JCTVC-O0363
Color Mapping SEI message

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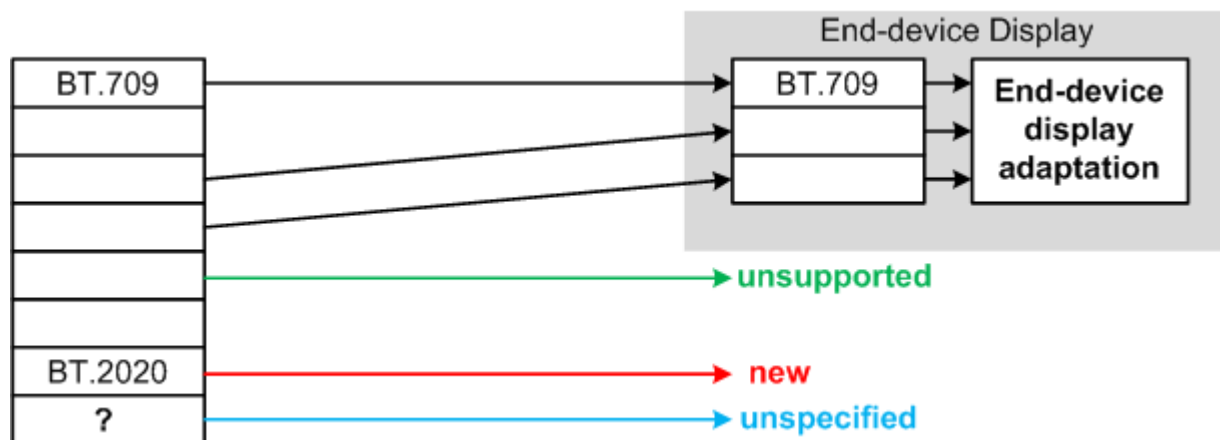
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Color Mapping SEI message

Proposition

- To support color mapping post-processing on reconstructed pictures
- The color mapping function is coded using a Color LUT

Context

- Several color formats (primaries, matrix coefficients, transfer characteristic) can be signaled in HEVC syntax (VUI)

- Some end-devices may not support all formats because of:
  - Limited rendering capability
  - New color formats (ex: BT.2020)
  - Pointless w.r.t. device/application
  - Unspecified color format

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Color Mapping SEI message

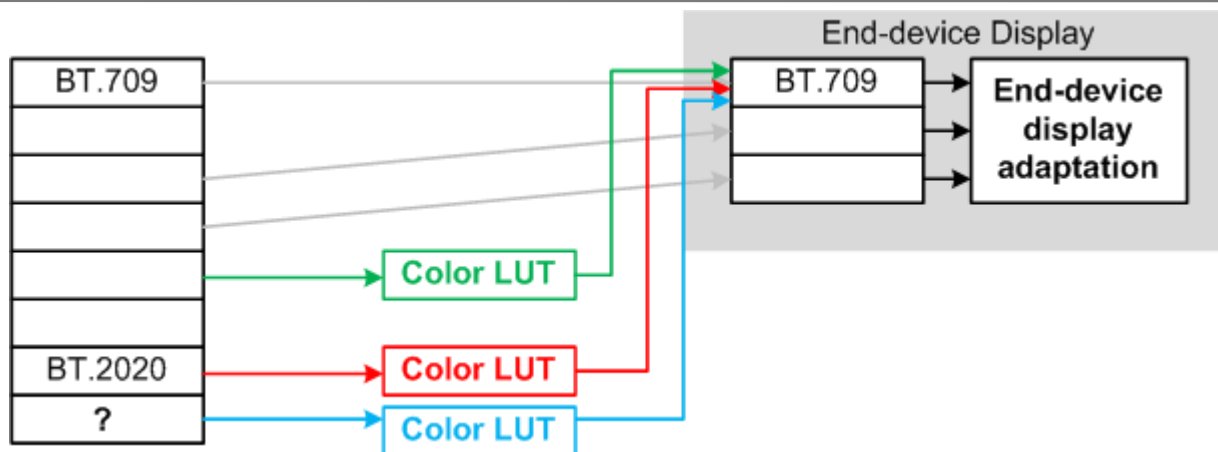| Value	Primaries	Informative Remark
0	Reserved	For future use by ITU-T | ISO/IEC
1	primary x y green 0.300 0.600 blue 0.150 0.060 red 0.640 0.330 white D65 0.3127 0.3290	1. ITU-R Rec. BT.709-5 2. ITU-R Rec. BT.1361 conventional colour gamut system and extended colour gamut system 3. IEC 61966-2-1 (sRGB or sYCC) 4. IEC 61966-2-4 5. Society of Motion Picture and Television Engineers RP 177 (1993) Annex B
2	Unspecified	Image characteristics are unknown or are determined by the application.
3	Reserved	For future use by ITU-T | ISO/IEC
4	primary x y green 0.210.71 blue 0.140.08 red 0.670.33 white C 0.310 0.316	ITU-R Rec. BT.470-6 System M (historical) United States National Television System Committee 1953 Recommendation for transmission standards for colour television United States Federal Communications Commission Title 47 Code of Federal Regulations (2003) 73.682 (a) (20)
5	primary x y green 0.290.60 blue 0.150.06 red 0.640.33 white D65 0.3127 0.3290	ITU-R Rec. BT.470-6 System B, G (historical) ITU-R Rec. BT.601-6 625 ITU-R Rec. BT.1358 625 ITU-R Rec. BT.1700 625 PAL and 625 SECAM
6	primary x y green 0.310 0.595 blue 0.155 0.070 red 0.630 0.340 white D65 0.3127 0.3290	ITU-R Rec. BT.601-6 525 ITU-R Rec. BT.1358 525 ITU-R Rec. BT.1700 NTSC Society of Motion Picture and Television Engineers 170M (2004) (functionally the same as the value 7)
7	primary x y green 0.310 0.595 blue 0.155 0.070 red 0.630 0.340 white D65 0.3127 0.3290	Society of Motion Picture and Television Engineers 240M (1999) (functionally the same as the value 6)
8	primary x y green 0.243 0.692 (Wratten 58) blue 0.145 0.049 (Wratten 47) red 0.681 0.319 (Wratten 25) white C 0.310 0.316	Generic film (colour filters using Illuminant C)
9	primary x y green 0.170 0.797 blue 0.131 0.046 red 0.708 0.292 white D65 0.3127 0.3290	Rec. ITU-R BT.2020
10..255	Reserved	For future use by ITU-T | ISO/IEC

unspecified

new

future

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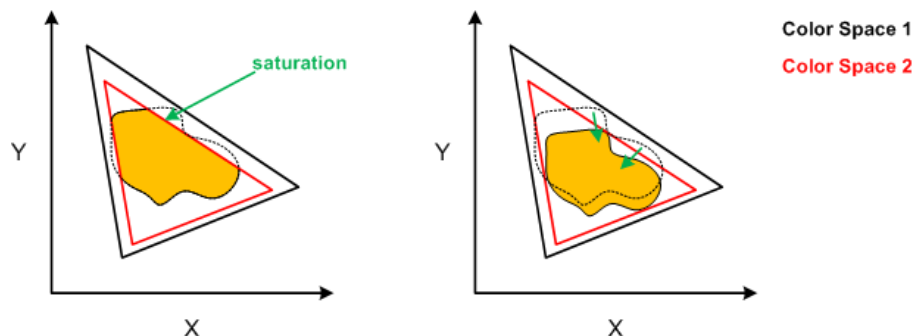
Color Mapping SEI message

The Color LUT allows mapping the reconstructed pictures to a supported color format

Advantages

- To increase color adaptability (end-devices not supporting all color format)
- To preserve colorist intent when converting color graded content
- To provide color mapping function tailored to particular applications
- Color LUTs is a common and universal color mapping format
- Same semantic as SEI Tone Mapping

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Color Mapping SEI message syntax

colour_mapping_info(payloadSize) {	Descriptor
colour_map_id	ue(v)
colour_map_cancel_flag	u(1)
if(!colour_map_cancel_flag) {	
colour_map_repetition_period	ue(v)
colour_map_video_signal_type_present_flag	u(1)
if(colour_map_video_signal_type_present_flag) {	
colour_map_video_format	u(3)
colour_map_video_full_range_flag	u(1)
colour_map_description_present_flag	u(1)
if (colour_map_description_present_flag) {	
colour_map_primaries	u(8)
colour_map_transfer_characteristics	u(8)
colour_map_matrix_coeffs	u(8)
}	
}	
3D_ LUT_ colour_data ( )	
}	
}	

3D_ LUT_ colour_data ( ) {	Descriptor
bit_depth_lut_minus8	u(4)
nbp_code	u(3)
coding_octant(0, 0, 0, 0)	
}	

nuh_layer_id identifies the layer of the reconstructed pictures to which the CLUT should be applied.

color_map_id, color_map_cancel_flag, color_map_repetition_period semantic is same as tone_map_id, tone_map_cancel_flag and tone_map_repetition_period defined in SEI tone mapping (Annex D).

colour_map_video_signal_type_present_flag, **colour_map_video_format,** **colour_map_video_full_range_flag,** **colour_map_description_present_flag, colour_map_primaries, colour_map_transfer_characteristics, colour_map_matrix_coeffs** semantic is the same as the semantic of the syntax elements video_signal_type_present_flag, video_format, video_full_range_flag, colour_description_present_flag, colour_primaries, transfer_characteristics, matrix_coeffs in VUI (specified in Annex E) respectively. These syntax elements describe the remapped output decoded pictures video signal characteristics.

bit_depth_lut_minus8 + 8 specifies the bit depth of the 3D LUT samples.

nbp_code indicates the 3D LUT size nbp as listed in Table 2 for the given value of nbp_code (nbp=2(nbp_code-1)+1).

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Color LUT coding syntax
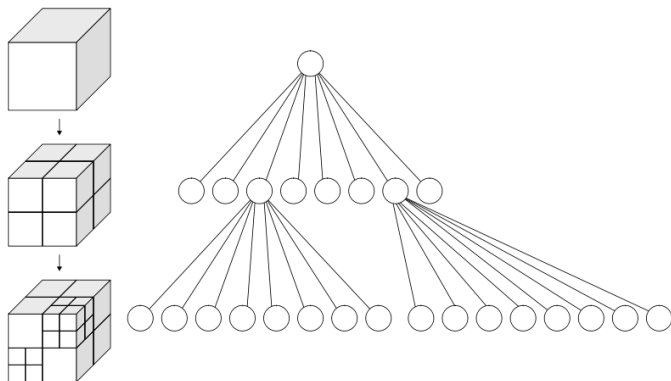
	Descriptor
coding_octant (layer_id, y,u,v) {	
for(i = 0; i < 8 ; i++) {	
n = getVertex(y, u, v, i)	
if (!coded_flag[n]) {	
encoded_vertex_flag[i]	u(1)
if (encoded_vertex_flag[i]) {	
resY[i]	ue(v)
resU[i]	ue(v)
resV[i]	ue(v)
}	
coded_flag[n] = true	
}	
}	
split_octant_flag	u(1)
if (split_octant_flag) {	
for(i = 0; i < 8 ; i++) {	
coding_octant (layer_id+1, y+dy[i],u+du[i],v+dv[i])	
}	
}	
}	

Octree based coding using DPCM coding of YUV color vertices

- Unused (or less used) 3D color space regions are encoded with coarsely lattice size
- Each color component of a vertex is predicted with previously encoded color components of neighboring parent octant vertices

encoded_vertex_flag[i] indicates whether the residual components values (resY[i],resU[i], resV[i]) are encoded or all inferred to be zero.

split_octant_flag specifies whether an octant is split into octants with half horizontal and vertical size. The values (y,u,v) specify the location of the first vertex in the 3D LUT.

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Conclusion

- Formerly presented in JCTVC (N0180) with an example of software application based on a modified SHM2.0 encoder and decoder

- Demonstration showing benefits

- CLUT accuracy showed in SCE4 (Color Gamut Scalability)

- Color metadata requirements expressed in (Draft under discussion):

    - **CM-UHDTV-0017 – Draft Commercial Requirements for UHD-1 Phase 1**

        Colourist (descriptive and mapping) metadata would be valuable carried with the content. If content uses of BT.2020 colour encoding, colourist metadata is necessary for smooth transition of display technologies, since the full BT.2020 colour gamut cannot be displayed by current video broadcast reference monitors or by current consumer displays. If content uses BT.709 colour encoding, colourist metadata can help for a smooth transition towards higher gamut capable displays. In particular gamut mapping can be provided to map BT.709 to higher gamut, allowing preservation of artistic intent to the maximum extent. The colourist metadata is generated during production. It can be used by the consumer end device or consumer display to map the production colour gamut into the consumer display colour gamut.

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Demonstration: BT.2020 => rec.709

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