shall ignore the value of osv\_reserved\_zero\_4bits.

**omni\_static\_viewport\_cnt\_minus1** plus 1 specifies the number of recommended viewport regions that are indicated by the omnidirectional viewport static information SEI message and the associated omnidirectional viewport SEI messages. The associated omnidirectional viewport SEI messages of an omnidirectional viewport static information SEI message are the omnidirectional viewport SEI messages with omni\_viewport\_cancel\_flag equal to 0 that apply to the same set of pictures of the CLVS to which the omnidirectional viewport static information SEI message applies.

**omni\_static\_viewport\_priority**[ i ] indicates the priority of the i-th viewport region specified by this SEI message and the associated omnidirectional viewport SEI messages. A lower value of omni\_static\_viewport\_priority[ i ] indicates a higher recommendation for the viewport. The viewport with a priority value 0 is the most recommended viewport.

**omni\_static\_viewport\_source**[ i ] specifies the source of the i-th viewport region specified by this SEI message and the associated omnidirectional viewport SEI messages as in Table D.X.

Table D.X: omni\_static\_viewport\_source[ i ] values

|  |  |
| --- | --- |
| **Value** | **Description** |
| 0 | A viewport per the director's cut |
| 1 | A viewport per the most-viewed viewport by statistics |
| 2 | A viewport per a method indicated by a URI |
| 3-255 | Reserved |

The value of omni\_static\_viewport\_source[ i ] shall be in the range of 0 to 2, inclusive, in bitstreams conforming to this version of this Specification. Other values for omni\_static\_viewport\_source[ i ] are reserved for future use by ITU-T | ISO/IEC. Decoders shall allow the value of omni\_static\_viewport\_source[ i ] greater than or equal to 3 to appear in the syntax and shall ignore the value of omni\_static\_viewport\_source[ i ] greater than or equal to 3.

**viewport\_generating\_uri**[ i ][ ViewportGeneratingUriIdx ] is the ViewportGeneratingUriIdx-th byte of a null-terminated string encoded in UTF-8 characters, specifying the universal resource identifier (URI) of the description of the method used to generate the i-th viewport region specified by this SEI message and the associated omnidirectional viewport SEI messages.

## Changes to the existing omnidirectional viewport SEI message

The syntax and semantics of the omnidirectional viewport SEI message are changed as follows (where yellow highlights are additions and strikethroughs in red fonts are removals):

|  |  |
| --- | --- |
| omni\_viewport( payloadSize ) { | **Descriptor** |
| **~~omni\_viewport\_id~~** | ~~u(10)~~ |
| **omni\_viewport\_cancel\_flag** | u(1) |
| if( !omni\_viewport\_cancel\_flag ) { |  |
| **omni\_viewport\_persistence\_flag** | u(1) |
| **ov\_reserved\_zero\_2bits** | u(2) |
| **omni\_viewport\_cnt\_minus1** | u(4) |
| for( i = 0; i  <=  omni\_viewport\_cnt\_minus1; i++ ) { |  |
| **omni\_viewport\_yaw\_center**[ i ] | i(32) |
| **omni\_viewport\_pitch\_center**[ i ] | i(32) |
| **omni\_viewport\_roll\_center**[ i ] | i(32) |
| **omni\_viewport\_yaw\_range**[ i ] | u(32) |
| **omni\_viewport\_pitch\_range**[ i ] | u(32) |
| } |  |
| } |  |
| } |  |

The omnidirectional viewport SEI message specifies the coordinates of one or more regions of spherical-coordinate geometry, bounded by four great circles, corresponding to viewports recommended for display. The reference spherical coordinate system used for the omnidirectional viewport SEI message is the same as for the omnidirectional projection indication SEI message with omni\_projection\_type equal to 0.

**~~omni\_viewport\_id~~** ~~contains an identifying number that may be used to identify the purpose of the one or more recommended viewport regions.~~

~~Values of omni\_viewport\_id from 0 to 511, inclusive, may be used as determined by the application. Values of omni\_viewport\_id from 512 to 1023 are reserved for future use by ITU-T | ISO/IEC. Decoders encountering a value of omni\_viewport\_id in the range of 512 to 1023, inclusive, shall ignore it.~~

**omni\_viewport\_cancel\_flag** equal to 1 indicates that the SEI message cancels the persistence of any previous omnidirectional viewport SEI message in output order. omni\_viewport\_cancel\_flag equal to 0 indicates that omnidirectional viewport information follows.

**omni\_viewport\_persistence\_flag** specifies the persistence of the omnidirectional viewport SEI message for the current layer.

omni\_viewport\_persistence\_flag equal to 0 specifies that the omnidirectional viewport SEI message applies to the current decoded picture only.

Let picA be the current picture. omni\_viewport\_persistence\_flag equal to 1 specifies that the omnidirectional viewport SEI message persists for the current layer in output order until one or more of the following conditions are true:

– A new CLVS of the current layer begins.

– The bitstream ends.

– A picture picB in the current layer in an access unit containing an omnidirectional viewport SEI message that is applicable to the current layer is output for which PicOrderCnt( picB ) is greater than PicOrderCnt( picA ), where PicOrderCnt( picB ) and PicOrderCnt( picA ) are the PicOrderCntVal values of picB and picA, respectively, immediately after the invocation of the decoding process for picture order count for picB.

When an omnidirectional viewport static information SEI message is not present in the CLVS that applies to the current picture and precedes the omnidirectional viewport SEI message in decoding order, an omnidirectional viewport SEI message with omni\_viewport\_cancel\_flag equal to 0 shall not be present in the CLVS that applies to the current picture. Decoders shall ignore omnidirectional viewport SEI messages with omni\_viewport\_cancel\_flag equal to 0 that do not follow, in decoding order, an omnidirectional viewport static information SEI message in the CLVS that applies to the current picture.

~~When an omnidirectional projection indication SEI message with omni\_projection\_information\_cancel\_flag equal to 0 is not present in the CLVS that applies to the current picture and precedes the omnidirectional viewport SEI message in decoding order, an omnidirectional viewport SEI message with omni\_viewport\_cancel\_flag equal to 0 shall not be present in the CLVS that applies to the current picture. Decoders shall ignore omnidirectional viewport SEI messages with omni\_viewport\_cancel\_flag equal to 0 that do not follow, in decoding order, an omnidirectional projection indication SEI message with omni\_projection\_information\_cancel\_flag equal to 0 in the CLVS that applies to the current picture.~~

**ov\_reserved\_zero\_2bits** shall be equal to 0 in bitstreams conforming to this version of this Specification. Other values for ov\_reserved\_zero\_2bits are reserved for future use by ITU-T | ISO/IEC. Decoders shall ignore the value of ov\_reserved\_zero\_2bits.

**omni\_viewport\_cnt\_minus1** plus 1 specifies the number of recommended viewport regions that are indicated by the SEI message. The value of omni\_viewport\_cnt\_minus1 shall be equal to omni\_static\_viewport\_cnt\_minus1 of the associated omnidirectional viewport static information SEI message.

**omni\_viewport\_yaw\_center**[ i ] indicates the center of the i-th recommended viewport region, around the up vector, in units of 2−16 degrees. The value of omni\_viewport\_yaw\_center[ i ] shall be in the range of −180 \* 216 (i.e., −11796480) to 180 \* 216 − 1 (i.e., 11796479), inclusive.

**omni\_viewport\_pitch\_center**[ i ] indicates the center of the i-th recommended viewport region, around the omni\_viewport\_yaw\_center, i.e., the right vector after yaw rotation, in units of 2−16 degrees. The value of omni\_viewport\_pitch\_center[ i ] shall be in the range of −90 \* 216 (i.e., −5898240) to 90 \* 216 (i.e., 5898240), inclusive.

**omni\_viewport\_roll\_center**[ i ] indicates the center of the i-th recommended viewport region, around the omni\_viewport\_pitch\_center, i.e., the forward vector after yaw and pitch rotation, in units of 2−16 degrees. The value of omni\_viewport\_roll\_center[ i ] shall be in the range of −180 \* 216 (i.e., −11796480) to  216 − 1 (i.e., 11796479), inclusive.

**omni\_viewport\_yaw\_range**[ i ] indicates the size of the i-th recommended viewport region of the projection mapped decoded picture in range of values of yaw in units of 2−16 degrees. The value of omni\_viewport\_yaw\_range[ i ] shall be in the range of 1 to 360 \* 216 (i.e., 23592960), inclusive.

**omni\_viewport\_pitch\_range**[ i ] indicates the size of the i-th recommended viewport region of the projection mapped decoded picture, in range of values of pitch in units of 2−16 degrees. The value of omni\_viewport\_pitch\_range[ i ] shall be in the range of 1 to 180 \* 216 (i.e., 11796480), inclusive.

# Patent rights declaration(s)

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