|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  28th Meeting: Torino, IT, 15–21 July 2017 | Document: JCTVC-AB0036 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **Supplemental enhancement information set SEI message** | | |
| *Status:* | Input document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Hyun-Mook Oh Sejin Oh Jong-Yeul Suh | Email: | hyunmook.oh@lge.com |
| *Source:* | LG Electronics | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

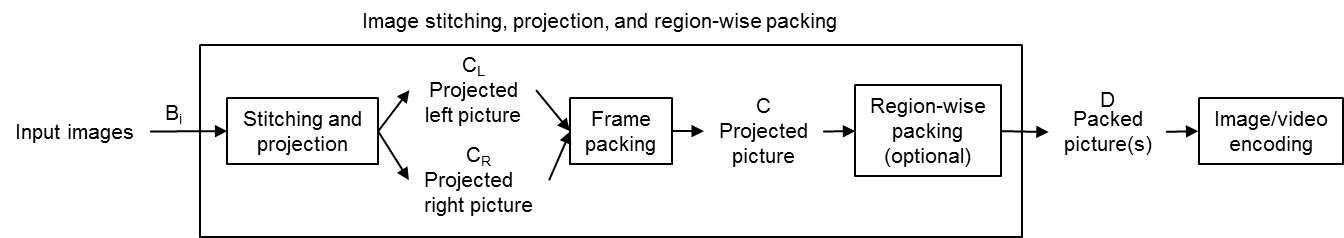
# Abstract

In this contribution, we propose a supplemental enhancement information set SEI message which indicates the list of SEI messages in the video stream and the processing order. It helps for receivers to reproduce the intention of the creator. As use cases for the proposed SEI messages, VR and HDR video pre-processing steps are reviewed as examples of multiple SEI message usages with sequential order.

# Background

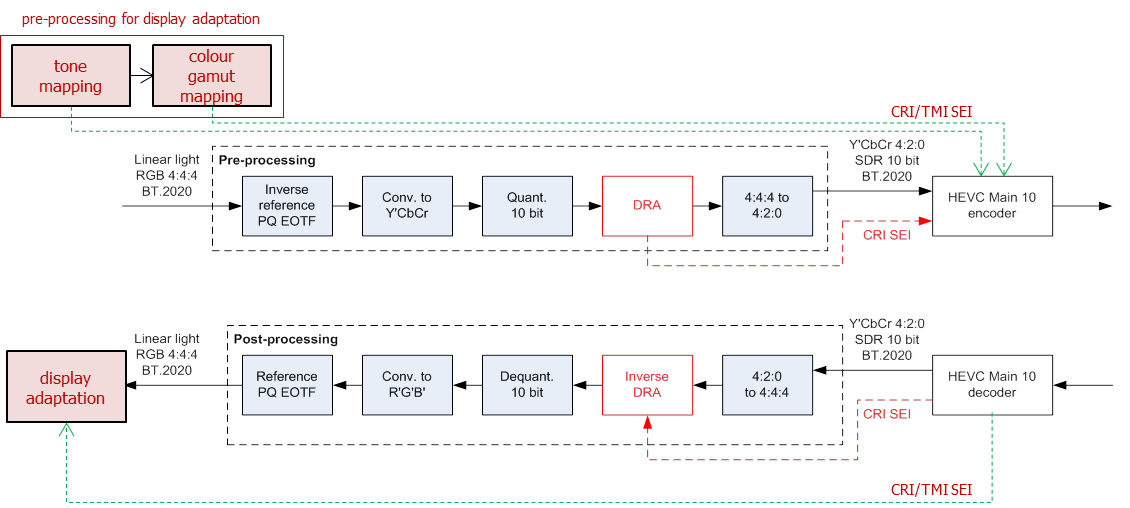
One of the topics discussed in the 27th JCT-VC meeting in Hobart was signaling of group of SEI messages contained in a video stream. In JCTVC-AA0026 [1], the groups are defined by two categories, called essential and non-essential supplemental information. The essential supplemental information contains a list of SEI messages that are present in the bitstream which are considered to be essential for receiver post-processing to enable a desirable user experience. The non-essential supplemental information was defined as an SEI message that is not considered by the encoder as an essential SEI message. The essentiality of an SEI message was determined by systems and application point of view.

Though the essential supplemental information is defined to support application layer needs, the provision of list of SEI messages could provide the benefit for a decoder to prepare post-processing. In the development of 360 video applications format [2], multiple processes are considered to generate a rectangular picture for encoder input. Such processes are the *projection* from the image data on the sphere to the rectangular picture and optional *region-wise packing* which rearranges the sub-pictures extracted and transformed from the projected picture. For stereoscopic video, *frame packing* is also applied prior to the *projection*. Thus, in order to produce the output image for 360 viewing experience in video bitstream, it is necessary to provide the list of SEI messages indicating how each process is applied and its order. The encoder pre-processing steps for stereoscopic 360 video are described in Figure 1.



**Figure** 1– **Stereoscopic image stitching, projection, and region-wise packing for stereoscopic 360-degree video in [2]**

Another example for using multiple SEI messages can be found in HDR video streams. When an SDR video stream down-converted from HDR video is delivered with SDR to HDR up-conversion parameters to support both SDR and HDR display devices, the conversion parameter can be carried by colour remapping information (CRI) or tone mapping information (TMI) SEI messages defined in HEVC [3]. On the other hand, those SEI messages could be used for display adaptation such as tone mapping and colour gamut mapping in general. In Figure 2, an example of producing the backward compatible single layer signal with the display adaptation metadata and its corresponding post-processing in the receiver is described. Since the video stream contains multiple CRI and TMI SEI messages for different purposes, the processing order of those SEI messages, such as SDR to HDR up-conversion, tone mapping, and colour gamut mapping, is critical to reproduce desired output picture. If the SEI messages are not applied by the intended processing order, the receiver could produce unsatisfactory or, even worse, un-displayable pictures.



**Figure** 2– **Pre-processing (top) and post-processing (down) for conversion from SDR to HDR with CRI SEI and display adaptation with CRI/TMI SEI (Modified from Figure 8-5 in TR1 [3])**

# Proposal

Based on the reviews on the use cases of multiple SEI messages, we propose to define the supplemental enhancement information set SEI message which provides the list of SEI messages with the recommended processing order. In order to indicate each SEI messages with efficiency, we propose to use payload type of corresponding SEI message. In order to cover the SEI messages with multiple purposes, SEI message identifier could be used for identification. Also, the update of an SEI message is signaled to indicate the dynamic change of information in the SEI message.

## Supplemental enhanced information set SEI message syntax

|  |  |
| --- | --- |
| supplemental\_enhancement\_information\_set( payloadSize ) { | **Descriptor** |
| **sei\_set\_id** | u(8) |
| **sei\_set\_cancel\_flag** | u(8) |
| if( ! sei\_set\_cancel\_flag ) { |  |
| **sei\_set\_persistence\_flag** | u(1) |
| **num\_sei\_msgs\_minus1** | u(8) |
| for( i = 0; i < = num\_sei\_msgs\_minus1; i++ ) { |  |
| **sei\_rec\_order\_constraint\_flag**[ i ] | u(1) |
| **sei\_msg\_id\_present\_flag**[ i ] | u(1) |
| **sei\_msg\_change\_flag**[ i ] | u(1) |
| **reserved\_5bits** | u(5) |
| **sei\_payload\_type**[ i ] | u(8) |
| if( sei\_msg\_id\_present\_flag[ i ] ) |  |
| **sei\_msg\_id**[ i ] | ue(v) |
| } |  |
| } |  |
| } |  |

## Supplemental enhanced information set SEI message semantics

The presence of the supplemental enhanced information set SEI message in a CLVS indicates that the list of SEI messages related to the coded video picture in the CLVS for an application. The information of the omnidirectional fisheye video carried in the omnidirectional fisheye video SEI message can be used by a receiver to reproduce the output picture intended by the encoder.

**sei\_set\_id** contains an identifying number that may be used to identify the purpose of the one or more SEI messages that are supplemental enhanced information set SEI message. The value of sei\_set\_id shall be in the range of 0 to 216 − 1, inclusive.

Values of sei\_set\_id from 0 to 255 and from 512 to 215 − 1 may be used as determined by the application. Values of sei\_set\_id from 256 to 511 and from 215 to 216 − 1 are reserved for future use by ITU-T | ISO/IEC. Decoders encountering a value of sei\_set\_id in the range of 256 to 511, inclusive, or in the range of 215 to 216 − 1, inclusive, shall ignore it.

**sei\_set\_cancel\_flag** equal to 1 indicates that the supplemental enhancement information set SEI message cancels the persistence of any previous supplemental enhancement information set SEI message in output order that applies to the current layer. sei\_set\_cancel\_flagequal to 0 indicates that supplemental enhancement information set information follows.

**sei\_set\_persistence\_flag** specifies the persistence of the supplemental enhancement information set SEI message for the current layer.

sei\_set\_persistence\_flag equal to 0 specifies that the supplemental enhancement information set applies to the current decoded picture only.

Let picA be the current picture. sei\_set\_persistence\_flag equal to 1 specifies that the supplemental enhancement information set SEI message persists for the current layer in output order until any 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 a supplemental enhancement information set 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 the picture order count of picB.

**num\_sei\_msgs\_minus1** plus 1 specifies the total number of SEI messages constained in the supplemental enhancement information set SEI message with sei\_set\_id.

**sei\_rec\_order\_constraint\_flag**[ i ] equal to 1 indicates that the i-th SEI message contained in the supplemental enhancement information set SEI message is recommended to be used in the sequential order of SEI messages with sei\_rec\_order\_constraint\_flag equal to 1. When both sei\_rec\_order\_constraint\_flag[ i ] and sei\_rec\_order\_constraint\_flag[ j ] equal to 1 and i is smaller than j, it is recommended to use SEI message designated by sei\_payload\_type[ i ] with sei\_msg\_id[ i ] prior to the SEI message designated by sei\_payload\_type[ j ] with sei\_msg\_id[ j ]. sei\_rec\_order\_constraint\_flag[ i ] equal to 0 indicates that there is no recommended order of use for the i-th SEI message contained in the supplemental enhancement information set SEI message.

**sei\_msg\_id\_present\_flag**[ i ] equal to 1 indicates that identification number sei\_msg\_id[ i ] is present for the i-th SEI message. sei\_msg\_id\_present\_flag[ i ] equal to 0 indicates that identification number sei\_msg\_id[ i ] is not present for the i-th SEI message.

When the following SEI messages are present in supplemental enhancement information set SEI message, sei\_msg\_id\_present\_flag[ i ] could be set equal to 1: Buffering period SEI message, Pan-scan rectangle SEI message, Picture snapshot SEI message, Progressive refinement segment start SEI message, Progressive refinement segment end SEI message, Tone mapping information SEI message, Frame packing arrangement SEI message, Active parameter sets SEI message, Knee function information SEI message, and Colour remapping information SEI message. Otherwise, sei\_msg\_id\_existence\_flag[ i ] should equal to 0.

**sei\_msg\_change\_flag**[ i ] equal to 1 indicates that the persistence flag in the i-th SEI message equal to 1. sei\_msg\_change\_flag[ i ] equal to 0 indicates that the persistence flag in the i-th SEI message equal to 0 or the persistence flag does not exist.

**sei\_payload\_type**[ i ] specifies the payload type, PayloadType defined in D.2.1, of the i-th SEI message in the supplemental enhancement information set SEI message designated by sei\_set\_id[ i ].

**sei\_msg\_id**[ i ] specifies the identification number that is used to indicate the purpose of the i-th SEI message. sei\_msg\_id[i] should be equal to the specific identification number in Buffering period SEI message, Pan-scan rectangle SEI message, Picture snapshot SEI message, Progressive refinement segment start SEI message, Progressive refinement segment end SEI message, Tone mapping information SEI message, Frame packing arrangement SEI message, Active parameter sets SEI message, Knee function information SEI message, or Colour remapping information SEI message.

1. **References**
2. JCTVC-AA0026, “SEI messages on SEI messages”, Y.-K. Wang, April 2017, Hobart.
3. W16824, “Text of ISO/IEC DIS 23090-2 Omnidirectional Media Format”, B. Choi, Y.-K. Wang, M. M. Hannuksela, Y. Lim, April 2017, Hobart.
4. JCTVC-Z1012, “Signaling, Backward Compatibility, and Display Adaptation for HDR/WCG Video(Draft 2)” E. François, D. Rusanovskyy, P. Yin, P. Topiwala, G. J. Sullivan, M. Naccari, January 2017, Geneva.

# Patent rights declaration(s)

**LG Electronics may have current or pending patent rights 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).**