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| *Title:* | **Additional Supplemental Enhancement Information for HEVC (Draft 3)** | | |
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| *Source:* | Editors | | |

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# Abstract

This document contains the draft text for changes to the High Efficiency Video Coding (HEVC) standard (Rec. ITU-T H.265 | ISO/IEC 23008-2) to specify additional supplemental enhancement information (SEI) messages for fisheye, SEI manifest, and SEI prefix, along with some corrections to the existing specification text.

**Changes to the specification text:**

*In 3, replace the definitions of tile, tile column, tile row, and tile scan with the following:*

**tile**: A rectangular region of *CTUs* within a particular *tile column* and a particular *tile row* in a *picture*.

**tile column**: A rectangular region of *CTUs* having a height equal to the height of the *picture* and a width specified by *syntax elements* in the *picture parameter set*.

**tile row**: A rectangular region of *CTUs* having a height specified by *syntax elements* in the *picture parameter set* and a width equal to the width of the *picture*.

**tile scan**: A specific sequential ordering of *CTUs* *partitioning* a *picture* in which the *CTUs* are ordered consecutively in *CTUs* *raster scan* in a *tile* whereas *tiles* in a *picture* are ordered consecutively in a *raster scan* of the *tiles* of the *picture*.

*In 5.8, replace Equation 5-20:*

Sqrt( x ) =  (5-20)

*with the following:*

Sqrt( x ) the square root of x. (5-20)

*Replace 7.3.3 with the following:*

**7.3.3 Profile, tier and level syntax**

|  |  |
| --- | --- |
| profile\_tier\_level( profilePresentFlag, maxNumSubLayersMinus1 ) { | **Descriptor** |
| if( profilePresentFlag ) { |  |
| **general\_profile\_space** | u(2) |
| **general\_tier\_flag** | u(1) |
| **general\_profile\_idc** | u(5) |
| for( j = 0; j < 32; j++ ) |  |
| **general\_profile\_compatibility\_flag**[ j ] | u(1) |
| **general\_progressive\_source\_flag** | u(1) |
| **general\_interlaced\_source\_flag** | u(1) |
| **general\_non\_packed\_constraint\_flag** | u(1) |
| **general\_frame\_only\_constraint\_flag** | u(1) |
| if( general\_profile\_idc = = 4 | | general\_profile\_compatibility\_flag[ 4 ] | |  general\_profile\_idc = = 5 | | general\_profile\_compatibility\_flag[ 5 ] | |  general\_profile\_idc = = 6 | | general\_profile\_compatibility\_flag[ 6 ] | |  general\_profile\_idc = = 7 | | general\_profile\_compatibility\_flag[ 7 ] | |  general\_profile\_idc = = 8 | | general\_profile\_compatibility\_flag[ 8 ] | |  general\_profile\_idc = = 9 | | general\_profile\_compatibility\_flag[ 9 ] | |  general\_profile\_idc = = 10 | | general\_profile\_compatibility\_flag[ 10 ] | |  general\_profile\_idc = = 11 | | general\_profile\_compatibility\_flag[ 11 ] ) {  /\* The number of bits in this syntax structure is not affected by this condition \*/ |  |
| **general\_max\_12bit\_constraint\_flag** | u(1) |
| **general\_max\_10bit\_constraint\_flag** | u(1) |
| **general\_max\_8bit\_constraint\_flag** | u(1) |
| **general\_max\_422chroma\_constraint\_flag** | u(1) |
| **general\_max\_420chroma\_constraint\_flag** | u(1) |
| **general\_max\_monochrome\_constraint\_flag** | u(1) |
| **general\_intra\_constraint\_flag** | u(1) |
| **general\_one\_picture\_only\_constraint\_flag** | u(1) |
| **general\_lower\_bit\_rate\_constraint\_flag** | u(1) |
| if( general\_profile\_idc = = 5 | | general\_profile\_compatibility\_flag[ 5 ] | |  general\_profile\_idc = = 9 | | general\_profile\_compatibility\_flag[ 9 ] | |  general\_profile\_idc = = 10 | | general\_profile\_compatibility\_flag[ 10 ] | |  general\_profile\_idc = = 11 | | general\_profile\_compatibility\_flag[ 11 ] ) { |  |
| **general\_max\_14bit\_constraint\_flag** | u(1) |
| **general\_reserved\_zero\_33bits** | u(33) |
| } else |  |
| **general\_reserved\_zero\_34bits** | u(34) |
| } else if( general\_profile\_idc = = 2 | | general\_profile\_compatibility\_flag[ 2 ] ) { |  |
| **general\_reserved\_zero\_7bits** | u(7) |
| **general\_one\_picture\_only\_constraint\_flag** | u(1) |
| **general\_reserved\_zero\_35bits** | u(35) |
| } else |  |
| **general\_reserved\_zero\_43bits** | u(43) |
| if( ( general\_profile\_idc = = 1 | | general\_profile\_compatibility\_flag[ 1 ] | |  general\_profile\_idc = = 2 | | general\_profile\_compatibility\_flag[ 2 ] | |  general\_profile\_idc = = 3 | | general\_profile\_compatibility\_flag[ 3 ] | |  general\_profile\_idc = = 4 | | general\_profile\_compatibility\_flag[ 4 ] | |  general\_profile\_idc = = 5 | | general\_profile\_compatibility\_flag[ 5 ] | |  general\_profile\_idc = = 9 | | general\_profile\_compatibility\_flag[ 9 ] | |  general\_profile\_idc = = 11 | | general\_profile\_compatibility\_flag[ 11 ] )  /\* The number of bits in this syntax structure is not affected by this condition \*/ |  |
| **general\_inbld\_flag** | u(1) |
| else |  |
| **general\_reserved\_zero\_bit** | u(1) |
| } |  |
| **general\_level\_idc** | u(8) |
| for( i = 0; i < maxNumSubLayersMinus1; i++ ) { |  |
| **sub\_layer\_profile\_present\_flag**[ i ] | u(1) |
| **sub\_layer\_level\_present\_flag**[ i ] | u(1) |
| } |  |
| if( maxNumSubLayersMinus1 > 0 ) |  |
| for( i = maxNumSubLayersMinus1; i < 8; i++ ) |  |
| **reserved\_zero\_2bits**[ i ] | u(2) |
| for( i = 0; i < maxNumSubLayersMinus1; i++ ) { |  |
| if( sub\_layer\_profile\_present\_flag[ i ] ) { |  |
| **sub\_layer\_profile\_space**[ i ] | u(2) |
| **sub\_layer\_tier\_flag**[ i ] | u(1) |
| **sub\_layer\_profile\_idc**[ i ] | u(5) |
| for( j = 0; j < 32; j++ ) |  |
| **sub\_layer\_profile\_compatibility\_flag**[ i ][ j ] | u(1) |
| **sub\_layer\_progressive\_source\_flag**[ i ] | u(1) |
| **sub\_layer\_interlaced\_source\_flag**[ i ] | u(1) |
| **sub\_layer\_non\_packed\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_frame\_only\_constraint\_flag**[ i ] | u(1) |
| if( sub\_layer\_profile\_idc[ i ] = = 4 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] | |  sub\_layer\_profile\_idc[ i ] = = 5 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] | |  sub\_layer\_profile\_idc[ i ] = = 6 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 6 ] | |  sub\_layer\_profile\_idc[ i ] = = 7 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 7 ] | |  sub\_layer\_profile\_idc[ i ] = = 8 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 8 ] | |  sub\_layer\_profile\_idc[ i ] = = 9 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 9 ] | |  sub\_layer\_profile\_idc[ i ] = = 10 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 10 ] | |  sub\_layer\_profile\_idc[ i ] = = 11 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 11 ] ) {  /\* The number of bits in this syntax structure is not affected by this condition \*/ |  |
| **sub\_layer\_max\_12bit\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_max\_10bit\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_max\_8bit\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_max\_422chroma\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_max\_420chroma\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_max\_monochrome\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_intra\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_one\_picture\_only\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_lower\_bit\_rate\_constraint\_flag**[ i ] | u(1) |
| if( sub\_layer\_profile\_idc[ i ] = = 5 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] | |  sub\_layer\_profile\_idc[ i ] = = 9 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 9 ] | |  sub\_layer\_profile\_idc[ i ] = = 10 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 10 ] | |  sub\_layer\_profile\_idc[ i ] = = 11 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 11 ] ) { |  |
| **sub\_layer\_max\_14bit\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_reserved\_zero\_33bits**[ i ] | u(33) |
| } else |  |
| **sub\_layer\_reserved\_zero\_34bits**[ i ] | u(34) |
| } else if( sub\_layer\_profile\_idc[ i ] = = 2 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 2 ] ) { |  |
| **sub\_layer\_reserved\_zero\_7bits**[ i ] | u(7) |
| **sub\_layer\_one\_picture\_only\_constraint\_flag**[ i ] | u(1) |
| **sub\_layer\_reserved\_zero\_35bits**[ i ] | u(35) |
| } else |  |
| **sub\_layer\_reserved\_zero\_43bits**[ i ] | u(43) |
| if( ( sub\_layer\_profile\_idc[ i ] = = 1 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 1 ] | |  sub\_layer\_profile\_idc[ i ] = = 2 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 2 ] | |  sub\_layer\_profile\_idc[ i ] = = 3 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 3 ] | |  sub\_layer\_profile\_idc[ i ] = = 4 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] | |  sub\_layer\_profile\_idc[ i ] = = 5 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] | |  sub\_layer\_profile\_idc[ i ] = = 9 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 9 ] | |  sub\_layer\_profile\_idc[ i ] = = 11 | |  sub\_layer\_profile\_compatibility\_flag[ i ][ 11 ] )  /\* The number of bits in this syntax structure is not affected by this condition \*/ |  |
| **sub\_layer\_inbld\_flag**[ i ] | u(1) |
| else |  |
| **sub\_layer\_reserved\_zero\_bit**[ i ] | u(1) |
| } |  |
| if( sub\_layer\_level\_present\_flag[ i ] ) |  |
| **sub\_layer\_level\_idc**[ i ] | u(8) |
| } |  |
| } |  |

*In 7.3.8.13 (Palette syntax), replace the following rows:*

|  |  |
| --- | --- |
| if ( !cu\_transquant\_bypass\_flag ) |  |

|  |  |
| --- | --- |
| if ( CopyAboveIndicesFlag[ xC ][ yC ] = = 0 ) { |  |

|  |  |
| --- | --- |
| if ( CopyAboveIndicesFlag[ xC ][ yC ] = = 0 ) |  |

*with the following rows, respectively (removing the space after "if"):*

|  |  |
| --- | --- |
| if( !cu\_transquant\_bypass\_flag ) |  |

|  |  |
| --- | --- |
| if( CopyAboveIndicesFlag[ xC ][ yC ] = = 0 ) { |  |

|  |  |
| --- | --- |
| if( CopyAboveIndicesFlag[ xC ][ yC ] = = 0 ) |  |

*In 7.4.3.3.1, replace the semantics of num\_ref\_idx\_l0\_default\_active\_minus1 and num\_ref\_idx\_l1\_default\_active\_minus1 with the following:*

**num\_ref\_idx\_l0\_default\_active\_minus1** specifies the inferred value of num\_ref\_idx\_l0\_active\_minus1 for P and B slices with num\_ref\_idx\_active\_override\_flag equal to 0. The value of num\_ref\_idx\_l0\_default\_active\_minus1 shall be in the range of 0 to 14, inclusive.

**num\_ref\_idx\_l1\_default\_active\_minus1** specifies the inferred value of num\_ref\_idx\_l1\_active\_minus1 for B slices with num\_ref\_idx\_active\_override\_flag equal to 0. The value of num\_ref\_idx\_l1\_default\_active\_minus1 shall be in the range of 0 to 14, inclusive.

*In 7.4.4, replace the following semantics of general\_non\_packed\_constraint\_flag:*

**general\_non\_packed\_constraint\_flag** equal to 1 specifies that there are no frame packing arrangement SEI messages, segmented rectangular frame packing arrangement SEI messages, equirectangular projection SEI messages, or cubemap projection SEI messages present in the CVS. general\_non\_packed\_constraint\_flag equal to 0 indicates that there may or may not be one or more frame packing arrangement SEI messages, segmented rectangular frame packing arrangement SEI messages, equirectangular projection SEI messages, or cubemap projection SEI messages present in the CVS.

NOTE 2 – Decoders may ignore the value of general\_non\_packed\_constraint\_flag, as there are no decoding process requirements associated with the presence or interpretation of frame packing arrangement SEI messages, segmented rectangular frame packing arrangement SEI messages, equirectangular projection SEI messages, or cubemap projection SEI messages.

*with the following:*

**general\_non\_packed\_constraint\_flag** equal to 1 specifies that there are no frame packing arrangement SEI messages, segmented rectangular frame packing arrangement SEI messages, equirectangular projection SEI messages, cubemap projection SEI messages, or fisheye video information SEI messages present in the CVS. general\_non\_packed\_constraint\_flag equal to 0 indicates that there may or may not be one or more frame packing arrangement SEI messages, segmented rectangular frame packing arrangement SEI messages, equirectangular projection SEI messages, cubemap projection SEI messages, or fisheye video information SEI messages present in the CVS.

NOTE 2 – Decoders may ignore the value of general\_non\_packed\_constraint\_flag, as there are no decoding process requirements associated with the presence or interpretation of frame packing arrangement SEI messages, segmented rectangular frame packing arrangement SEI messages, equirectangular projection SEI messages, cubemap projection SEI messages, or fisheye video information SEI messages.

*In 7.4.4, replace the following semantics of general\_inbld\_flag:*

**general\_inbld\_flag** equal to 1 specifies that the INBLD capability as specified in Annex F is required for decoding of the layer to which the profile\_tier\_level( ) syntax structure applies. general\_inbld\_flag equal to 0 specifies that the INBLD capability as specified in Annex F is not required for decoding of the layer to which the profile\_tier\_level( ) syntax structure applies. When profilePresentFlag is equal to 1, general\_profile\_idc is not equal to 9 and is not in the range of 1 to 5, inclusive, and general\_profile\_compatibility\_flag[ 9 ] is not equal to 1 and general\_profile\_compatibility\_flag[ j ] is not equal to 1 for any value of j in the range of 1 to 5, inclusive, the value of general\_inbld\_flag is inferred to be equal to 0.

*with the following:*

**general\_inbld\_flag** equal to 1 specifies that the INBLD capability as specified in Annex F is required for decoding of the layer to which the profile\_tier\_level( ) syntax structure applies. general\_inbld\_flag equal to 0 specifies that the INBLD capability as specified in Annex F is not required for decoding of the layer to which the profile\_tier\_level( ) syntax structure applies. When profilePresentFlag is equal to 1, general\_profile\_idc is not equal to 9 or 11 and is not in the range of 1 to 5, inclusive, general\_profile\_compatibility\_flag[ 9 ] is not equal to 1, general\_profile\_compatibility\_flag[ 11 ] is not equal to 1, and general\_profile\_compatibility\_flag[ j ] is not equal to 1 for any value of j in the range of 1 to 5, inclusive, the value of general\_inbld\_flag is inferred to be equal to 0.

*In 7.4.4, replace the following paragraph:*

The semantics of the syntax elements **sub\_layer\_profile\_space**[ i ], **sub\_layer\_tier\_flag**[ i ], **sub\_layer\_profile\_idc**[ i ], **sub\_layer\_profile\_compatibility\_flag**[ i ][ j ], **sub\_layer\_progressive\_source\_flag**[ i ], **sub\_layer\_‌interlaced\_‌source\_‌flag**[ i ], **sub\_layer\_non\_packed\_‌constraint\_flag**[ i ], **sub\_layer\_frame\_only\_‌constraint\_flag**[ i ], **sub\_layer\_max\_12bit\_‌constraint\_flag**[ i ], **sub\_layer\_max\_10bit\_‌constraint\_flag**[ i ], **sub\_layer\_max\_8bit\_‌constraint\_flag**[ i ], **sub\_layer\_max\_422chroma\_‌constraint\_flag**[ i ], **sub\_layer\_max\_420chroma\_‌constraint\_‌flag**[ i ], **sub\_layer\_max\_monochrome\_‌constraint\_flag**[ i ], **sub\_layer\_intra\_‌constraint\_flag**[ i ], **sub\_layer\_‌one\_picture\_‌only\_‌constraint\_flag**[ i ], **sub\_layer\_lower\_bit\_rate\_‌constraint\_flag**[ i ], **sub\_layer\_max\_14bit\_‌constraint\_flag**, **sub\_layer\_reserved\_zero\_33bits**[ i ], **sub\_layer\_reserved\_zero\_34bits**[ i ], **sub\_layer\_‌reserved\_zero\_7bits**[ i ]**, sub\_layer\_‌reserved\_zero\_35bits**[ i ], **sub\_layer\_reserved\_zero\_43bits**[ i ], **sub\_layer\_‌inbld\_‌flag**[ i ], **sub\_layer\_reserved\_zero\_bit**[ i ] and **sub\_layer\_level\_idc**[ i ] are, apart from the specification of the inference of not present values, the same as the syntax elements general\_profile\_space, general\_tier\_flag, general\_profile\_idc, general\_profile\_compatibility\_flag[ j ], general\_progressive\_source\_flag, general\_interlaced\_‌source\_‌flag, general\_non\_packed\_**‌**constraint\_flag, general\_frame\_only\_**‌**constraint\_flag, general\_max\_12bit\_**‌**constraint\_flag, general\_max\_10bit\_**‌**constraint\_flag, general\_max\_8bit\_**‌**constraint\_flag, general\_max\_422chroma\_**‌**constraint\_flag, general\_max\_420chroma\_**‌**constraint\_flag, general\_max\_monochrome\_**‌**constraint\_flag, general\_intra\_**‌**constraint\_flag, general\_one\_picture\_only\_**‌**constraint\_flag, general\_lower\_bit\_rate\_**‌**constraint\_flag, general\_max\_14bit\_**‌**constraint\_flag, general\_reserved\_zero\_33bits, general\_reserved\_zero\_34bits, general\_reserved\_zero\_7bits, general\_‌reserved\_‌zero\_‌35bits, general\_reserved\_zero\_43bits, general\_inbld\_flag, general\_reserved\_zero\_bit and general\_level\_idc, respectively, but apply to the sub-layer representation with TemporalId equal to i.

*with the following:*

Each of the syntax elements  
 **sub\_layer\_profile\_space**[ i ],  
 **sub\_layer\_tier\_flag**[ i ],  
 **sub\_layer\_profile\_idc**[ i ],  
 **sub\_layer\_profile\_compatibility\_flag**[ i ][ j ],  
 **sub\_layer\_progressive\_source\_flag**[ i ],  
 **sub\_layer\_interlaced\_source\_flag**[ i ],  
 **sub\_layer\_non\_packed\_constraint\_flag**[ i ],  
 **sub\_layer\_frame\_only\_constraint\_flag**[ i ],  
 **sub\_layer\_max\_12bit\_constraint\_flag**[ i ],  
 **sub\_layer\_max\_10bit\_constraint\_flag**[ i ],  
 **sub\_layer\_max\_8bit\_constraint\_flag**[ i ],  
 **sub\_layer\_max\_422chroma\_constraint\_flag**[ i ],  
 **sub\_layer\_max\_420chroma\_constraint\_flag**[ i ],  
 **sub\_layer\_max\_monochrome\_constraint\_flag**[ i ],  
 **sub\_layer\_intra\_constraint\_flag**[ i ],  
 **sub\_layer\_one\_picture\_only\_constraint\_flag**[ i ],  
 **sub\_layer\_lower\_bit\_rate\_constraint\_flag**[ i ],  
 **sub\_layer\_max\_14bit\_constraint\_flag**[ i ],  
 **sub\_layer\_reserved\_zero\_33bits**[ i ],  
 **sub\_layer\_reserved\_zero\_34bits**[ i ],  
 **sub\_layer\_reserved\_zero\_7bits**[ i ]**,  
 sub\_layer\_reserved\_zero\_35bits**[ i ],  
 **sub\_layer\_reserved\_zero\_43bits**[ i ],  
 **sub\_layer\_inbld\_flag**[ i ],  
 **sub\_layer\_reserved\_zero\_bit**[ i ], and  
 **sub\_layer\_level\_idc**[ i ]  
is referred to as the i-th corresponding sub-layer syntax element of each of the syntax elements  
 general\_profile\_space,  
 general\_tier\_flag,  
 general\_profile\_idc,  
 general\_profile\_compatibility\_flag[ j ],  
 general\_progressive\_source\_flag,  
 general\_interlaced\_source\_flag,  
 general\_non\_packed\_constraint\_flag,  
 general\_frame\_only\_constraint\_flag,  
 general\_max\_12bit\_constraint\_flag,  
 general\_max\_10bit\_constraint\_flag,  
 general\_max\_8bit\_constraint\_flag,  
 general\_max\_422chroma\_constraint\_flag,  
 general\_max\_420chroma\_constraint\_flag,  
 general\_max\_monochrome\_constraint\_flag,  
 general\_intra\_constraint\_flag,  
 general\_one\_picture\_only\_constraint\_flag,  
 general\_lower\_bit\_rate\_constraint\_flag,  
 general\_max\_14bit\_constraint\_flag,  
 general\_reserved\_zero\_33bits,  
 general\_reserved\_zero\_34bits,  
 general\_reserved\_zero\_7bits,  
 general\_reserved\_zero\_35bits,  
 general\_reserved\_zero\_43bits,  
 general\_inbld\_flag,  
 general\_reserved\_zero\_bit, and  
 general\_level\_idc,  
respectively.

The semantics of a particular syntax element's i-th corresponding sub-layer syntax element, apart from the specification of the inference of not present value, is the same as the particular syntax element, but applies to the sub-layer representation with TemporalId equal to i.

*In 7.4.7.1, replace the semantics of delta\_poc\_msb\_cycle\_lt[ i ] with the following:*

**delta\_poc\_msb\_cycle\_lt**[ i ] is used to determine the value of the most significant bits of the picture order count value of the i-th entry in the long-term RPS of the current picture. The value of delta\_poc\_msb\_cycle\_lt[ i ] shall be in the range of 0 to 2(32 − log2\_max\_pic\_order\_cnt\_lsb\_minus4 − 4 ), inclusive. When delta\_poc\_msb\_cycle\_lt[ i ] is not present, it is inferred to be equal to 0.

The variable DeltaPocMsbCycleLt[ i ] is derived as follows:

if( i = = 0 | | i = = num\_long\_term\_sps )  
 DeltaPocMsbCycleLt[ i ] = delta\_poc\_msb\_cycle\_lt[ i ]  
else (7-52)  
 DeltaPocMsbCycleLt[ i ] = delta\_poc\_msb\_cycle\_lt[ i ] + DeltaPocMsbCycleLt[ i − 1 ]

*In 7.4.8, replace the semantics of delta\_poc\_s0\_minus1[ i ] with the following:*

**delta\_poc\_s0\_minus1**[ i ] plus 1, when i is equal to 0, specifies the difference between the picture order count values of the current picture and the i-th entry in the stRpsIdx-th candidate short-term RPS that has picture order count value less than that of the current picture, or, when i is greater than 0, specifies the difference between the picture order count values of the ( i − 1 )-th entry and the i-th entry in the stRpsIdx-th candidate short-term RPS that have picture order count values less than the picture order count value of the current picture. The value of delta\_poc\_s0\_minus1[ i ] shall be in the range of 0 to 215 − 1, inclusive.

*In 7.4.9.14, replace the following paragraphs:*

**cu\_qp\_delta\_abs** specifies the absolute value of the difference CuQpDeltaVal between the luma quantization parameter of the current coding unit and its prediction.

**cu\_qp\_delta\_sign\_flag** specifies the sign of CuQpDeltaVal as follows:

* If cu\_qp\_delta\_sign\_flag is equal to 0, the corresponding CuQpDeltaVal has a positive value.
* Otherwise (cu\_qp\_delta\_sign\_flag is equal to 1), the corresponding CuQpDeltaVal has a negative value.

When cu\_qp\_delta\_sign\_flag is not present, it is inferred to be equal to 0.

When cu\_qp\_delta\_abs is present, the variables IsCuQpDeltaCoded and CuQpDeltaVal are derived as follows:

IsCuQpDeltaCoded = 1 (7-87)

CuQpDeltaVal = cu\_qp\_delta\_abs \* ( 1 − 2 \* cu\_qp\_delta\_sign\_flag ) (7-88)

The value of CuQpDeltaVal shall be in the range of −( 26 + QpBdOffsetY / 2 ) to +( 25 + QpBdOffsetY / 2 ), inclusive.

*with the following:*

**cu\_qp\_delta\_abs** specifies the absolute value of the difference CuQpDeltaVal between the luma quantization parameter of the current coding unit and its prediction.

When cu\_qp\_delta\_abs is present, the variable IsCuQpDeltaCoded is set equal to 1.

**cu\_qp\_delta\_sign\_flag**, when present, specifies the value of CuQpDeltaVal as follows.

When cu\_qp\_delta\_sign\_flag is not present, it is inferred to be equal to 0.

The variable CuQpDeltaVal is set as follows:

CuQpDeltaVal = cu\_qp\_delta\_abs \* ( 1 − 2 \* cu\_qp\_delta\_sign\_flag ) (7-87)

The value of CuQpDeltaVal shall be in the range of −( 26 + QpBdOffsetY / 2 ) to +( 25 + QpBdOffsetY / 2 ), inclusive.

*And renumber the Equations 7-89 and 7-90 in 7.4.9.15 to be Equations 7-88 and 7-89, respectively.*

*In 8.4.4.2.5 (Specification of intra prediction mode INTRA\_DC), replace Equation 8-47:*

dcVal =  (8-47)

*with (replacing "k − 1" with "k + 1")*

dcVal =  (8-47)

*In 9.3.4.2.1 (General), Table 9-48, replace the following two rows:*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| last\_sig\_coeff\_x\_suffix | bypass | bypass | bypass | bypass | bypass | bypass |
| last\_sig\_coeff\_y\_suffix | bypass | bypass | bypass | bypass | bypass | bypass |

*with the following:*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| last\_sig\_coeff\_x\_suffix | bypass | bypass | bypass | na | na | na |
| last\_sig\_coeff\_y\_suffix | bypass | bypass | bypass | na | na | na |

*In A.3.5, replace the following paragraphs:*

Conformance of a bitstream to the format range extensions profiles is indicated by general\_profile\_idc being equal to 4 or general\_profile\_compatibility\_flag[ 4 ] being equal to 1 with the additional indications specified in Table A.2. Conformance of a sub-layer representation with TemporalId equal to i to the format range extensions profiles is indicated by sub\_layer\_profile\_idc[ i ] being equal to 4 or sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] being equal to 1 with the additional indications specified in Table A.2, with general\_max\_12bit\_**‌**constraint\_flag, general\_max\_10bit\_**‌**constraint\_flag, general\_max\_8bit\_**‌**constraint\_flag, general\_max\_422chroma\_**‌**constraint\_flag, general\_max\_420chroma\_**‌**constraint\_flag, general\_max\_monochrome\_**‌**constraint\_flag, general\_intra\_**‌**constraint\_flag, general\_one\_picture\_only\_**‌**constraint\_flag and general\_lower\_bit\_rate\_**‌**constraint\_flag replaced by sub\_layer\_max\_12bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_10bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_8bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_422chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_420chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_monochrome\_**‌**constraint\_flag[ i ], sub\_layer\_intra\_**‌**constraint\_flag[ i ], sub\_layer\_one\_picture\_only\_**‌**constraint\_flag[ i ] and sub\_layer\_lower\_bit\_rate\_**‌**constraint\_flag[ i ], respectively.

All other combinations of general\_max\_12bit\_**‌**constraint\_flag, general\_max\_10bit\_**‌**constraint\_flag, general\_max\_8bit\_**‌**constraint\_flag, general\_max\_422chroma\_**‌**constraint\_flag, general\_max\_420chroma\_**‌**constraint\_flag, general\_max\_‌monochrome\_**‌**constraint\_flag, general\_intra\_**‌**constraint\_flag, general\_one\_picture\_only\_**‌**constraint\_flag and general\_lower\_bit\_rate\_**‌**constraint\_flag with general\_profile\_idc equal to 4 or general\_profile\_compatibility\_flag[ 4 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. All other combinations of sub\_layer\_max\_12bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_10bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_8bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_‌422chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_420chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_monochrome\_**‌**constraint\_flag[ i ], sub\_layer\_intra\_**‌**constraint\_flag[ i ], sub\_layer\_one\_picture\_only\_**‌**constraint\_flag[ i ] and sub\_‌layer\_‌lower\_bit\_rate\_**‌**constraint\_flag[ i ] with sub\_layer\_profile\_idc[ i ] equal to 4 or sub\_layer\_‌profile\_‌compatibility\_flag[ i ][ 4 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. Such combinations shall not be present in bitstreams conforming to this Specification. However, decoders conforming to the format range extensions profiles shall allow other combinations as specified below in this clause to occur in the bitstream.

*with the following:*

Conformance of a bitstream to the format range extensions profiles is indicated by general\_profile\_idc being equal to 4 or general\_profile\_compatibility\_flag[ 4 ] being equal to 1 with the additional indications specified in Table A.2. Conformance of a sub-layer representation with TemporalId equal to i to the format range extensions profiles is indicated by sub\_layer\_profile\_idc[ i ] being equal to 4 or sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] being equal to 1 with the additional indications specified in Table A.2, with each of the syntax elements in Table A.2 being replaced by its i-th corresponding sub-layer syntax element.

All other combinations of the syntax elements in Table A.2 with general\_profile\_idc equal to 4 or general\_profile\_compatibility\_flag[ 4 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. All other combinations of the i-th corresponding sub-layer syntax elements of the syntax elements in Table A.2 with sub\_layer\_profile\_idc[ i ] equal to 4 or sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. Such combinations shall not be present in bitstreams conforming to this document. However, decoders conforming to the format range extensions profiles shall allow other combinations as specified below in this subclause to occur in the bitstream.

*In A.3.5, replace the following bullet item:*

– sub\_layer\_profile\_idc[ i ] is equal to 4 or sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] is equal to 1 for the sub-layer representation, and the value of each constraint flag listed in Table A.2 is greater than or equal to the value(s) specified in the row of Table A.2 for the format range extensions profile for which the decoder conformance is evaluated, with general\_max\_12bit\_**‌**constraint\_flag, general\_max\_10bit\_**‌**constraint\_flag, general\_max\_8bit\_**‌**constraint\_flag, general\_max\_422chroma\_**‌**constraint\_flag, general\_max\_420chroma\_**‌**constraint\_flag, general\_max\_monochrome\_**‌**constraint\_flag, general\_intra\_**‌**constraint\_flag, general\_one\_‌picture\_‌only\_**‌**constraint\_flag and general\_lower\_bit\_rate\_**‌**constraint\_flag replaced by sub\_layer\_max\_12bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_10bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_8bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_422chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_420chroma\_**‌**constraint\_flag[ i ], sub\_layer\_‌max\_‌monochrome\_**‌**constraint\_flag[ i ], sub\_layer\_intra\_**‌**constraint\_flag[ i ], sub\_layer\_one\_picture\_only\_**‌**constraint\_flag[ i ] and sub\_layer\_lower\_bit\_rate\_**‌**constraint\_flag[ i ], respectively.

*with the following:*

– sub\_layer\_profile\_idc[ i ] is equal to 4 or sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] is equal to 1 for the sub-layer representation, and the value of each constraint flag listed in Table A.2 is greater than or equal to the value(s) specified in the row of Table A.2 for the format range extensions profile for which the decoder conformance is evaluated, with each of the syntax elements in Table A.2 being replaced by its i-th corresponding sub-layer syntax element.

*In A.3.6, replace the following paragraphs:*

The following profiles, collectively referred to as the high throughput profiles, are specified in this clause:

* The High Throughput 4:4:4, High Throughput 4:4:4 10 and High Throughput 4:4:4 14 profiles
* The High Throughput 4:4:4 16 Intra profile

NOTE 1 – For purposes of this terminology, the screen content coding extensions profiles specified in clause A.3.7 are not included in the set of profiles that are collectively referred to as the high throughput profiles, although the names of some of the screen content coding extensions profiles include the term "High Throughput".

*with the following:*

The following profiles, collectively referred to as the high throughput profiles, are specified in this clause:

* The High Throughput 4:4:4, High Throughput 4:4:4 10 and High Throughput 4:4:4 14 profiles
* The High Throughput 4:4:4 16 Intra profile

NOTE 1 – For purposes of this terminology, the high throughput screen content coding extensions profiles specified in clause A.3.8 are not included in the set of profiles that are collectively referred to as the high throughput profiles, although the names of some of the high throughput screen content coding extensions profiles include the term "High Throughput".

*In A.3.6, replace the following paragraphs:*

Conformance of a bitstream to the high throughput profiles is indicated by general\_profile\_idc being equal to 5 or general\_profile\_compatibility\_flag[ 5 ] being equal to 1 with the additional indications specified in Table A.3. Conformance of a sub-layer representation with TemporalId equal to i to the high throughput profiles is indicated by sub\_layer\_profile\_idc[ i ] being equal to 5 or sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] being equal to 1 with the additional indications specified in Table A.3, with general\_max\_12bit\_**‌**constraint\_flag, general\_max\_10bit\_**‌**constraint\_flag, general\_max\_8bit\_**‌**constraint\_flag, general\_max\_422chroma\_**‌**constraint\_flag, general\_max\_420chroma\_**‌**constraint\_flag, general\_max\_monochrome\_**‌**constraint\_flag, general\_intra\_**‌**constraint\_flag, general\_one\_picture\_only\_**‌**constraint\_flag and general\_lower\_bit\_rate\_**‌**constraint\_flag being replaced by sub\_layer\_max\_12bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_10bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_8bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_422chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_420chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_monochrome\_**‌**constraint\_flag[ i ], sub\_layer\_intra\_**‌**constraint\_flag[ i ], sub\_layer\_one\_picture\_only\_**‌**constraint\_flag[ i ] and sub\_layer\_lower\_bit\_rate\_**‌**constraint\_flag[ i ], respectively.

All other combinations of general\_max\_12bit\_**‌**constraint\_flag, general\_max\_10bit\_**‌**constraint\_flag, general\_max\_8bit\_**‌**constraint\_flag, general\_max\_422chroma\_**‌**constraint\_flag, general\_max\_420chroma\_**‌**constraint\_flag, general\_max\_‌monochrome\_**‌**constraint\_flag, general\_intra\_**‌**constraint\_flag, general\_one\_picture\_only\_**‌**constraint\_flag and general\_lower\_bit\_rate\_**‌**constraint\_flag with general\_profile\_idc equal to 5 or general\_profile\_compatibility\_flag[ 5 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. All other combinations of sub\_layer\_max\_12bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_10bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_8bit\_**‌**constraint\_flag[ i ], sub\_layer\_‌max\_422chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_420chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_monochrome\_**‌**constraint\_flag[ i ], sub\_layer\_intra\_**‌**constraint\_flag[ i ], sub\_layer\_one\_picture\_only\_**‌**constraint\_flag[ i ] and sub\_layer\_‌lower\_bit\_rate\_**‌**constraint\_flag[ i ], with sub\_layer\_profile\_idc[ i ] equal to 5 or sub\_layer\_profile\_‌compatibility\_‌flag[ i ][ 5 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. Such combinations shall not be present in bitstreams conforming to this Specification. However, decoders conforming to the format range extensions profiles shall allow other combinations as specified below in this clause to occur in the bitstream.

*with the following:*

Conformance of a bitstream to the high throughput profiles is indicated by general\_profile\_idc being equal to 5 or general\_profile\_compatibility\_flag[ 5 ] being equal to 1 with the additional indications specified in Table A.3. Conformance of a sub-layer representation with TemporalId equal to i to the high throughput profiles is indicated by sub\_layer\_profile\_idc[ i ] being equal to 5 or sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] being equal to 1 with the additional indications specified in Table A.3, with each of the syntax elements in Table A.3 being replaced by its i-th corresponding sub-layer syntax element.

All other combinations of the syntax elements in Table A.3 with general\_profile\_idc equal to 5 or general\_profile\_compatibility\_flag[ 5 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. All other combinations of the i-th corresponding sub-layer syntax elements of the syntax elements in Table A.3 with sub\_layer\_profile\_idc[ i ] equal to 5 or sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. Such combinations shall not be present in bitstreams conforming to this document. However, decoders conforming to the format range extensions profiles shall allow other combinations as specified below in this subclause to occur in the bitstream.

*In A.3.6, replace the following bullet item:*

– sub\_layer\_profile\_idc[ i ] is equal to 5 or sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] is equal to 1 for the sub-layer representation, and the value of each constraint flag listed in Table A.3 is greater than or equal to the value(s) specified in the row of Table A.3 for the high throughput profile for which the decoder conformance is evaluated, with general\_max\_14bit\_**‌**constraint\_flag, general\_max\_12bit\_**‌**constraint\_flag, general\_max\_10bit\_**‌**constraint\_flag, general\_max\_8bit\_**‌**constraint\_flag, general\_max\_422chroma\_**‌**constraint\_flag, general\_max\_420chroma\_**‌**constraint\_flag, general\_max\_monochrome\_**‌**constraint\_flag, general\_intra\_**‌**constraint\_flag, general\_one\_picture\_only\_**‌**constraint\_flag and general\_lower\_bit\_rate\_**‌**constraint\_flag being replaced by sub\_layer\_max\_14bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_12bit\_**‌**constraint\_flag[ i ], sub\_layer\_‌max\_10bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_8bit\_**‌**constraint\_flag[ i ], sub\_layer\_max\_422chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_420chroma\_**‌**constraint\_flag[ i ], sub\_layer\_max\_monochrome\_**‌**constraint\_‌flag[ i ], sub\_layer\_intra\_**‌**constraint\_flag[ i ], sub\_layer\_one\_picture\_only\_**‌**constraint\_flag[ i ], and sub\_layer\_‌lower\_bit\_rate\_**‌**constraint\_flag[ i ], respectively.

*with the following:*

— sub\_layer\_profile\_idc[ i ] is equal to 5 or sub\_layer\_profile\_compatibility\_flag[ i ][ 5 ] is equal to 1 for the sub-layer representation, and the value of each constraint flag listed in Table A.3 is greater than or equal to the value(s) specified in the row of Table A.3 for the high throughput profile for which the decoder conformance is evaluated, with each of the syntax elements in Table A.3 being replaced by its i-th corresponding sub-layer syntax element.

*Replace A.3.7 with the following:*

**A.3.7 Screen content coding extensions profiles**

The following profiles, collectively referred to as the screen content coding extensions profiles, are specified in this clause:

– The Screen-Extended Main and Screen-Extended Main 10 profiles

– The Screen-Extended Main 4:4:4 and Screen-Extended Main 4:4:4 10 profiles

NOTE – For purposes of this terminology, the high throughput screen content coding extensions profiles specified in clause A.3.8 are not included in the set of profiles that are collectively referred to as the screen content coding extensions profiles, although the names of some of the high throughput screen content coding extensions profiles include the term "Screen-Extended".

Bitstreams conforming to the screen content coding extensions profiles shall obey the following constraints:

– The constraints specified in Table A.4 shall apply, in which entries marked with "–" indicate that the table entry does not impose a profile-specific constraint on the corresponding syntax element.

– Active VPSs shall have vps\_base\_layer\_internal\_flag and vps\_base\_layer\_available\_flag both equal to 1 only.

– Active SPSs for the base layer shall have separate\_colour\_plane\_flag, when present, equal to 0 only.

– CtbLog2SizeY derived according to active SPSs for the base layer shall be in the range of 4 to 6, inclusive.

– When an active SPS for the base layer has palette\_mode\_enabled\_flag equal to 1, palette\_max\_size shall be less than or equal to 64 and PaletteMaxPredictorSize shall be less than or equal to 128.

– In bitstreams conforming to the Screen-Extended Main, Screen-Extended Main 10, Screen-Extended Main 4:4:4, or Screen-Extended Main 4:4:4 10, active SPSs for the base layer shall have extended\_precision\_processing\_flag, and cabac\_bypass\_alignment\_enabled\_flag, when present, equal to 0 only.

– In bitstreams conforming to the Screen-Extended Main or Screen-Extended Main 10 profiles, when an active PPS for the base layer has tiles\_enabled\_flag equal to 1, it shall have entropy\_coding\_sync\_enabled\_flag equal to 0.

– When an active PPS for the base layer has tiles\_enabled\_flag equal to 1, ColumnWidthInLumaSamples[ i ] shall be greater than or equal to 256 for all values of i in the range of 0 to num\_tile\_columns\_minus1, inclusive, and RowHeightInLumaSamples[ j ] shall be greater than or equal to 64 for all values of j in the range of 0 to num\_tile\_rows\_minus1, inclusive.

– The number of times read\_bits( 1 ) is called in clauses 9.3.4.3.3 and 9.3.4.3.4 when parsing coding\_tree\_unit( ) data for any CTU shall be less than or equal to 5 \* RawCtuBits / 3.

– general\_level\_idc and sub\_layer\_level\_idc[ i ] for all values of i in active SPSs for the base layer shall not be equal to 255 (which indicates level 8.5).

– The tier and level constraints specified for the Screen-Extended Main, Screen-Extended Main 10, Screen-Extended Main 4:4:4 or Screen-Extended Main 4:4:4 10 profiles in clause A.4, as applicable, shall be fulfilled.

**Table A.4 – Allowed values for syntax elements in the screen content coding extensions profiles**

|  |  |  |
| --- | --- | --- |
| **Profile for which constraint is specified** | **chroma\_format\_idc** | **bit\_depth\_luma\_minus8** and **bit\_depth\_chroma\_minus8** |
| Screen-Extended Main | 1 | 0 |
| Screen-Extended Main 10 | 1 | 0..2 |
| Screen-Extended Main 4:4:4 | 0, 1, or 3 | 0 |
| Screen-Extended Main 4:4:4 10 | 0, 1, or 3 | 0..2 |

Conformance of a bitstream to the screen content coding extensions profiles is indicated by general\_profile\_idc being equal to 9 or general\_profile\_compatibility\_flag[ 9 ] being equal to 1 with the additional indications specified in Table A.5. Conformance of a sub-layer representation with TemporalId equal to i to the screen content coding extensions profiles is indicated by sub\_layer\_profile\_idc[ i ] being equal to 9 or sub\_layer\_profile\_compatibility\_flag[ i ][ 9 ] being equal to 1 with the additional indications specified in Table A.5, with each of the syntax elements in Table A.5 being replaced by its i-th corresponding sub-layer syntax element.

All other combinations of the syntax elements in Table A.5 with general\_profile\_idc equal to 9 or general\_profile\_compatibility\_flag[ 9 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. All other combinations of the i-th corresponding sub-layer syntax elements of the syntax elements in Table A.5 with sub\_layer\_profile\_idc[ i ] equal to 9 or sub\_layer\_profile\_compatibility\_flag[ i ][ 9 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. Such combinations shall not be present in bitstreams conforming to this Specification. However, decoders conforming to the screen content coding extensions profiles shall allow other combinations as specified below in this clause to occur in the bitstream.

**Table A.5 – Bitstream indications for conformance to screen content coding extensions profiles**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Profile for which the bitstream indicates conformance** | **general\_max\_14bit\_constraint\_flag** | **general\_max\_12bit\_constraint\_flag** | **general\_max\_10bit\_constraint\_flag** | **general\_max\_8bit\_constraint\_flag** | **general\_max\_422chroma\_constraint\_flag** | **general\_max\_420chroma\_constraint\_flag** | **general\_max\_monochrome\_constraint\_flag** | **general\_intra\_constraint\_flag** | **general\_one\_picture\_only\_constraint\_flag** | **general\_lower\_bit\_rate\_constraint\_flag** |
| Screen-Extended Main | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| Screen-Extended Main 10 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| Screen-Extended Main 4:4:4 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Screen-Extended Main 4:4:4 10 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Decoders conforming to a screen content coding extensions profile at a specific level (identified by a specific value of general\_level\_idc) of a specific tier (identified by a specific value of general\_tier\_flag) shall be capable of decoding all bitstreams and sub-layer representations for which all of the following conditions apply:

* Any of the following conditions apply:

– The bitstream or sub-layer representation is indicated to conform to the Main, Main Still Picture, or Monochrome profile.

– The decoder conforms to the Screen-Extended Main 10 or Screen-Extended Main 4:4:4 10 profile, and the bitstream or sub-layer representation is indicated to conform to the Main 10 profile.

– The decoder conforms to the Screen-Extended Main 4:4:4 or Screen-Extended Main 4:4:4 10 profile, and the bitstream or sub-layer representation is indicated to conform to the Main 4:4:4 profile.

– The decoder conforms to the Screen-Extended Main 4:4:4 10 profile, and the bitstream or sub-layer representation is indicated to conform to the Main 4:4:4 10 profile.

– general\_profile\_idc is equal to 4 or general\_profile\_compatibility\_flag[ 4 ] is equal to 1 or general\_profile\_idc is equal to 9 or general\_profile\_compatibility\_flag[ 9 ] is equal to 1 for the bitstream, and the value of each constraint flag listed in Table A.5 is greater than or equal to the value(s) specified in the row of Table A.5 for the screen content coding extensions profile for which the decoder conformance is evaluated, and general\_max\_422chroma\_constraint\_flag is equal to general\_max\_420chroma\_constraint\_flag.

– sub\_layer\_profile\_idc[ i ] is equal to 4 or sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] is equal to 1 or sub\_layer\_profile\_idc[ i ] is equal to 9 or sub\_layer\_profile\_compatibility\_flag[ i ][ 9 ] is equal to 1 for the sub-layer representation, and the value of each constraint flag listed in Table A.5 is greater than or equal to the value(s) specified in the row of Table A.5 for the screen content coding extensions profile for which the decoder conformance is evaluated, and general\_max\_422chroma\_constraint\_flag is equal to general\_max\_420chroma\_constraint\_flag, with each of the syntax elements in Table A.5 being replaced by its i-th corresponding sub-layer syntax element.

* The bitstream or sub-layer representation is indicated to conform to a level that is not level 8.5 and is lower than or equal to the specified level.
* The bitstream or sub-layer representation is indicated to conform to a tier that is lower than or equal to the specified tier.

*Add clause A.3.8, as follows:*

**A.3.8 High throughput screen content coding extensions profiles**

The following profiles, collectively referred to as the high throughput screen content coding extensions profiles, are specified in this clause:

– The Screen-Extended High Throughput 4:4:4, Screen-Extended High Throughput 4:4:4 10, and Screen-Extended High Throughput 14 profiles

Bitstreams conforming to the screen content coding extensions profiles shall obey the following constraints:

– The constraints specified in Table A.6 shall apply, in which entries marked with "–" indicate that the table entry does not impose a profile-specific constraint on the corresponding syntax element.

– Active VPSs shall have vps\_base\_layer\_internal\_flag and vps\_base\_layer\_available\_flag both equal to 1 only.

– Active SPSs for the base layer shall have separate\_colour\_plane\_flag, when present, equal to 0 only.

– CtbLog2SizeY derived according to active SPSs for the base layer shall be in the range of 4 to 6, inclusive.

– When an active SPS for the base layer has palette\_mode\_enabled\_flag equal to 1, palette\_max\_size shall be less than or equal to 64 and PaletteMaxPredictorSize shall be less than or equal to 128.

– Active SPSs for the base layer shall have extended\_precision\_processing\_flag, and cabac\_bypass\_alignment\_enabled\_flag, when present, equal to 0 only.

– Active PPSs for the base layer shall have entropy\_coding\_sync\_enabled\_flag equal to 1 only.

NOTE – Unlike for some other profiles specified in this annex, an active PPS for the base layer for Screen-Extended High Throughput 4:4:4, Screen-Extended High Throughput 4:4:4 10, or Screen-Extended High Throughput 4:4:4 14 profiles may have tiles\_enabled\_flag equal to 1 with entropy\_coding\_sync\_enabled\_flag equal to 1.

– When an active PPS for the base layer has tiles\_enabled\_flag equal to 1, ColumnWidthInLumaSamples[ i ] shall be greater than or equal to 256 for all values of i in the range of 0 to num\_tile\_columns\_minus1, inclusive, and RowHeightInLumaSamples[ j ] shall be greater than or equal to 64 for all values of j in the range of 0 to num\_tile\_rows\_minus1, inclusive.

– The number of times read\_bits( 1 ) is called in clauses 9.3.4.3.3 and 9.3.4.3.4 when parsing coding\_tree\_unit( ) data for any CTU shall be less than or equal to 5 \* RawCtuBits / 3.

– general\_level\_idc and sub\_layer\_level\_idc[ i ] for all values of i in active SPSs for the base layer shall not be equal to 255 (which indicates level 8.5).

– The tier and level constraints specified for the Screen-Extended High Throughput 4:4:4, Screen-Extended High Throughput 4:4:4 10, and Screen-Extended High Throughput 14 profiles in clause A.4, as applicable, shall be fulfilled.

**Table A.6 – Allowed values for syntax elements in the high throughput screen content coding extensions profiles**

|  |  |  |
| --- | --- | --- |
| **Profile for which constraint is specified** | **chroma\_format\_idc** | **bit\_depth\_luma\_minus8** and **bit\_depth\_chroma\_minus8** |
| Screen-Extended High Throughput 4:4:4 | – | 0 |
| Screen-Extended High Throughput 4:4:4 10 | – | 0..2 |
| Screen-Extended High Throughput 4:4:4 14 | – | 0..6 |

Conformance of a bitstream to the high throughput screen content coding extensions profiles is indicated by general\_profile\_idc being equal to 11 or general\_profile\_compatibility\_flag[ 11 ] being equal to 1 with the additional indications specified in Table A.7. Conformance of a sub-layer representation with TemporalId equal to i to the screen content coding extensions profiles is indicated by sub\_layer\_profile\_idc[ i ] being equal to 11 or sub\_layer\_profile\_compatibility\_flag[ i ][ 11 ] being equal to 1 with the additional indications specified in Table A.7, with each of the syntax elements in Table A.7 being replaced by its i-th corresponding sub-layer syntax element.

All other combinations of the syntax elements in Table A.7 with general\_profile\_idc equal to 11 or general\_profile\_compatibility\_flag[ 11 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. All other combinations of the i-th corresponding sub-layer syntax elements of the syntax elements in Table A.7 with sub\_layer\_profile\_idc[ i ] equal to 11 or sub\_layer\_profile\_compatibility\_flag[ i ][ 11 ] equal to 1 are reserved for future use by ITU-T | ISO/IEC. Such combinations shall not be present in bitstreams conforming to this Specification. However, decoders conforming to the screen content coding extensions profiles shall allow other combinations as specified below in this clause to occur in the bitstream.

**Table A.7 – Bitstream indications for conformance to high throughput screen content coding extensions profiles**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Profile for which the bitstream indicates conformance** | **general\_max\_14bit\_constraint\_flag** | **general\_max\_12bit\_constraint\_flag** | **general\_max\_10bit\_constraint\_flag** | **general\_max\_8bit\_constraint\_flag** | **general\_max\_422chroma\_constraint\_flag** | **general\_max\_420chroma\_constraint\_flag** | **general\_max\_monochrome\_constraint\_flag** | **general\_intra\_constraint\_flag** | **general\_one\_picture\_only\_constraint\_flag** | **general\_lower\_bit\_rate\_constraint\_flag** |
| Screen-Extended High Throughput 4:4:4 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Screen-Extended High Throughput 4:4:4 10 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Screen-Extended High Throughput 4:4:4 14 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

Decoders conforming to a high throughput screen content coding extensions profile at a specific level (identified by a specific value of general\_level\_idc) of a specific tier (identified by a specific value of general\_tier\_flag) shall be capable of decoding all bitstreams and sub-layer representations for which all of the following conditions apply:

* Any of the following conditions apply:

– The bitstream or sub-layer representation is indicated to conform to the Main, Main Still Picture, or Monochrome profile.

– The bitstream or sub-layer representation is indicated to conform to the High Throughput 4:4:4 profile.

– The decoder conforms to the Screen-Extended High Throughput 4:4:4 10 or Screen-Extended High Throughput 4:4:4 14 profile, and the bitstream or sub-layer representation is indicated to conform to the High Throughput 4:4:4 10 profile.

– The decoder conforms to the Screen-Extended High Throughput 4:4:4 14 profile, and the bitstream or sub-layer representation is indicated to conform to the High Throughput 4:4:4 14 profile.

– general\_profile\_idc is equal to 4 or general\_profile\_compatibility\_flag[ 4 ] is equal to 1 or general\_profile\_idc is equal to 11 or general\_profile\_compatibility\_flag[ 11 ] is equal to 1 for the bitstream, and the value of each constraint flag listed in Table A.7 is greater than or equal to the value(s) specified in the row of Table A.7 for the screen content coding extensions profile for which the decoder conformance is evaluated, and general\_max\_422chroma\_constraint\_flag is equal to general\_max\_420chroma\_constraint\_flag.

– sub\_layer\_profile\_idc[ i ] is equal to 4 or sub\_layer\_profile\_compatibility\_flag[ i ][ 4 ] is equal to 1 or sub\_layer\_profile\_idc[ i ] is equal to 11 or sub\_layer\_profile\_compatibility\_flag[ i ][ 11 ] is equal to 1 for the sub-layer representation, and the value of each constraint flag listed in Table A.7 is greater than or equal to the value(s) specified in the row of Table A.7 for the screen content coding extensions profile for which the decoder conformance is evaluated, and general\_max\_422chroma\_constraint\_flag is equal to general\_max\_420chroma\_constraint\_flag, with each of the syntax elements in Table A.7 being replaced by its i-th corresponding sub-layer syntax element, respectively.

* The bitstream or sub-layer representation is indicated to conform to a level that is not level 8.5 and is lower than or equal to the specified level.
* The bitstream or sub-layer representation is indicated to conform to a tier that is lower than or equal to the specified tier.

*Replace D.2.1 with the following:*

**D.2.1 General SEI message syntax**

|  |  |
| --- | --- |
| sei\_payload( payloadType, payloadSize ) { | **Descriptor** |
| if( nal\_unit\_type  = =  PREFIX\_SEI\_NUT ) |  |
| if( payloadType  = =  0 ) |  |
| buffering\_period( payloadSize ) |  |
| else if( payloadType  = =  1 ) |  |
| pic\_timing( payloadSize ) |  |
| else if( payloadType  = =  2 ) |  |
| pan\_scan\_rect( payloadSize ) |  |
| else if( payloadType  = =  3 ) |  |
| filler\_payload( payloadSize ) |  |
| else if( payloadType  = =  4 ) |  |
| user\_data\_registered\_itu\_t\_t35( payloadSize ) |  |
| else if( payloadType  = =  5 ) |  |
| user\_data\_unregistered( payloadSize ) |  |
| else if( payloadType  = =  6 ) |  |
| recovery\_point( payloadSize ) |  |
| else if( payloadType  = =  9 ) |  |
| scene\_info( payloadSize ) |  |
| else if( payloadType  = =  15 ) |  |
| picture\_snapshot( payloadSize ) |  |
| else if( payloadType  = =  16 ) |  |
| progressive\_refinement\_segment\_start( payloadSize ) |  |
| else if( payloadType  = =  17 ) |  |
| progressive\_refinement\_segment\_end( payloadSize ) |  |
| else if( payloadType  = =  19 ) |  |
| film\_grain\_characteristics( payloadSize ) |  |
| else if( payloadType  = =  22 ) |  |
| post\_filter\_hint( payloadSize ) |  |
| else if( payloadType  = =  23 ) |  |
| tone\_mapping\_info( payloadSize ) |  |
| else if( payloadType  = =  45 ) |  |
| frame\_packing\_arrangement( payloadSize ) |  |
| else if( payloadType  = =  47 ) |  |
| display\_orientation( payloadSize ) |  |
| else if( payloadType  = =  56 ) |  |
| green\_metadata( payloadsize ) /\* specified in ISO/IEC 23001-11 \*/ |  |
| else if( payloadType  = =  128 ) |  |
| structure\_of\_pictures\_info( payloadSize ) |  |
| else if( payloadType  = =  129 ) |  |
| active\_parameter\_sets( payloadSize ) |  |
| else if( payloadType  = =  130 ) |  |
| decoding\_unit\_info( payloadSize ) |  |
| else if( payloadType  = =  131 ) |  |
| temporal\_sub\_layer\_zero\_index( payloadSize ) |  |
| else if( payloadType  = =  133 ) |  |
| scalable\_nesting( payloadSize ) |  |
| else if( payloadType  = =  134 ) |  |
| region\_refresh\_info( payloadSize ) |  |
| else if( payloadType  = =  135 ) |  |
| no\_display( payloadSize ) |  |
| else if( payloadType  = =  136 ) |  |
| time\_code( payloadSize ) |  |
| else if( payloadType  = =  137 ) |  |
| mastering\_display\_colour\_volume( payloadSize ) |  |
| else if( payloadType  = =  138 ) |  |
| segmented\_rect\_frame\_packing\_arrangement( payloadSize ) |  |
| else if( payloadType  = =  139 ) |  |
| temporal\_motion\_constrained\_tile\_sets( payloadSize ) |  |
| else if( payloadType  = =  140 ) |  |
| chroma\_resampling\_filter\_hint( payloadSize ) |  |
| else if( payloadType  = =  141 ) |  |
| knee\_function\_info( payloadSize ) |  |
| else if( payloadType  = =  142 ) |  |
| colour\_remapping\_info( payloadSize ) |  |
| else if( payloadType  = =  143 ) |  |
| deinterlaced\_field\_identification( payloadSize ) |  |
| else if( payloadType  = =  144 ) |  |
| content\_light\_level\_info( payloadSize ) |  |
| else if( payloadType  = =  145 ) |  |
| dependent\_rap\_indication( payloadSize ) |  |
| else if( payloadType  = =  146 ) |  |
| coded\_region\_completion( payloadSize ) |  |
| else if( payloadType  = =  147 ) |  |
| alternative\_transfer\_characteristics( payloadSize ) |  |
| else if( payloadType  = =  148 ) |  |
| ambient\_viewing\_environment( payloadSize ) |  |
| else if( payloadType  = =  149 ) |  |
| content\_colour\_volume( payloadSize ) |  |
| else if( payloadType  = =  150 ) |  |
| equirectangular\_projection( payloadSize ) |  |
| else if( payloadType  = =  151 ) |  |
| cubemap\_projection( payloadSize ) |  |
| else if( payloadType  = =  152 ) |  |
| fisheye\_video\_info( payloadSize ) |  |
| else if( payloadType  = =  154 ) |  |
| sphere\_rotation( payloadSize ) |  |
| else if( payloadType  = =  155 ) |  |
| regionwise\_packing( payloadSize ) |  |
| else if( payloadType  = =  156 ) |  |
| omni\_viewport( payloadSize ) |  |
| else if( payloadType  = =  157 ) |  |
| regional\_nesting( payloadSize ) |  |
| else if( payloadType  = =  158 ) |  |
| mcts\_extraction\_info\_sets( payloadSize ) |  |
| else if( payloadType  = =  159 ) |  |
| mcts\_extraction\_info\_nesting( payloadSize ) |  |
| else if( payloadType  = =  160 ) |  |
| layers\_not\_present( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  161 ) |  |
| inter\_layer\_constrained\_tile\_sets( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  162 ) |  |
| bsp\_nesting( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  163 ) |  |
| bsp\_initial\_arrival\_time( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  164 ) |  |
| sub\_bitstream\_property( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  165 ) |  |
| alpha\_channel\_info( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  166 ) |  |
| overlay\_info( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  167 ) |  |
| temporal\_mv\_prediction\_constraints( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  168 ) |  |
| frame\_field\_info( payloadSize ) /\* specified in Annex F \*/ |  |
| else if( payloadType  = =  176 ) |  |
| three\_dimensional\_reference\_displays\_info( payloadSize ) /\* specified in Annex G \*/ |  |
| else if( payloadType  = =  177 ) |  |
| depth\_representation\_info( payloadSize ) /\* specified in Annex G \*/ |  |
| else if( payloadType  = =  178 ) |  |
| multiview\_scene\_info( payloadSize ) /\* specified in Annex G \*/ |  |
| else if( payloadType  = =  179 ) |  |
| multiview\_acquisition\_info( payloadSize ) /\* specified in Annex G \*/ |  |
| else if( payloadType  = =  180 ) |  |
| multiview\_view\_position( payloadSize ) /\* specified in Annex G \*/ |  |
| else if( payloadType  = =  181 ) |  |
| alternative\_depth\_info( payloadSize ) /\* specified in Annex I \*/ |  |
| else if( payloadType  = =  200 ) |  |
| sei\_manifest( payloadSize ) |  |
| else if( payloadType  = =  201 ) |  |
| sei\_prefix\_indication( payloadSize ) |  |
| else |  |
| reserved\_sei\_message( payloadSize ) |  |
| else /\* nal\_unit\_type  = =  SUFFIX\_SEI\_NUT \*/ |  |
| if( payloadType  = =  3 ) |  |
| filler\_payload( payloadSize ) |  |
| else if( payloadType  = =  4 ) |  |
| user\_data\_registered\_itu\_t\_t35( payloadSize ) |  |
| else if( payloadType  = =  5 ) |  |
| user\_data\_unregistered( payloadSize ) |  |
| else if( payloadType  = =  17 ) |  |
| progressive\_refinement\_segment\_end( payloadSize ) |  |
| else if( payloadType  = =  22 ) |  |
| post\_filter\_hint( payloadSize ) |  |
| else if( payloadType  = =  132 ) |  |
| decoded\_picture\_hash( payloadSize ) |  |
| else if( payloadType  = =  146 ) |  |
| coded\_region\_completion( payloadSize ) |  |
| else |  |
| reserved\_sei\_message( payloadSize ) |  |
| if( more\_data\_in\_payload( ) ) { |  |
| if( payload\_extension\_present( ) ) |  |
| **reserved\_payload\_extension\_data** | u(v) |
| **payload\_bit\_equal\_to\_one** /\* equal to 1 \*/ | f(1) |
| while( !byte\_aligned( ) ) |  |
| **payload\_bit\_equal\_to\_zero** /\* equal to 0 \*/ | f(1) |
| } |  |
| } |  |

*Renumber clauses D.2.41.3 through D.2.41.5 as D.2.41.4 through D.2.41.6.*

*Add clause D.2.41.3, as follows:*

**D.2.41.3 Fisheye video information SEI message syntax**

|  |  |
| --- | --- |
| fisheye\_video\_info( payloadSize ) { | **Descriptor** |
| **fisheye\_cancel\_flag** | u(1) |
| if( !fisheye\_cancel\_flag ) { |  |
| **fisheye\_persistence\_flag** | u(1) |
| **fisheye\_view\_dimension\_idc** | u(3) |
| **fisheye\_reserved\_zero\_3bits** | u(3) |
| **fisheye\_num\_active\_areas\_minus1** | u(8) |
| for( i = 0; i  <=  fisheye\_num\_active\_areas\_minus1; i++ ) { |  |
| **fisheye\_circular\_region\_centre\_x**[ i ] | u(32) |
| **fisheye\_circular\_region\_centre\_y**[ i ] | u(32) |
| **fisheye\_rect\_region\_top**[ i ] | u(32) |
| **fisheye\_rect\_region\_left**[ i ] | u(32) |
| **fisheye\_rect\_region\_width**[ i ] | u(32) |
| **fisheye\_rect\_region\_height**[ i ] | u(32) |
| **fisheye\_circular\_region\_radius**[ i ] | u(32) |
| **fisheye\_scene\_radius**[ i ] | u(32) |
| **fisheye\_camera\_centre\_azimuth**[ i ] | i(32) |
| **fisheye\_camera\_centre\_elevation**[ i ] | i(32) |
| **fisheye\_camera\_centre\_tilt**[ i ] | i(32) |
| **fisheye\_camera\_centre\_offset\_x**[ i ] | u(32) |
| **fisheye\_camera\_centre\_offset\_y**[ i ] | u(32) |
| **fisheye\_camera\_centre\_offset\_z**[ i ] | u(32) |
| **fisheye\_field\_of\_view**[ i ] | u(32) |
| **fisheye\_num\_polynomial\_coeffs**[ i ] | u(16) |
| for( j = 0; j < fisheye\_num\_polynomial\_coeffs[ i ]; j++ ) |  |
| **fisheye\_polynomial\_coeff**[ i ][ j ] | i(32) |
| } |  |
| } |  |
| } |  |

*In D.2.43 (Motion-constrained tile sets extraction information sets SEI message syntax), replace the following rows:*

|  |  |
| --- | --- |
| for( k = 0; k  <=  vps\_rbsp\_data\_length[ i ][ j ]; k++ ) |  |

|  |  |
| --- | --- |
| for( k = 0; k  <=  sps\_rbsp\_data\_length[ i ][ j ]; k++ ) |  |

|  |  |
| --- | --- |
| for( k = 0; k  <=  pps\_rbsp\_data\_length[ i ][ j ]; k++ ) |  |

*with the following rows, respectively (changing "  <=  " to " < "):*

|  |  |
| --- | --- |
| for( k = 0; k < vps\_rbsp\_data\_length[ i ][ j ]; k++ ) |  |

|  |  |
| --- | --- |
| for( k = 0; k < sps\_rbsp\_data\_length[ i ][ j ]; k++ ) |  |

|  |  |
| --- | --- |
| for( k = 0; k < pps\_rbsp\_data\_length[ i ][ j ]; k++ ) |  |

*Renumber clause D.2.45 (Reserved SEI message syntax) as D.2.47.*

*Add clauses D.2.45 and D.2.46, as follows:*

**D.2.45 SEI manifest SEI message syntax**

|  |  |
| --- | --- |
| sei\_manifest( payloadSize ) { | **Descriptor** |
| **manifest\_num\_sei\_msg\_types** | u(16) |
| for( i = 0; i < manifest\_num\_sei\_msg\_types; i++ ) { |  |
| **manifest\_sei\_payload\_type**[ i ] | u(16) |
| **manifest\_sei\_description**[ i ] | u(8) |
| } |  |
| } |  |

**D.2.46 SEI prefix indication SEI message syntax**

|  |  |
| --- | --- |
| sei\_prefix\_indication( payloadSize ) { | **Descriptor** |
| **prefix\_sei\_payload\_type** | u(16) |
| **num\_sei\_prefix\_indications\_minus1** | u(8) |
| for( i = 0; i  <=  num\_sei\_prefix\_indications\_minus1; i++ ) { |  |
| **num\_bits\_in\_prefix\_indication\_minus1**[ i ] | u(16) |
| for( j = 0; j  <=  num\_bits\_in\_prefix\_indication\_minus1[ i ]; j++ ) |  |
| **sei\_prefix\_data\_bit**[ i ][ j ] | u(1) |
| while( !byte\_aligned( ) ) |  |
| **byte\_alignment\_bit\_equal\_to\_one** /\* equal to 1 \*/ | f(1) |
| } |  |
| } |  |

*In D.3.1, replace the following paragraphs:*

The list SingleLayerSeiList is set to consist of the payloadType values 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 134 to 151, inclusive, and 154 to 159, inclusive.

The list VclAssociatedSeiList is set to consist of the payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 151, inclusive, and 154 to 159, inclusive.

The list PicUnitRepConSeiList is set to consist of the payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 151, inclusive, and 154 to 159, inclusive.

*with the following:*

The list SingleLayerSeiList is set to consist of the payloadType values 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 134 to 152, inclusive, 154 to 159, inclusive, and 200 to 201, inclusive.

The list VclAssociatedSeiList is set to consist of the payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 152, inclusive, 154 to 159, inclusive, and 200 to 201, inclusive.

The list PicUnitRepConSeiList is set to consist of the payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 152, inclusive, 154 to 159, inclusive, and 200 to 201, inclusive.

*In D.3.1, in Table D.1, insert the following row immediately after the row for "Cubemap projection" in the table:*

|  |  |
| --- | --- |
| Fisheye video information | Specified by the syntax of the SEI message |

*In D.3.1, in Table D.1, append the following rows to the end of the table:*

|  |  |
| --- | --- |
| SEI manifest | The CLVS containing the SEI message |
| SEI prefix indication | The CLVS containing the SEI message |

*In D.3.16 (Frame packing arrangement SEI message semantics), replace the semantics of frame\_packing\_arrangement\_type, including Table D.8, with the following:*

**frame\_packing\_arrangement\_type** identifies the indicated interpretation of the sample arrays of the output cropped decoded picture as specified in Table D.8.

When frame\_packing\_arrangement\_type is equal to 3 or 4, each component plane of the output cropped decoded picture contains all samples (when field\_pic\_flag is equal to 0) or the samples corresponding to the top or bottom field (when field\_pic\_flag is equal to 1) of the samples of a frame packing arrangement structure.

Table D.8 – Definition of frame\_packing\_arrangement\_type

|  |  |
| --- | --- |
| **Value** | **Interpretation** |
| 3 | The frame packing arrangement structure contains a side-by-side packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D.4, Figure D.5 and Figure D.8. |
| 4 | The frame packing arrangement structure contains a top-bottom packing arrangement of corresponding planes of two constituent frames as illustrated in Figure D.6 and Figure D.7. |
| 5 | The component planes of the output cropped decoded pictures in output order form a temporal interleaving of alternating first and second constituent frames as illustrated in Figure D.9. |

*Replace D.3.28 (Mastering display colour volume SEI message semantics) with the following:*

**D.3.28 Mastering display colour volume SEI message semantics**

This SEI message identifies the colour volume (the colour primaries, white point, and luminance range) of a display considered to be the mastering display for the associated video content – e.g., the colour volume of a display that was used for viewing while authoring the video content. The described mastering display is a three-colour additive display system that has been configured to use the indicated mastering colour volume.

This SEI message does not identify the measurement methodologies and procedures used for determining the indicated values or provide any description of the mastering environment. It also does not provide information on colour transformations that would be appropriate to preserve creative intent on displays with colour volumes different from that of the described mastering display.

The information conveyed in this SEI message is intended to be adequate for purposes corresponding to the use of SMPTE ST 2086 (2018).

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

**display\_primaries\_x**[ c ], when in the range of 5 to 37 000, inclusive, specifies the normalized x chromaticity coordinate of the colour primary component c of the mastering display, according to the CIE 1931 definition of x as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15), in increments of 0.00002. When display\_primaries\_x[ c ] is not in the range of 5 to 37 000, inclusive, the normalized x chromaticity coordinate of the colour primary component c of the mastering display is unknown or unspecified or specified by other means not specified in this Specification.

**display\_primaries\_y**[ c ], when in the range of 5 to 42 000, inclusive, specifies the normalized y chromaticity coordinate of the colour primary component c of the mastering display, according to the CIE 1931 definition of y as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15), in increments of 0.00002. When display\_primaries\_y[ c ] is not in the range of 5 to 42 000, inclusive, the normalized y chromaticity coordinate of the colour primary component c of the mastering display is unknown or unspecified or specified by other means not specified in this Specification.

For describing mastering displays that use red, green, and blue colour primaries, it is suggested that index value c equal to 0 should correspond to the green primary, c equal to 1 should correspond to the blue primary and c equal to 2 should correspond to the red colour primary (see also Annex E and Table E.3).

**white\_point\_x**, when in the range of 5 to 37 000, inclusive, specifies the normalized x chromaticity coordinate of the white point of the mastering display, according to the CIE 1931 definition of x as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15), in normalized increments of 0.00002. When white\_point\_x is not in the range of 5 to 37 000, inclusive, the normalized x chromaticity coordinate of the white point of the mastering display is indicated to be unknown or unspecified or specified by other means not specified in this Specification.

**white\_point\_y**, when in the range of 5 to 42 000, inclusive, specifies the normalized y chromaticity coordinate of the white point of the mastering display, according to the CIE 1931 definition of y as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15), in normalized increments of 0.00002. When white\_point\_y is not in the range of 5 to 42 000, inclusive, the normalized y chromaticity coordinate of the white point of the mastering display is indicated to be unknown or unspecified or specified by other means not specified in this Specification.

NOTE 1 – SMPTE ST 2086 (2018) specifies that the normalized x and y chromaticity coordinate values for the mastering display colour primaries and white point are to be represented with four decimal places. This would correspond with using values of the syntax elements display\_primaries\_x[ c ], display\_primaries\_y[ c ], white\_point\_x, and white\_point\_y, as defined in this Specification, that are multiples of 5.

NOTE 2 – An example of the use of values outside the range for which semantics are specified in this Specification is that ANSI/CTA 861-G (2016) uses normalized (x, y) chromaticity coordinate values of (0,0) for the white point to indicate that the white point chromaticity is unknown.

**max\_display\_mastering\_luminance**, when in the range of 50 000 to 100 000 000, specifies the nominal maximum display luminance of the mastering display in units of 0.0001 candelas per square metre. When max\_display\_mastering\_luminance is not in the range of 50 000 to 100 000 000, the nominal maximum display luminance of the mastering display is indicated to be unknown or unspecified or specified by other means not specified in this Specification.

NOTE 3 – SMPTE ST 2086 (2018) specifies that the nominal maximum display luminance of the mastering display is to be specified as a multiple of 1 candela per square meter. This would correspond with using values of the syntax element max\_display\_mastering\_luminance, as defined in this Specification, that are a multiple of 10 000.

NOTE 4 – An example of the use of values outside the range for which semantics are specified in this Specification is that ANSI/CTA 861-G (2016) uses the value 0 for the nominal maximum display luminance of the mastering display to indicate that the nominal maximum display luminance of the mastering display is unknown.

**min\_display\_mastering\_luminance**, when in the range of 1 to 50 000, specifies the nominal minimum display luminance of the mastering display in units of 0.0001 candelas per square metre. When min\_display\_mastering\_luminance is not in the range of 1 to 50 000, the nominal maximum display luminance of the mastering display is unknown or unspecified or specified by other means not specified in this Specification. When max\_display\_mastering\_luminance is equal to 50 000, min\_display\_mastering\_luminance shall not be equal to 50 000.

NOTE 5 – SMPTE ST 2086 (2018) specifies that the nominal minimum display luminance of the mastering display is to be specified as a multiple of 0.0001 candelas per square metre, which corresponds to the semantics specified in this Specification.

NOTE 6 – An example of the use of values outside the range for which semantics are specified in this Specification is that ANSI/CTA 861-G (2016) uses the value 0 for the nominal minimum display luminance of the mastering display to indicate that the nominal minimum display luminance of the mastering display is unknown.

NOTE 7 – Another example of the potential use of values outside the range for which semantics are specified in this Specification is that SMPTE ST 2086 (2018) indicates that values outside the specified range could be used to indicate that the black level and contrast of the mastering display have been adjusted using picture line-up generation equipment (PLUGE).

At the minimum luminance, the mastering display is considered to have the same nominal chromaticity as the white point.

*In D.3.30, Equation D-43, replace "*if ( availableFlagLXA )*" with "*if( availableFlagLXA )*" (removing the space after "if").*

*In D.3.30, replace the following paragraph:*

The temporal motion-constrained tile sets SEI message applicable to targetLayerId shall not be present for any picture in associatedPicSet when tiles\_enabled\_flag is equal to 0 for any PPS that is active for any picture in associatedPicSet.

*with the following:*

When the temporal motion-constrained tile sets SEI message applicable to targetLayerId is present for any picture in associatedPicSet when tiles\_enabled\_flag is equal to 0 for any PPS that is active for any picture in associatedPicSet, the picture contains only one tile, which forms the only MCTS, and the values of mc\_all\_tiles\_exact\_sample\_value\_match\_flag and each\_tile\_one\_tile\_set\_flag shall both be equal to 1.

*In D.3.39 (Ambient viewing environment SEI message semantics), replace the following:*

**ambient\_light\_x** and **ambient\_light\_y** specify the normalized x and y chromaticity coordinates, respectively, of the environmental ambient light in the nominal viewing environment, according to the CIE 1931 definition of x and y as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15), in normalized increments of 0.00002. The values of ambient\_light\_x and ambient\_light\_y shall be in the range of 0 to 50 000.

*with the following:*

**ambient\_light\_x** and **ambient\_light\_y** specify the normalized x and y chromaticity coordinates, respectively, of the environmental ambient light in the nominal viewing environment, according to the CIE 1931 definition of x and y as specified in ISO 11664-1 (see also ISO 11664-3 and CIE 15), in normalized increments of 0.00002. The values of ambient\_light\_x and ambient\_light\_y shall be in the range of 0 to 50 000, inclusive.

*In the title of clause D.3.41.1, change "semanitcs" to "semantics".*

*In D.3.41.6.3, replace Equation D-58 with the following (swapping the uses of α and γ):*

ϕ = ϕd \* π ÷ 180  
θ = θd \* π ÷ 180  
α = αd \* π ÷ 180  
β = βd \* π ÷ 180  
γ = γd \* π ÷ 180  
x1 = Cos( ϕ ) \* Cos( θ )  
y1 = Sin( ϕ ) \* Cos( θ )  
z1 = Sin( θ )  
x2 = Cos( β ) \* Cos ( α ) \* x1 − Cos( β ) \* Sin( α ) \* y1 + Sin( β ) \* z1 (D‑58)  
y2 = ( Cos( γ ) \* Sin( α ) + Sin( γ ) \* Sin( β ) \* Cos( α ) ) \* x1 +  
 ( Cos( γ ) \* Cos( α ) − Sin( γ ) \* Sin( β ) \* Sin( α ) ) \* y1 −  
 Sin( γ ) \* Cos( β ) \* z1  
z2 = ( Sin( γ ) \* Sin( α ) − Cos( γ ) \* Sin( β ) \* Cos( α ) ) \* x1 +  
 ( Sin( γ ) \* Cos( α ) + Cos( γ ) \* Sin( β ) \* Sin( α ) ) \* y1 +  
 Cos( γ ) \* Cos( β ) \* z1  
ϕ′ = Atan2( y2, x2 ) \* 180 ÷ π  
θ′ = Asin( z2 ) \* 180 ÷ π

*Renumber clauses D.3.41.1 through D.3.41.6 (and their subordinate subclauses) as D.3.41.2 through D.3.41.7 (and their subordinate subclauses).*

*Move clause D.3.41.7 (and its subordinate subclauses) to be D.3.41.1 (and its subordinate subclauses).*

*In D.3.41.1.1, add the following parapgraph in the end:*

To remap colour sample locations of a fisheye video picture to a unit sphere, the sample locations in each of the active regions is converted to locations on the unit sphere as specified in clause D.3.41.1.7.

*Add clause D.3.41.1.7, as follows:*

***D.3.41.1.7 Conversion from a sample location of an active area to sphere coordinates relative to the global coordinate axes***

Inputs to this process are:

– the sample location (x, y) in units of luma samples,

– the centre location (xc, yc) and the radius (rc) of the circular region that contains the i-th active area, given by fisheye\_circular\_region\_centre\_x[ i ], fisheye\_circular\_region\_centre\_y[ i ], and fisheye\_circular\_region\_radius[ i ], respectively, all in units of 2−16 luma samples,

– the field of view (θv) of the lens corresponding to the i-th active area, given by fisheye\_field\_of\_view[ i ], in units of 2−16 degrees,

– the rotation parameters (αc, βc, γc), given by fisheye\_camera\_centre\_azimuth[ i ], fisheye\_camera\_centre\_elevation[ i ], and fisheye\_camera\_centre\_tilt[ i ], respectively, all in units of 2−16 degrees, and

– the number of polynomial coefficients numCoeffs and the polynomial coefficients coeffVal[ j ] (for j ranging from 0 to numCoeffs − 1, inclusive) of the i-th active area, given by fisheye\_num\_polynomial\_coeffs[ i ] and fisheye\_polynomial\_coeff[ i ][ j ] (for j ranging from 0 to fisheye\_num\_polynomial\_coeffs[ i ] − 1, inclusive), respectively.

Outputs of this process are:

– sphere coordinates (ϕ, θ) relative to the global coordinate axes.

The method of converting a sample location of an active area to sphere coordinates is determined as follows:

– If numCoeffs is equal to 0, there is only one method of converting a sample location of an active area to sphere coordinates that is specified, which is to not use polynomial coefficients.

– Otherwise (numCoeffs is not equal to 0), there are two methods of converting a sample location of an active area to sphere coordinates that are specified, which are to not use polynomial coefficients or to use polynomial coefficients. The method using polynomial coefficients is preferred, as this method is intended to provide a more precise model of the fisheye characteristics. However, the other method may also be appropriate for some uses, as it provides a single conversion process that can be used regardless of whether numCoeffs is equal to 0 or not. This Specification does not prescribe which of the two methods is to be used in this case.

The outputs are derived as follows:

– If polynomial coefficients are not used, the angle ϕ′ is derived by

ϕ′ = ( Sqrt( ( x − xc ÷ 216 )2 + ( y − yc ÷ 216 )2 ) ÷ ( rc ÷ 216 ) ) \* ( θv ÷ 216 \* π ÷ 180 ) ÷ 2 (D‑XX)

– Otherwise (polynomial coefficients are used), the angle ϕ′ is derived by

ϕ′ = ( ( coeffVal[ j ] \* 2−24 ) \* ( Sqrt( ( x – xc \* 2−16 )2 + ( y – yc \* 2−16 )2 ) ÷ ( rc \* 2−16 ) )j )  
 (D‑XX)



The outputs are then derived as follows:

θ′ = Atan2( y − yc ÷ 216, x − xc ÷ 216 )  
x1 = Cos( ϕ′ )  
y1 = Sin( ϕ′ ) \* Cos( θ′ )  
z1 = Sin( ϕ′ ) \* Sin( θ′ )  
α = ( αc ÷ 216 ) \* π ÷ 180  
β = ( βc ÷ 216 ) \* π ÷ 180  
γ = ( γc ÷ 216 ) \* π ÷ 180  
x2 = Cos( β ) \* Cos ( γ ) \* x1 − Cos( β ) \* Sin( γ ) \* y1 + Sin( β ) \* z1 (D‑XX)y2 = ( Cos( α ) \* Sin( γ ) + Sin( α ) \* Sin( β ) \* Cos( γ ) ) \* x1 +  
 ( Cos( α ) \* Cos( γ ) − Sin( α ) \* Sin( β ) \* Sin( γ ) ) \* y1 −  
 Sin( α ) \* Cos( β ) \* z1z2 = ( Sin( α ) \* Sin( γ ) − Cos( α ) \* Sin( β ) \* Cos( γ ) ) \* x1 +  
 ( Sin( α ) \* Cos( γ ) + Cos( α ) \* Sin( β ) \* Sin( γ ) ) \* y1 +  
 Cos( α ) \* Cos( β ) \* z1ϕ = Atan2( y2, x2 ) \* 180 ÷ π  
θ = Asin( z2 ) \* 180 ÷ π

*Renumber clauses D.3.41.4 through D.3.41.6 (and their subordinate subclauses) as D.3.41.5 through D.3.41.7 (and subordinate subclauses)*

*Add clause D.3.41.4, as follows:*

**D.3.41.4 Fisheye video information SEI message semantics**

The presence of the fisheye video information SEI message for any picture of a CLVS indicates that the picture is a fisheye video picture containing a number of active areas captured by fisheye camera lens. The information carried in the fisheye video information SEI message enables remapping of the colour samples of the pictures onto a sphere coordinate space in sphere coordinates (ϕ, θ), for use in omnidirectional video applications for which the viewing perspective is from the origin looking outward toward the inside of the sphere. The sphere coordinates are defined so that ϕ is the azimuth (longitude, increasing eastward) and θ is the elevation (latitude, increasing northward).

When a fisheye video information SEI message is present for any picture of a CLVS of a particular layer, a fisheye video information SEI message shall be present for the first picture of the CLVS and no equirectangular projection SEI message or cubemap projection SEI message shall be present for any picture of the CLVS.

When general\_non\_packed\_constraint\_flag is equal to 1 in the active SPS for the current layer, there shall be no fisheye video information SEI messages applicable for any picture of the CLVS of the current layer.

When aspect\_ratio\_idc is present and greater than 1 in the active SPS for the current layer, there should be no fisheye video information SEI messages applicable for any picture of the CLVS of the current layer.

When a frame packing arrangement SEI message with frame\_packing\_arrangement\_cancel\_flag equal to 0 or a segmented rectangular frame packing arrangement SEI message with segmented\_rect\_frame\_packing\_arrangement\_cancel\_flag equal to 0 that applies to the picture is present, a fisheye video information SEI message with fisheye\_cancel\_flag equal to 0 that applies to the picture shall not be present. Decoders shall ignore fisheye video information SEI messages when a frame packing arrangement SEI message with frame\_packing\_arrangement\_cancel\_flag equal to 0 or a segmented rectangular frame packing arrangement SEI message with segmented\_rect\_frame\_packing\_arrangement\_cancel\_flag equal to 0 that applies to the picture is present.

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

**fisheye\_persistence\_flag** specifies the persistence of the fisheye video information SEI message for the current layer.

fisheye\_persistence\_flag equal to 0 specifies that the fisheye video information SEI message applies to the current decoded picture only.

Let picA be the current picture. fisheye\_persistence\_flag equal to 1 specifies that the fisheye video information 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 a fisheye video information 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.

**fisheye\_view\_dimension\_idc** indicates the alignment and viewing direction of a fisheye lens, as follows:

– fisheye\_view\_dimension\_idc equal to 0 indicates that fisheye\_num\_active\_areas is equal to 2, and the values of fisheye\_camera\_centre\_azimuth, fisheye\_camera\_centre\_elevation, fisheye\_camera\_centre\_tilt, fisheye\_camera\_centre\_offset\_x, fisheye\_camera\_centre\_offset\_y, and fisheye\_camera\_centre\_offset\_z are such that the active areas have aligned optical axes and face opposite directions, and the sum of fisheye\_field\_of\_view values is greater than or equal to 360 \* 216.

– fisheye\_view\_dimension\_idc equal to 1 indicates that fisheye\_num\_active\_areas is equal to 2, and the values of fisheye\_camera\_centre\_azimuth, fisheye\_camera\_centre\_elevation, fisheye\_camera\_centre\_tilt, fisheye\_camera\_centre\_offset\_x, fisheye\_camera\_centre\_offset\_y, and fisheye\_camera\_centre\_offset\_z are such that the active areas have parallel optical axes that are orthogonal to the line intersecting the camera centre points, and the camera corresponding to i equal to 0 is the left view.

– fisheye\_view\_dimension\_idc equal to 2 indicates that fisheye\_num\_active\_areas is equal to 2, and the values of fisheye\_camera\_centre\_azimuth, fisheye\_camera\_centre\_elevation, fisheye\_camera\_centre\_tilt, fisheye\_camera\_centre\_offset\_x, fisheye\_camera\_centre\_offset\_y, and fisheye\_camera\_centre\_offset\_z are such that the active areas have parallel optical axes that are orthogonal to the line intersecting the camera centre points, and the camera corresponding to i equal to 0 is the right view.

– fisheye\_view\_dimension\_idc equal to 7 indicates that no additional constraints are implied for the syntax element values within the fisheye video information SEI message.

– Values of fisheye\_view\_dimension\_idc in the range of 3 to 6, inclusive, are reserved for future use by ITU-T | ISO/IEC. Decoders encountering a value of fisheye\_view\_dimension\_idc in the range of 3 to 6, inclusive, shall ignore it.

**fisheye**\_**reserved\_zero\_3bits** shall be equal to 0 in bitstreams conforming to this version of this Specification. Other values for fisheye\_reserved\_zero\_3bits are reserved for future use by ITU-T | ISO/IEC. Decoders shall ignore the value of fisheye\_reserved\_zero\_3bits.

**fisheye\_num\_active\_areas\_minus1** plus 1 specifies the number of active areas in the coded picture. The value of fisheye\_num\_active\_areas\_minus1 shall be in the range of 0 to 3, inclusive. Values of fisheye\_num\_active\_areas\_minus1 greater than 3 are reserved for future use by ITU-T | ISO/IEC. Decoders encountering a fisheye video information SEI message with fisheye\_num\_active\_areas\_minus1 greater than 3 shall ignore the fisheye video information SEI message.

**fisheye\_circular\_region\_centre\_x**[ i ] and **fisheye\_circular\_region\_centre\_y**[ i ] specify the horizontal and vertical coordinates of the centre of the circular region that contains the i-th active area in the coded picture, respectively, in units of 2−16 luma samples. The value of fisheye\_circular\_region\_centre\_x[ i ] and fisheye\_circular\_region\_centre\_y[ i ] shall be in the range of 0 to 65 536 \* 216 − 1 (i.e., 4 294 967 295), inclusive.

**fisheye\_rect\_region\_top**[ i ], **fisheye\_rect\_region\_left**[ i ], **fisheye\_rect\_region\_width**[ i ], and **fisheye\_rect\_region\_height**[ i ] specify the coordinates of the top-left corner and the width and height of the i-th rectangular region that contains the i-th active area, in units of luma samples.

The value of fisheye\_rect\_region\_top[ i ] shall be in the range of SubHeightC \* conf\_win\_top\_offset to pic\_height\_in\_luma\_samples − ( SubHeightC \* conf\_win\_bottom\_offset + 1 ), inclusive.

The value of fisheye\_rect\_region\_left[ i ] shall be in the range of SubWidthC \* conf\_win\_left\_offset to pic\_width\_in\_luma\_samples − ( SubWidthC \* conf\_win\_right\_offset + 1 ), inclusive.

The value of fisheye\_rect\_region\_width[ i ] shall be in the range of 1 to pic\_width\_in\_luma\_samples − SubWidthC \* ( conf\_win\_left\_offset + conf\_win\_right\_offset ), inclusive.

The value of fisheye\_rect\_region\_height[ i ] shall be in the range of 1 to pic\_height\_in\_luma\_samples − SubHeightC \* ( conf\_win\_top\_offset + conf\_win\_bottom\_offset ), inclusive.

The sum of fisheye\_rect\_region\_top[ i ] and fisheye\_rect\_region\_height[ i ] shall be less than pic\_height\_in\_luma\_samples − SubHeightC \* conf\_win\_bottom\_offset.

The sum of fisheye\_rect\_region\_left[ i ] and fisheye\_rect\_region\_width[ i ] shall be less than pic\_width\_in\_luma\_samples − SubWidthC \* conf\_win\_right\_offset.

**fisheye\_circular\_region\_radius**[ i ] specifies the radius of the circular region that contains the i-th active area that is defined as a length from the centre of the circular region specified by fisheye\_circular\_region\_centre\_x[ i ] and fisheye\_circular\_region\_centre\_y[ i ] to the outermost pixel boundary of the circular region, in units of 2−16 luma samples, that corresponds to the maximum field of view of the i-th fisheye lens, specified by fisheye\_field\_of\_view[ i ]. The value of fisheye\_circular\_region\_radius[ i ] shall be in the range of 0 to 65 536 \* 216 − 1 (i.e., 4 294 967 295), inclusive.

The i-th active area is defined as the intersection of the i-th rectangular region, specified by fisheye\_rect\_region\_top[ i ], fisheye\_rect\_region\_left[ i ], fisheye\_rect\_region\_width[ i ], and fisheye\_rect\_region\_height[ i ], and the i-th circular region, specified by fisheye\_circular\_region\_centre\_x[ i ], fisheye\_circular\_region\_centre\_y[ i ], and fisheye\_circular\_region\_radius[ i ].

Each active area shall contain at least one sample location. There shall not be any sample location that is within more than one active area.

**fisheye\_scene\_radius**[ i ] specifies the radius of a circular region within the i-th active area in units of 2−16 luma samples, where the obstruction, such as the camera body, is not included in the region specified by fisheye\_circular\_region\_centre\_x[ i ], fisheye\_circular\_region\_centre\_y[ i ], and fisheye\_scene\_radius[ i ]. The value of fisheye\_scene\_radius[ i ] shall be less than or equal to fisheye\_circular\_region\_radius[ i ], and shall be in the range of 0 to 65 536 \* 216 − 1 (i.e., 4 294 967 295), inclusive. The enclosed area is the suggested area for stitching as recommended by the encoder.

**fisheye\_camera\_centre\_azimuth**[ i ] and **fisheye\_camera\_centre\_elevation**[ i ] indicate the spherical coordinates that correspond to the centre of the circular region that contains the i-th active area in the cropped output picture, in units of 2−16 degrees. The value of fisheye\_camera\_centre\_azimuth[ i ] shall be in the range of −180 \* 216 (i.e., −11 796 480) to 180 \* 216 − 1 (i.e., 11 796 479), inclusive, and the value of fisheye\_camera\_centre\_elevation[ i ] shall be in the range of −90 \* 216 (i.e., −5 898 240) to 90 \* 216 (i.e., 5 898 240), inclusive.

**fisheye\_camera\_centre\_tilt**[ i ] indicates the tilt angle of the sphere region that corresponds to the i-th active area of the cropped output picture, in units of 2−16 degrees. The value of fisheye\_camera\_centre\_tilt[ i ] shall be in the range of −180 \* 216 (i.e., −11 796 480) to 180 \* 216 − 1 (i.e., 11 796 479), inclusive.

**fisheye\_camera\_centre\_offset\_x**[ i ], **fisheye\_camera\_centre\_offset\_y**[ i ] and **fisheye\_camera\_centre\_offset\_z**[ i ] indicate the XYZ offset values, in units of 2−16 millimeters, of the focal centre of the fisheye camera lens corresponding to the i-th active area from the focal centre origin of the overall fisheye camera configuration. The value of each of fisheye\_camera\_centre\_offset\_x[ i ], fisheye\_camera\_centre\_offset\_y[ i ], and fisheye\_camera\_centre\_offset\_z[ i ] shall be in the range of 0 to 65 536 \* 216 − 1 (i.e., 4 294 967 295), inclusive.

**fisheye\_field\_of\_view**[ i ] specifies the field of view of the lens that corresponds to the i-th active area in the coded picture, in units of 2−16 degrees. The value of fisheye\_field\_of\_view[ i ] shall be in the range of 0 to 360 \* 216 (i.e., 23 592 960), inclusive.

**fisheye\_num\_polynomial\_coeffs**[ i ] specifies the number of polynomial coefficients for the circular region corresponding to the i-th active area. The value of fisheye\_num\_polynomial\_coeffs[ i ] shall be in the range of 0 to 8, inclusive. Values of fisheye\_num\_polynomial\_coeffs[ i ] greater than 8 are reserved for future use by ITU-T | ISO/IEC. Decoders encountering a fisheye video information SEI message with fisheye\_num\_polynomial\_coeffs[ i ] greater than 8 shall ignore the fisheye video information SEI message.

**fisheye\_polynomial\_coeff**[ i ][ j ] specifies the j-th polynomial coefficient value, in units of 2−24, of the curve function that maps the normalized distance of a luma sample from the centre of the circular region corresponding to the i-th active area to the angular value of a sphere coordinate from the normal vector of a nominal imaging plane that passes through the centre of the sphere coordinate system for the i-th active region. The value of fisheye\_polynomial\_coeff[ i ][ j ] shall be in the range of −128 \* 224 (i.e., 2 147 483 648) to 128 \* 224 − 1 (i.e., 2 147 483 647), inclusive.

*In D.3.41.6.2 (Projection for one sample location), in Equation D-57, replace the following:*

θ =

*with the following:*

θ =

*In D.3.41.6.4 (Conversion of sample locations for rectangular region-wise packing), Equation D-59, replace the 8 instances of "*if ( transformType  = =*" with "*if( transformType  = =*" (removing the space after "if").*

*Renumber clause D.3.45 (Reserved SEI message semantics) as D.3.47.*

*Add clauses D.3.45 and D.3.46, as follows:*

**D.3.45 SEI manifest SEI message semantics**

The SEI manifest SEI message conveys information on SEI messages that are indicated as expected (i.e., likely) to be present or not present. Such information may include:

1. The indication that certain types of SEI messages are expected (i.e., likely) to be present (although not guaranteed to be present) in the CVS.
2. For each type of SEI message that is indicated as expected (i.e., likely) to be present in the CVS, the degree of expressed necessity of interpretation of the SEI messages of this type.

The degree of necessity of interpretation of an SEI message type may be indicated as "necessary", "unnecessary", or "undetermined".

An SEI message is indicated by the encoder (i.e., the content producer) as being "necessary" when the information conveyed by the SEI message is considered as necessary for interpretation by the decoder or receiving system in order to properly process the content and enable an adequate user experience; it does not mean that the bitstream is required to contain the SEI message in order to be a conforming bitstream. It is at the discretion of the encoder to determine which SEI messages are to be considered as necessary in a particular CVS. However, it is suggested that some SEI messages, such as the frame packing arrangement, segmented rectangular frame packing arrangement, and omnidirectional projection indication SEI messages, should typically be considered as necessary.

1. The indication that certain types of SEI messages are expected (i.e., likely) not to be present (although not guaranteed not to be present) in the CVS.

NOTE – An example of such a usage of an SEI manifest SEI message is to express the expectation that there are no frame packing arrangement SEI messages, segmented rectangular frame packing arrangement SEI messages, display orientation SEI messages, or omnidirectional projection indication SEI messages in the CVS, and therefore that the rendering of the decoded video pictures for display purposes would not need any of the additional post-processing that is commonly associated with the interpretation of these SEI messages.

The content of an SEI manifest SEI message may, for example, be used by transport-layer or systems-layer processing elements to determine whether the CVS is suitable for delivery to a receiving and decoding system, based on whether the receiving system can properly process the CVS to enable an adequate user experience or whether the CVS satisfies the application needs.

When an SEI manifest SEI message is present in any access unit of a CVS, an SEI manifest SEI message shall be present in the first access unit of the CVS. The SEI manifest SEI message persists in decoding order from the current access unit until the end of the CVS. When there are multiple SEI manifest SEI messages present in a CVS, they shall have the same content.

An SEI NAL unit containing an SEI manifest SEI message shall not contain any other SEI messages other than SEI prefix indication SEI messages. When present in an SEI NAL unit, the SEI manifest SEI message shall be the first SEI message in the SEI NAL unit.

**manifest\_num\_sei\_msg\_types** specifies the number of types of SEI messages for which information is provided in the SEI manifest SEI message.

**manifest\_sei\_payload\_type**[ i ] indicates the payloadType value of the i-th type of SEI message for which information is provided in the SEI manifest SEI message. The values of manifest\_sei\_payload\_type[ m ] and manifest\_sei\_payload\_type[ n ] shall not be identical when m is not equal to n.

**manifest\_sei\_description**[ i ] provides information on SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] as specified in Table D.23.

Table D.23 – manifest\_sei\_description[ i ] values

|  |  |
| --- | --- |
| **Value** | **Description** |
| 0 | Indicates that there is no SEI message with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS. |
| 1 | Indicates that there are SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS, and these SEI messages are considered as necessary. |
| 2 | Indicates that there are SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS, and these SEI messages are considered as unnecessary. |
| 3 | Indicates that there are SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS, and the necessity of these SEI messages is undetermined. |
| 4-255 | Reserved |

The value of manifest\_sei\_description[ i ] shall be in the range of 0 to 3, inclusive, in bitstreams conforming to this version of this Specification. Other values for manifest\_sei\_description[ i ] are reserved for future use by ITU-T | ISO/IEC. Decoders shall allow the value of manifest\_sei\_description[ i ] greater than or equal to 4 to appear in the syntax and shall ignore all information for payloadType equal to manifest\_sei\_payload\_type[ i ] signalled in the SEI manifest SEI message and shall ignore all SEI prefix indication SEI messages with prefix\_sei\_payload\_type equal to manifest\_sei\_payload\_type[ i ] when manifest\_sei\_description[ i ] is greater than or equal to 4.

**D.3.46 SEI prefix indication SEI message semantics**

The SEI prefix indication SEI message carries one or more SEI prefix indications for SEI messages of a particular value of payloadType. Each SEI prefix indication is a bit string that follows the SEI payload syntax of that value of payloadType and contains a number of complete syntax elements starting from the first syntax element in the SEI payload.

Each SEI prefix indication for an SEI message of a particular value of payloadType indicates that one or more SEI messages of this value of payloadType are expected (i.e., likely) to be present in the CVS and to start with the provided bit string. A starting bit string would typically contain only a true subset of an SEI payload of the type of SEI message indicated by the payloadType, may contain a complete SEI payload, and shall not contain more than a complete SEI payload. It is not prohibited for SEI messages of the indicated value of payloadType to be present that do not start with any of the indicated bit strings.

These SEI prefix indications should provide sufficient information for indicating what type of processing is needed or what type of content is included. The former (type of processing) indicates decoder-side processing capability, e.g., whether some type of frame unpacking is needed. The latter (type of content) indicates, for example, whether the bitstream contains subtitle captions in a particular language.

The content of an SEI prefix indication SEI message may, for example, be used by transport-layer or systems-layer processing elements to determine whether the CVS is suitable for delivery to a receiving and decoding system, based on whether the receiving system can properly process the CVS to enable an adequate user experience or whether the CVS satisfies the application needs (as determined in some manner by external means outside the scope of this Specification).

In one example, when the payloadType indicates the frame packing arrangement SEI message, an SEI prefix indication should include up to at least the syntax element frame\_packing\_arrangement\_type; and when the payloadType indicates the omnidirectional projection indication SEI message, an SEI prefix indication should include up to at least the syntax element projection\_type.

In another example, for user data registered SEI messages that are used to carry captioning information, an SEI prefix indication should include up to at least the language code; and for user data unregistered SEI messages extended for private use, an SEI prefix indication should include up to at least the UUID.

When an SEI prefix indication SEI message is present in any access unit of a CVS, an SEI prefix indication SEI message shall be present in the first access unit of the CVS. The SEI prefix indication SEI message persists in decoding order from the current access unit until the end of the CVS. When there are multiple SEI prefix indication SEI messages present in a CVS for a particular value of payloadType, they shall have the same content.

An SEI NAL unit containing an SEI prefix indication SEI message for a particular value of payloadType shall not contain any other SEI messages other than an SEI manifest SEI message and SEI prefix indication SEI messages for other values of payloadType.

**prefix\_sei\_payload\_type** indicates the payloadType value of the SEI messages for which one or more SEI prefix indications are provided in the SEI prefix indication SEI message. When an SEI manifest SEI message is also present for the CVS, the value of prefix\_sei\_payload\_type shall be equal to one of the manifest\_sei\_payload\_type[ m ] values for which manifest\_sei\_description[ m ] is equal to 1 to 3, inclusive, as indicated by an SEI manifest SEI message that applies to the CVS.

**num\_sei\_prefix\_indications\_minus1** plus 1 specifies the number of SEI prefix indications.

**num\_bits\_in\_prefix\_indication\_minus1**[ i ] plus 1 specifies the number of bits in the i-th SEI prefix indication.

**sei\_prefix\_data\_bit**[ i ][ j ] specifies the j-th bit of the i-th SEI prefix indication.

The bits sei\_prefix\_data\_bit[ i ][ j ] for j ranging from 0 to num\_bits\_in\_prefix\_indication\_minus1[ i ], inclusive, follow the syntax of the SEI payload with payloadType equal to prefix\_sei\_payload\_type, and contain a number of complete syntax elements starting from the first syntax element in the SEI payload syntax, and may or may not contain all the syntax elements in the SEI payload syntax. The last bit of these bits (i.e., the bit sei\_prefix\_data\_bit[ i ][ num\_bits\_in\_prefix\_indication\_minus1[ i ] ]) shall be the last bit of a syntax element in the SEI payload syntax, unless it is a bit within an itu\_t\_t35\_payload\_byte or user\_data\_payload\_byte.

NOTE – The exception for itu\_t\_t35\_payload\_byte and user\_data\_payload\_byte is provided because these syntax elements may contain externally-specified syntax elements, and the determination of the boundaries of such externally-specified syntax elements is a matter outside the scope of this Specification.

**byte\_alignment\_bit\_equal\_to\_one** shall be equal to 1.

*In F.14.2.4 (Inter-layer constrained tile sets SEI message syntax), replace the following row:*

|  |  |
| --- | --- |
| if ( !il\_all\_tiles\_exact\_sample\_value\_match\_flag ) |  |

*with the following (removing the space after "if"):*

|  |  |
| --- | --- |
| if( !il\_all\_tiles\_exact\_sample\_value\_match\_flag ) |  |

*In F.14.3.1 (General SEI payload semantics), replace the following paragraphs:*

The list VclAssociatedSeiList is set to consist of the payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 151, inclusive, 154 to 159, inclusive, 161, 165, 167, and 168.

The list PicUnitRepConSeiList is set to consist of the payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 151, inclusive, and 154 to 168, inclusive.

*with the following:*

The list VclAssociatedSeiList is set to consist of the payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 152, inclusive, 154 to 159, inclusive, 161, 165, 167, 168, and 200 to 201, inclusive.

The list PicUnitRepConSeiList is set to consist of the payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 152, inclusive, 154 to 168, inclusive, and 200 to 201, inclusive.

*In G.14.3.1 (General SEI payload semantics), replace the following paragraphs:*

The list VclAssociatedSeiList is set to consist of payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 151, inclusive, 154 to 159, inclusive, 161, 165, 167, 168, 177, 178, and 179.

The list PicUnitRepConSeiList is set to consist of payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 151, inclusive, 154 to 168, inclusive, and 176 to 180, inclusive.

*with the following:*

The list VclAssociatedSeiList is set to consist of payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 152, inclusive, 154 to 159, inclusive, 161, 165, 167, 168, 177, 178, 179, and 200 to 201, inclusive.

The list PicUnitRepConSeiList is set to consist of payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 152, inclusive, 154 to 168, inclusive, 176 to 180, inclusive, and 200 to 201, inclusive.

*In I.14.3.1 (General SEI payload semantics), replace the following paragraphs:*

The list VclAssociatedSeiList is set to consist of payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 151, inclusive, 154 to 159, inclusive, 161, 165, 167, 168, 177, 178, and 179.

The list PicUnitRepConSeiList is set to consist of payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 151, inclusive, 154 to 168, inclusive, and 176 to 181, inclusive.

*with the following:*

The list VclAssociatedSeiList is set to consist of payloadType values 2, 3, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 131, 132, 134 to 152, inclusive, 154 to 159, inclusive, 161, 165, 167, 168, 177, 178, 179, and 200 to 201, inclusive.

The list PicUnitRepConSeiList is set to consist of payloadType values 0, 1, 2, 6, 9, 15, 16, 17, 19, 22, 23, 45, 47, 56, 128, 129, 131, 132, 133, 135 to 152, inclusive, 154 to 168, inclusive, 176 to 181, inclusive, and 200 to 201, inclusive.

*In the Bibliography, replace "SMPTE ST 2086 (2014)" with "SMPTE ST 2086 (2018)".*

*In the Bibliography, add the following additional citation (and renumber items 16 and higher in the existing list to account for the additional entry):*

[16] ANSI/CTA 861-G (2016), *A DTV Profile for Uncompressed High Speed Digital Interfaces*.

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