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| *Title:* | **Additional proposed modifications of the draft shutter interval information SEI message syntax** | | |
| *Status:* | Input document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution discusses the draft shutter interval information SEI message as found in JCTVC-AK1005, which was adopted at the 37th JCT-VC meeting of October 2019; and proposed modifications to the draft as found in JCTVC-AL0021. JCTVC-AL0021 asserts that the syntax, as currently drafted, has undesirable characteristics and proposes six variant syntaxes to address these issues. This contribution proposes two additional variants to address those syntax characteristics that we agree are undesirable, and provides corresponding semantics.

In version 2 of this contribution, variation A is identical to variation #1 of JCTVC-AL0021. Version 2 also adds semantics to specify the presence and persistence of the shutter interval information SEI message in a CLVS.

# Problem Statement

JCTVC-AL0021 asserts the following are undesirable characteristics of the current syntax (enumerated here for clarity):

1. That it seems pointless and confusing to send sii\_num\_units\_in\_shutter\_interval when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 0, since the syntax element has no apparent purpose or meaning in that case.
2. That it seems pointless and confusing to send sii\_max\_sub\_layers\_minus1 when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 1, since the syntax element has no apparent purpose in that case.
3. That when the value of sps\_max\_sub\_layers\_minus1 in the SPS is equal to 0, it is strange to allow fixed\_shutter\_interval\_within\_clvs\_flag to be equal to 0, since this case becomes just an alternative way to express the same case as with fixed\_shutter\_interval\_within\_clvs\_flag to be equal to 1.
4. That the syntax seems excessive in terms of bit usage, using 68 + *n* \* 32 bits for a CLVS with *n* temporal sub-layers.

We agree with #1, #2, and #3. We also agree that #4 is desirable but assert that it would not be achieved by all of the variants proposed in JCTVC-AL0021.

The following are asserted for the variants proposed in JCTVC-AL0021:

* The syntax of each of variant #1 and #2 are easy to understand, though alternative syntax may use fewer bits.
* The syntax of each of variant #3 and #4 are easy to understand, but the use of ue(v) may not be more efficient as the values of sub-layer shutter interval may not be small.
* The syntax of each of variant #5 and #6 seems more complicated than alternative proposed syntax as the value of shutter interval is derived from an multiple (num\_ticks\_in\_shutter\_interval[ i ]) of a clock tick (sii\_num\_units\_in\_tick ÷ sii\_time\_scale), which may require more care when selecting a value for sii\_time\_scale when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 0.

# Proposal

Syntax and semantics for two proposed variants are presented below. Differences from JCTVC-AK1005 are highlighted in green below. Corresponding modifications of JCTVC-AK1005 are provided separately as JCTVC-AL0023-spec\_text-var\_A-v2.docx and JCTVC-A0023-spec\_text-var\_B-v2.docx

In version 2 of this contribution, the syntax of variant A is identical to that of JCTVC-AL0021 variant #1.

Variant B is similar to JCTVC-AL0021 variant #6. The main difference is that num\_ticks\_in\_shutter\_interval[ i ] is replaced by a ratio derived from sub\_layer\_shutter\_interval\_numer[ i ] and sub\_layer\_shutter\_interval\_denom[ i ].

Note that proposed variant B (below) is also similar to syntax discussed previously as JCTVC-AK0026 variant #1, which was not adopted. Instead, JCTVC-AK0026 variant #2 was adopted and formed the basis of the current syntax and semantics specified in JCTVC-AK1005.

## Proposed variation A (addressing issues #1, #2, and #3)

### Shutter interval information SEI message syntax

|  |  |
| --- | --- |
| shutter\_interval\_info( payloadSize ) { | **Descriptor** |
| **sii\_time\_scale** | u(32) |
| **fixed\_shutter\_interval\_within\_clvs\_flag** | u(1) |
| if( fixed\_shutter\_interval\_within\_clvs\_flag ) |  |
| **sii\_num\_units\_in\_shutter\_interval** | u(32) |
| else { |  |
| **sii\_max\_sub\_layers\_minus1** | u(3) |
| for( i = 0; i <= sii\_max\_sub\_layers\_minus1; i++ ) |  |
| **sub\_layer\_num\_units\_in\_shutter\_interval**[ i ] | u(32) |
| } |  |
| } |  |

### Shutter interval information SEI message syntax

The shutter interval information SEI message indicates the shutter interval for the associated video source pictures prior to encoding and display, e.g., for camera-captured content, the shutter interval is amount of time that an image sensor is exposed to produce each source picture.

When a shutter interval information SEI message is present for any picture of a CLVS of a particular layer, a shutter interval information SEI message shall be present for the first picture of the CLVS. The shutter interval information SEI message persists for the current layer in decoding order from the current picture until the end of the CLVS. All shutter interval information SEI messages that apply to the same CLVS shall have the same content.

**sii\_time\_scale** specifies the number of time units that pass in one second. The value of sii\_time\_scale shall be greater than 0. For example, a time coordinate system that measures time using a 27 MHz clock has an sii\_time\_scale of 27 000 000.

**fixed\_shutter\_interval\_within\_clvs\_flag** equal to 1 specifies that the indicated shutter interval is the same for all temporal sub-layers in the CLVS. fixed\_shutter\_interval\_within\_clvs\_flagequal to 0 specifies that the indicated shutter interval may not be the same for all temporal sub-layers in the CLVS. When the value of sii\_max\_sub\_layers\_minus1 is equal to 0, the value of fixed\_shutter\_interval\_within\_clvs\_flag shall be equal to 1. ~~When fixed\_shutter\_interval\_within\_clvs\_flag is equal to 0, sii\_num\_units\_in\_shutter\_interval has no meaning and should be equal to 0.~~

**sii\_num\_units\_in\_shutter\_interval**, when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 1, specifies the number of time units of a clock operating at the frequency sii\_time\_scale Hz that corresponds to the indicated shutter interval of each picture in the CLVS. The value 0 may be used to indicate that the associated video content contains screen capture content, computer generated content, or other non-camera-captured content.

The indicated shutter interval, denoted by the variable shutterInterval, in units of seconds, is equal to the quotient of sii\_num\_units\_in\_shutter\_interval divided by sii\_time\_scale. For example, to represent a shutter interval equal to 0.04 seconds, sii\_time\_scale may be equal to 27 000 000 and sii\_num\_units\_in\_shutter\_interval may be equal to 1 080 000.

**sub\_layer\_num\_units\_in\_shutter\_interval**[ i ], when present, specifies the number of time units of a clock operating at the frequency sii\_time\_scale Hz that corresponds to the shutter interval of each picture in the sub-layer representation with TemporalId equal to i in the CLVS. The sub-layer shutter interval for the sub-layer representation with TemporalId equal to i, denoted by the variable subLayerShutterInterval[ i ], in units of seconds, is equal to the quotient of sub\_layer\_num\_units\_in\_shutter\_interval[ i ] divided by sii\_time\_scale.

The variable subLayerShutterInterval[ i ], corresponding to the indicated shutter interval of each picture in the sub-layer representation with TemporalId equal to i in the CLVS, is thus derived as follows:

if( fixed\_shutter\_interval\_within\_clvs\_flag )  
 subLayerShutterInterval[ i ] = sii\_num\_units\_in\_shutter\_interval ÷ sii\_time\_scale (D.X)  
else  
 subLayerShutterInterval[ i ] = sub\_layer\_num\_units\_in\_shutter\_interval[ i ] ÷ sii\_time\_scale

### Bit usage

Bit usage of proposed variant A is as follows: 65 bits, when fixed\_shutter\_interval\_within\_clvs\_flag equal to 0; and 68 + n \* 32 bits for a CLVS with n temporal sub-layers, when fixed\_shutter\_interval\_within\_clvs\_flag equal to 1.

## Proposed variation B (addressing issues #1, #2, #3, and #4)

### Shutter interval information SEI message syntax

|  |  |
| --- | --- |
| shutter\_interval\_info( payloadSize ) { | **Descriptor** |
| **sii\_num\_units\_in\_shutter\_interval** | u(32) |
| **sii\_time\_scale** | u(32) |
| **fixed\_shutter\_interval\_within\_clvs\_flag** | u(1) |
| if( !fixed\_shutter\_interval\_within\_clvs\_flag ) |  |
| **sii\_max\_sub\_layers\_minus1** | u(3) |
| for( i = 0; i <= sii\_max\_sub\_layers\_minus1; i++ ) { |  |
| **sub\_layer\_shutter\_interval\_numer[ i ]** | ue(v) |
| **sub\_layer\_shutter\_interval\_denom[ i ]** | ue(v) |
| } |  |
| } |  |

### Shutter interval information SEI message syntax

The shutter interval information SEI message indicates the shutter interval for the associated video source pictures prior to encoding and display, e.g., for camera-captured content, the shutter interval is amount of time that an image sensor is exposed to produce each source picture.

When a shutter interval information SEI message is present for any picture of a CLVS of a particular layer, a shutter interval information SEI message shall be present for the first picture of the CLVS. The shutter interval information SEI message persists for the current layer in decoding order from the current picture until the end of the CLVS. All shutter interval information SEI messages that apply to the same CLVS shall have the same content.

**sii\_num\_units\_in\_shutter\_interval**, when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 1, specifies the number of time units of a clock operating at the frequency sii\_time\_scale Hz that corresponds to the indicated shutter interval of each picture in the CLVS. The value 0 may be used to indicate that the associated video content contains screen capture content, computer generated content, or other non-camera-captured content. ~~When fixed\_shutter\_interval\_within\_clvs\_flag is equal to 0, sii\_num\_units\_in\_shutter\_interval has no meaning and should be equal to 0.~~

The indicated shutter interval, denoted by the variable shutterInterval, in units of seconds, is equal to the quotient of sii\_num\_units\_in\_shutter\_interval divided by sii\_time\_scale. For example, to represent a shutter interval equal to 0.04 seconds, sii\_time\_scale may be equal to 27 000 000 and sii\_num\_units\_in\_shutter\_interval may be equal to 1 080 000.

**sii\_time\_scale** specifies the number of time units that pass in one second. The value of sii\_time\_scale shall be greater than 0. For example, a time coordinate system that measures time using a 27 MHz clock has an sii\_time\_scale of 27 000 000.

**sii\_max\_sub\_layers\_minus1** plus 1 specifies the maximum number of temporal sub-layers that may be present in each CLVS referring to the SPS. The value of sii\_max\_sub\_layers\_minus1 shall be equal to the value of sps\_max\_sub\_layers\_minus1 in the SPS.

**fixed\_shutter\_interval\_within\_clvs\_flag** equal to 1 specifies that the indicated shutter interval is the same for all temporal sub-layers in the CLVS. fixed\_shutter\_interval\_within\_clvs\_flagequal to 0 specifies that the indicated shutter interval may not be the same for all temporal sub-layers in the CLVS. When the value of sii\_num\_units\_in\_shutter\_interval is equal to 0, or when the value of sii\_max\_sub\_layers\_minus1 is equal to 0, the value of fixed\_shutter\_interval\_within\_clvs\_flag shall be equal to 1.

**sub\_layer\_shutter\_interval\_numer**[ i ]specifies the numerator used to derive sub layer shutter interval, defined by variable subLayerShutterInterval[ i ], in units of seconds, when HighestTid is equal to i. The value 0 may be used to indicate that the associated video content contains screen capture content, computer generated content, or other non-camera-captured content.

**sub\_layer\_shutter\_interval\_denom**[ i ]specifies the denominator used to derive sub layer shutter interval, defined by variable subLayerShutterInterval[ i ], in units of seconds, when HighestTid is equal to i. The value of sub\_layer\_shutter\_interval\_denom[ i ] shall be greater than 0.

The variable subLayerShutterInterval[ i ], corresponding to the indicated shutter interval of each picture in the sub-layer representation with TemporalId equal to i in the CLVS, is thus derived as follows:

if( fixed\_shutter\_interval\_within\_clvs\_flag )  
 subLayerShutterInterval[ i ] = sii\_num\_units\_in\_shutter\_interval ÷ sii\_time\_scale (D.X)  
else  
 subLayerShutterInterval[ i ] = sub\_layer\_num\_units\_in\_shutter\_interval ÷ sii\_time\_scale \* sub\_layer\_shutter\_interval\_numer[ i ] ÷ sub\_layer\_shutter\_interval\_denom[ i ]

### Bit usage

Bit usage of proposed variant B is as follows: 65 bits, when fixed\_shutter\_interval\_within\_clvs\_flag equal to 0; and typically less than 68 + n \* 32 bits for a CLVS with n temporal sub-layers, when fixed\_shutter\_interval\_within\_clvs\_flag is equal to 1.

The number of bits used for 0-th order Exp-Golomb code, ue(v), for various ranges of codeNum are tabulated in Table 1.

**Table 1. Number of bits for various ranges of codeNum for 0-th order Exp-Golomb codewords**

|  |  |  |
| --- | --- | --- |
| Range of codeNum | | Number of bits |
| min | Max |
| 1 | 2 | 3 |
| 3 | 6 | 5 |
| 7 | 14 | 7 |
| 15 | 30 | 9 |
| 31 | 62 | 11 |
| 63 | 126 | 13 |
| 127 | 254 | 15 |
| 255 | 510 | 17 |
| 511 | 1022 | 19 |
| 1023 | 2046 | 21 |
| 2047 | 4094 | 23 |
| 4095 | 8190 | 25 |
| 8191 | 16382 | 27 |
| 16383 | 32766 | 29 |
| 32767 | 65534 | 31 |

Bit usage of proposed variant B may be less than that for the syntax as currently drafted when the values of sub\_layer\_shutter\_interval\_numer[ i ] and sub\_layer\_shutter\_interval\_denom[ i ] have certain relationships. As examples, the total number of bits coded for the combination of sub\_layer\_shutter\_interval\_numer[ i ] and sub\_layer\_shutter\_interval\_denom[ i ] may be less than or equal to 32 for the following:

* when the value of sub\_layer\_shutter\_interval\_numer[ i ] is 1 or 2 and the value of sub\_layer\_shutter\_interval\_denom[ i ] is less than or equal to 32766;
* when the value of sub\_layer\_shutter\_interval\_numer[ i ] is equal to 254 and the value of sub\_layer\_shutter\_interval\_denom[ i ] is equal to 255.

In the second example (when sub\_layer\_shutter\_interval\_numer[ i ] is equal to 254), the value of the ratio of sub\_layer\_shutter\_interval\_numer[ i ] and sub\_layer\_shutter\_interval\_denom[ i ] would correspond to the finest precision possible for values of the ratio less than or equal to 1. In this example, the precision of the ratio would be 1/255

Thus, values of sub\_layer\_shutter\_interval\_numer[ i ] and sub\_layer\_shutter\_interval\_denom[ i ] may be selected so that the bit usage of proposed variant B would be less than 68 + n \* 32 bits for a CLVS with n temporal sub-layers; and may result in more precision than for variant A.

# Patent rights declaration(s)

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