|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  17th Meeting: Valencia, ES, 27 March – 4 April 2014 | Document: JCTVC-Q0072 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **SCE1: Color gamut scalability using gain-offset models** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | A. Aminlou  K. Ugur  M. M. Hannuksela | Tel: Email: | +90 536 567 29997 [kemal.ugur@nokia.com](mailto:kemal.ugur@nokia.com) |
| *Source:* | Nokia | | |

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

# Abstract

This contribution reports the results of tests 1.1, 1.2, 1.3 and 1.4 of SCE1. These tests propose methods for color gamut scalability. Three tools are proposed and tested: Firstly, the YUV space is divided into a NYxNCbxNCr region and for each region different gain-offset parameters are signaled. Secondly, a YUV matrix based mapping is used to derive the mapped pixel values. As a third modification, second order polynomial equations are used for matrix based mapping, instead of linear equations.

# Introduction

SHVC WD4 includes a mechanism for color gamut scalability, to support coding EL with BT.2020 at UHD resolution and base layer with BT.709 at HD resolution. This is done by modifying the upsampling process, where the bit-shifts within upsampling process depend on the bit-depths of both EL and BL picture and using weighted prediction for inter-layer processing. In order to further improve the coding efficiency of the above use-case, SCE1 was formed.

# Details of the proposal

In order to improve coding efficiency for CoGS we propose three modifications for weighted prediction process.

1. **Region based gain-offset mapping:** Based on the observations in JCTVC-L0334 and JCTVC-M0197, dividing the YUV color space into regions and using different color space mapping function for each region improves the coding efficiency. We propose to divide the YUV into an NxNxN (N=8 in the tests) region and signal separate gain offset parameters for each region.
2. **Matrix based mapping:** As earlier analyzed in JCTVC-L0334, utilizing a matrix based mapping more accurately reflects the BT.2020 to BT.709 mapping:  
    (1)

*Gain(Y, Cb, Cr)*is a 3x3 matrix and *Offset(Y, Cb, Cr)* is a 1x3 matrix. Encoder uses simple linear regression to derive the parameters of the matrices (using more complicated algorithms could further improve coding efficiency)

1. **Polynomial based mapping:** In order to better capture the non-linear relationship between two color spaces, as an alternative to Equation 1, we use a second order polynomial equation as follows:

 (2)

Similar to Equation 1, *Gain1(Y, Cb, Cr)* and *Gain2(Y, Cb, Cr)*are 3x3 matrices and *Offset(Y, Cb, Cr)* is a 1x3 matrix. (*Y0*, *Cb0*, *Cr0*) is the central point of the corresponding region. For example, when there are 8x8x8 regions and BL data are 10bit, Y0 =((Y709>>7)<<7)+64. This is to reduce the dynamic range of polynomial part of Equation 2. The benefit of using polynomial equations is that one could reduce the number of regions as non-linear characteristics can already be captured with the polynomial equation.

## Details of mapping process

The details of mapping process can be summarized as below:

1. Divide color components (Y, Cb and Cr) ranges of the base layer picture into NY, NCb and NCr regions, respectively. Each range of Y, Cb, and Cr has the length of LY, LCbr, LCr, respectively. As a result, the YCbCr domain of the base layer is divided to NY×NCb×NCr regions. Each region is represented by index value of [iY, iCb, iCr].
2. Decode/Find the gain-offset matrices of Gain and Offset for all regions at the encoder/decoder side.
3. For all pixel of (Y709, Cr709, Cb709) in the base layer
   1. Find the correspond region of [iY, iCb, iCr] using (3)
   2. Map the pixel by the corresponding matrices, for example using (4)

 (3)  (4)

## Gain-offset matrix estimation

At the encoder side, for each I-frame, the weight-offset matrices are found by least square error method for each region of [iY, iCb, iCr].

Let’s define set of S[iY, iCb, iCr] as (5) which includes all the pixel of the base layer frame which are in region of [iY, iCb, iCr].

|  |  |
| --- | --- |
|  | (5) |

Then the coefficients for each color component in the regions of [iY, iCb, iCr] are found as below. The square error can be calculated for a color component, for example for Y component using (6),

|  |  |
| --- | --- |
|  | (6) |

where YE is the original values of the enhancement layer picture, and Y2020 is the calculated value of the target picture using the described mapping method. According to the described method, the value of Y2020 for each pixel is calculated using (7)

|  |  |
| --- | --- |
|  | (7) |

where gYX (X=Y, Cb, Cr) and oY are the coefficients of the first row of Gain[iY, iCb, iCr] and Offset[iY, iCb, iCr] matrices.

To have the optimum values of gYX and oY variables, the first derivation of EY with respect to each variable should be equal to zero. This forms a system of four equations and for variables, where the values of gYX and oY are found with a closed form solution. The value of other gij and oi variables is found for the other color components (Cb and Cr) using the similar manner.

## Gain-offset matrix coding

The calculated Gain-offset matrices are calculated for each I-frame and signaled in the PPS, and are reused for all P/B frames in the Intra period. This means that in RA case, weight-offset matrices are found and signaled every about one second, while in AI case, they are found and signaled every frame.

The coefficients of Gain and Offset matrices are real number that should be converted to signed integer values to be coded into the bitstream. Coefficients of Offset matrix are truncated to the signed integer values without any quantization. The coefficients on the main diagonal of matrix Gain (i.e. gYY, gCbCb, gCrCr) are subtracted by 1.0. Then all coefficients of matrix Gain are quantized to M bit (e.g 10 bit).

The Gain[iY, iCb, iCr] and Offset[iY, iCb, iCr] are coded into the enhancement layer bitstream as below. For each frame a “FramePresentFlag” is coded which indicates whether any parameters is code for this frame or not. In the value of this flag is zero, the RegionPresentFlag” of all regions are set to zero. Otherwise, parameters of some regions may be coded as below. For a given [iY, iCb, iCr], firstly the “RegionPresentFlag” is coded, indicating whether Gain and Offset matrices should be coded or not. If the flag is “0”, it means that Gain and Offset are not coded. In this case, Gain and Offset are set to fixed predefined matrices (e.g. Identity and zero, respectively) for I-frames, or they are copied from previously coded I-frames for P/B-frames. If the flag is coded as “1”, it means that the matrices are coded by signed variable length coding in the slice header.

## Details of the tests

Four tests are performed with different configurations:

**Configuration 1:** N=8, linear matrix mapping

**Configuration 2**: N=1, linear matrix mapping

**Configuration 3**: N=8, no matrix based mapping

**Configuration 4**: N=1, polynomial matrix mapping enabled

# Complexity analysis

Complexity of the proposal is analysed as recommended by SCE1. For the number of multipliers and bit-depth of multiplier, please see attached excel sheets.

## Summary

Summary information about complexity characteristics and coding efficiency of each configuration can be found below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Configuration 1** | **Configuration 2** | **Configuration 3** | **Configuration 4** |
| Number of multipliers (worst case) 2x1 scalability ratio | 76.125 | 76.125 | 75.375 | 78.375 |
| Size of table | 8x8x8 | 1 | 8x8x8 | 1 |
| Cross-colour dependency in region selection | Yes | Yes | Yes | Yes |
| Cross-colour dependency in mapping process | Yes | Yes | No | Yes |
| Other | Multiplier of each pixel depends on the value of the pixel | - | Multiplier of each pixel depends on the value of the pixel | - |
| BD-rateY (AI\_1x) | -8.1% | -3.3% | -5.2% | -7.7% |
| BD-rateY (AI\_2x) | -8.5% | -3.2% | -5.1% | -6.7% |
| BD-rateY (RA\_1x) | -9.7% | -3.2% | -6.9% | -8.1% |
| BD-rateY (RA\_2x) | -6.4% | -2.1% | -4.3% | -4.6% |

Detailed complexity analyses are attached.

# Experimental Results

(Please refer to the next page)

**Configuration 1:** N=8, linear matrix mapping

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 1x 10-bit base** | | | **AI HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -8.1% | -15.3% | -18.4% | -8.5% | -12.3% | -16.7% |
| **Overall (Test vs Ref)** | -8.1% | -15.3% | -18.4% | -8.5% | -12.3% | -16.7% |
| **Overall (Test vs single layer)** | 21.2% | 11.6% | -8.3% | 10.6% | 9.1% | -0.1% |
| **Overall (Ref vs single layer)** | 32.3% | 31.8% | 11.7% | 21.2% | 24.7% | 19.4% |
| **EL only (Test vs Ref)** | -29.4% | -34.5% | -37.7% | -16.7% | -19.9% | -24.4% |
| **Overall (Test EL+BL vs single EL+BL)** | -35.3% | -40.9% | -51.8% | -27.4% | -28.0% | -35.5% |
| Enc Time[%] |  | | |  | | |
| Dec Time[%] |  | | |  | | |
| Enc Mem[%] |  | | |  | | |
| BL Match | Matched | | | Matched | | |
|  |  |  |  |  |  |  |
|  | **RA HEVC 1x 10-bit base** | | | **RA HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -9.7% | -15.9% | -19.4% | -6.4% | -10.2% | -14.2% |
| **Overall (Test vs Ref)** | -9.7% | -15.9% | -19.4% | -6.4% | -10.2% | -14.2% |
| **Overall (Test vs single layer)** | 30.6% | 24.6% | 2.2% | 21.0% | 19.9% | 9.4% |
| **Overall (Ref vs single layer)** | 45.0% | 48.8% | 26.2% | 29.3% | 33.3% | 27.6% |
| **EL only (Test vs Ref)** | -29.0% | -33.5% | -36.1% | -12.0% | -15.3% | -19.3% |
| **Overall (Test EL+BL vs single EL+BL)** | -28.9% | -31.8% | -43.8% | -19.4% | -18.0% | -26.6% |
| BL Match | Matched | | | Matched | | |

**Configuration 2**: N=1, linear matrix mapping

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 1x 10-bit base** | | | **AI HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -3.3% | -6.1% | -5.7% | -3.2% | -3.2% | -4.4% |
| **Overall (Test vs Ref)** | -3.3% | -6.1% | -5.7% | -3.2% | -3.2% | -4.4% |
| **Overall (Test vs single layer)** | 28.0% | 23.7% | 5.6% | 17.3% | 20.6% | 14.3% |
| **Overall (Ref vs single layer)** | 32.3% | 31.8% | 11.7% | 21.2% | 24.7% | 19.4% |
| **EL only (Test vs Ref)** | -16.2% | -18.4% | -18.4% | -6.4% | -6.2% | -7.5% |
| **Overall (Test EL+BL vs single EL+BL)** | -32.5% | -34.7% | -44.7% | -23.7% | -21.5% | -26.0% |
| BL Match | Matched | | | Matched | | |
|  |  |  |  |  |  |  |
|  | **RA HEVC 1x 10-bit base** | | | **RA HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -3.2% | -5.1% | -5.7% | -2.1% | -1.8% | -3.5% |
| **Overall (Test vs Ref)** | -3.2% | -5.1% | -5.7% | -2.1% | -1.8% | -3.5% |
| **Overall (Test vs single layer)** | 40.4% | 41.0% | 19.1% | 26.6% | 30.9% | 23.0% |
| **Overall (Ref vs single layer)** | 45.0% | 48.8% | 26.2% | 29.3% | 33.3% | 27.6% |
| **EL only (Test vs Ref)** | -9.6% | -11.3% | -12.1% | -3.9% | -3.4% | -5.2% |
| **Overall (Test EL+BL vs single EL+BL)** | -24.6% | -23.8% | -35.8% | -16.1% | -12.0% | -17.6% |
| BL Match | Matched | | | Matched | | |

**Configuration 3**: N=8, no matrix based mapping

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 1x 10-bit base** | | | **AI HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -5.2% | -6.1% | -12.0% | -5.1% | -4.4% | -9.8% |
| **Overall (Test vs Ref)** | -5.2% | -6.1% | -12.0% | -5.1% | -4.4% | -9.8% |
| **Overall (Test vs single layer)** | 25.3% | 23.7% | -1.3% | 14.9% | 19.3% | 7.9% |
| **Overall (Ref vs single layer)** | 32.3% | 31.8% | 11.7% | 21.2% | 24.7% | 19.4% |
| **EL only (Test vs Ref)** | -21.4% | -21.7% | -27.2% | -10.7% | -9.6% | -15.0% |
| **Overall (Test EL+BL vs single EL+BL)** | -33.4% | -34.7% | -48.5% | -24.6% | -21.8% | -30.2% |
| BL Match | Matched | | | Matched | | |
|  |  |  |  |  |  |  |
|  | **RA HEVC 1x 10-bit base** | | | **RA HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -6.9% | -8.3% | -13.8% | -4.3% | -4.8% | -9.4% |
| **Overall (Test vs Ref)** | -6.9% | -8.3% | -13.8% | -4.3% | -4.8% | -9.4% |
| **Overall (Test vs single layer)** | 34.9% | 36.2% | 9.0% | 23.8% | 27.1% | 15.5% |
| **Overall (Ref vs single layer)** | 45.0% | 48.8% | 26.2% | 29.3% | 33.3% | 27.6% |
| **EL only (Test vs Ref)** | -21.3% | -22.0% | -26.8% | -8.3% | -8.4% | -13.0% |
| **Overall (Test EL+BL vs single EL+BL)** | -26.9% | -26.3% | -40.8% | -17.6% | -13.9% | -22.8% |
| BL Match | Matched | | | Matched | | |

**Configuration 4**: N=1, polynomial matrix mapping enabled

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **AI HEVC 1x 10-bit base** | | | **AI HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -7.7% | -11.1% | -10.0% | -6.7% | -7.8% | -8.0% |
| **Overall (Test vs Ref)** | -7.7% | -11.1% | -10.0% | -6.7% | -7.8% | -8.0% |
| **Overall (Test vs single layer)** | 22.0% | 17.0% | 1.3% | 12.9% | 14.8% | 10.0% |
| **Overall (Ref vs single layer)** | 32.3% | 31.8% | 11.7% | 21.2% | 24.7% | 19.4% |
| **EL only (Test vs Ref)** | -32.9% | -34.6% | -33.9% | -13.5% | -14.2% | -14.5% |
| **Overall (Test EL+BL vs single EL+BL)** | -35.7% | -38.6% | -48.4% | -26.4% | -24.9% | -29.8% |
| BL Match | Matched | | | Matched | | |
|  |  |  |  |  |  |  |
|  | **RA HEVC 1x 10-bit base** | | | **RA HEVC 2x 8-bit base** | | |
|  | Y | U | V | Y | U | V |
|  |  |  |  |  |  |  |
| Class A+ | -8.1% | -10.4% | -10.8% | -4.6% | -4.8% | -5.7% |
| **Overall (Test vs Ref)** | -8.1% | -10.4% | -10.8% | -4.6% | -4.8% | -5.7% |
| **Overall (Test vs single layer)** | 33.0% | 32.9% | 13.3% | 23.4% | 26.9% | 20.1% |
| **Overall (Ref vs single layer)** | 45.0% | 48.8% | 26.2% | 29.3% | 33.3% | 27.6% |
| **EL only (Test vs Ref)** | -24.7% | -26.2% | -26.4% | -8.9% | -8.8% | -9.6% |
| **Overall (Test EL+BL vs single EL+BL)** | -28.3% | -28.2% | -40.2% | -18.1% | -14.3% | -20.6% |
| BL Match | Matched | | | Matched | | |

# Specification text

|  |  |
| --- | --- |
| … |  |
| if( nuh\_layer\_id > 0 && NumActiveRefLayerPics > 0 ) { |  |
| cgs\_matrix( ) |  |
| … |  |

**Configuration 1 N:8, linear matrix mapping**

|  |  |
| --- | --- |
| cgs\_matrix( ) { |  |
| for( n = 0; n < numRefLayerPics; n++ ) { |  |
| **cgs\_enabled\_flag**[ n ] | u(1) |
| if( cgs\_enabled\_flag ) { |  |
| **cgs**\_**coeff\_precision**[ n ] | ue(v) |
| for( i = 0; i < 8; i++ ) { |  |
| for( j = 0; j < 8; j++ ) { |  |
| for( k = 0; k < 8; k++ ) { |  |
| **cgs\_present\_flag**[ i ][ j ][ k ][ n ] | u(1) |
| if( cgs\_present\_flag[ i ][ j ][ k ][ n ] ) { |  |
| for( cIdx = 0; cIdx < 3; cIdx++ ) { |  |
| for( d = 0; d < 4;d++ ) { |  |
| **cgs\_coeff**[ cIdx ][ d ][ i ][ j ][ k ][ n ] | se(v) |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |

**cgs\_enabled\_flag**[ n ] equal to 1 specifies that color gamut mapping is applied to reference layer picture to derive the inter-layer reference picture. **cgs\_enabled\_flag**[ n ] equal to 0 specifies that color gamut mapping is not applied to reference layer picture to derive the inter-layer reference picture.

**cgs\_coeff\_precision**[ n ] specifies the precision for the color gamut mapping coefficients used in color gamut mapping process.

**cgs\_present\_flag**[ i ][ j ][ k ][ n ] equal to 1 specifies that syntax elements cgs\_coeff[ cIdx ][ d ][ i ][ j ][ k ]are present for the region specified with [ i ][ j ][ k ]. cgs\_present\_flag[ i ][ j ][ k ] equal to 0 specifies that syntax elements cgs\_coeff[ cIdx  ][ d ][ i ][ j ][ k ] are not present and the corresponding default values are used.

**cgs\_coeff**[ cIdx ][ d ][ i ][ j ][ k ][ n ] specifies the color gamut mapping coefficients for component indicated by cIdx

**Configuration 2 N:1, linear matrix mapping**

|  |  |
| --- | --- |
| cgs\_matrix( ) { |  |
| for( n = 0; n < numRefLayerPics; n++ ) { |  |
| **cgs\_enabled\_flag**[ n ] | u(1) |
| if( cgs\_enabled\_flag ) { |  |
| **cgs**\_**coeff\_precision**[ n ] | ue(v) |
| **cgs\_present\_flag**[ n ] | u(1) |
| if( cgs\_present\_flag[ n ] ) { |  |
| for( cIdx = 0; cIdx < 3; cIdx++ ) { |  |
| for( d = 0; d < 4;d++ ) { |  |
| **cgs\_coeff**[ cIdx ][ d ][ n ] | se(v) |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |

**cgs\_enabled\_flag**[ n ] equal to 1 specifies that color gamut mapping is applied to reference layer picture to derive the inter-layer reference picture. **cgs\_enabled\_flag**[ n ] equal to 0 specifies that color gamut mapping is not applied to reference layer picture to derive the inter-layer reference picture.

**cgs\_coeff\_precision**[ n ] specifies the precision for the color gamut mapping coefficients used in color gamut mapping process.

**cgs\_present\_flag**[ n ] equal to 1 specifies that syntax elements cgs\_coeff[ cIdx ][ d ] are present. cgs\_present\_flag equal to 0 specifies that syntax elements cgs\_coeff[ cIdx  ][ d ] are not present and the corresponding default values are used.

**cgs\_coeff**[ cIdx ][ d ][ n ] specifies the color gamut mapping coefficients for component indicated by cIdx

**Configuration 3 N:8, no matrix based mapping:**

|  |  |
| --- | --- |
| cgs\_matrix( ) { |  |
| for( n = 0; n < numRefLayerPics; n++ ) { |  |
| **cgs\_enabled\_flag**[ n ] | u(1) |
| if( cgs\_enabled\_flag ) { |  |
| **cgs**\_**coeff\_precision**[ n ] | ue(v) |
| for( i = 0; i < 8; i++ ) { |  |
| for( j = 0; j < 8; j++ ) { |  |
| for( k = 0; k < 8; k++ ) { |  |
| **cgs\_present\_flag**[ i ][ j ][ k ][ n ] | u(1) |
| if( cgs\_present\_flag[ i ][ j ][ k ][ n ] ) { |  |
| for( cIdx = 0; cIdx < 3; cIdx++ ) { |  |
| for( d = 0; d < 2;d++ ) { |  |
| **cgs\_coeff**[ cIdx ][ d ][ i ][ j ][ k ][ n ] | se(v) |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |

**cgs\_enabled\_flag**[ n ] equal to 1 specifies that color gamut mapping is applied to reference layer picture to derive the inter-layer reference picture. **cgs\_enabled\_flag**[ n ] equal to 0 specifies that color gamut mapping is not applied to reference layer picture to derive the inter-layer reference picture.

**cgs\_coeff\_precision**[ n ] specifies the precision for the color gamut mapping coefficients used in color gamut mapping process.

**cgs\_present\_flag**[ i ][ j ][ k ][ n ] equal to 1 specifies that syntax elements cgs\_coeff[ cIdx ][ d ][ i ][ j ][ k ]are present for the region specified with [ i ][ j ][ k ]. cgs\_present\_flag[ i ][ j ][ k ] equal to 0 specifies that syntax elements cgs\_coeff[ cIdx  ][ d ][ i ][ j ][ k ] are not present and the corresponding default values are used.

**cgs\_coeff**[ cIdx ][ d ][ i ][ j ][ k ][ n ] specifies the color gamut mapping coefficients for component indicated by cIdx

**Case 4 Polynomial case:**

|  |  |
| --- | --- |
| cgs\_matrix( ) { |  |
| for( n = 0; n < numRefLayerPics; n++ ) { |  |
| **cgs\_enabled\_flag**[ n ] | u(1) |
| if( cgs\_enabled\_flag ) { |  |
| **cgs**\_**coeff\_precision**[ n ] | ue(v) |
| **cgs\_present\_flag**[ n ] | u(1) |
| if( cgs\_present\_flag[ n ] ) { |  |
| for( cIdx = 0; cIdx < 3; cIdx++ ) { |  |
| for( d = 0; d < 7;d++ ) { |  |
| **cgs\_coeff**[ cIdx ][ d ][ n ] | se(v) |
| } |  |
| } |  |
| } |  |
| } |  |
| } |  |

**cgs\_enabled\_flag**[ n ] equal to 1 specifies that color gamut mapping is applied to reference layer picture to derive the inter-layer reference picture. **cgs\_enabled\_flag**[ n ] equal to 0 specifies that color gamut mapping is not applied to reference layer picture to derive the inter-layer reference picture.

**cgs\_coeff\_precision**[ n ] specifies the precision for the color gamut mapping coefficients used in color gamut mapping process.

**cgs\_present\_flag**[ n ] equal to 1 specifies that syntax elements cgs\_coeff[ cIdx ][ d ] are present. cgs\_present\_flag equal to 0 specifies that syntax elements cgs\_coeff[ cIdx  ][ d ] are not present and the corresponding default values are used.

**cgs\_coeff**[ cIdx ][ d ][ n ] specifies the color gamut mapping coefficients for component indicated by cIdx

# Patent rights declaration(s)

**Nokia may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**