

Centralized Texture-Depth Packing SEI Message for HEVC (Revisions of JCT3V-L0022)

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Centralized Texture-Depth Packing (CTDP) SEI Message Syntax

1. removing the syntax of texture_sampling_type and depth_sampling_type as suggested in the previous meeting

CTDP SEI Syntax

centralized_texture-depth_packing(payloadSize) {	Descriptor
centralized_texture-depth_packing_cancel_flag	u(1)
if(! centralized_texture-depth_packing_cancel_flag) {	
centralized_texture-depth_packing_content_interpretation_type	u(3)
half_depth_line_number	u(10)
depth_spatial_flipping_flag	u(1)
depth_chroma_sampling_type	u(3)
depth_subpixel_arrangement_type	u(2)
depth_representation_type	ue(v)
baseline_dist_flag	u(1)
focal_length_flag	u(1)
z_near_flag	u(1)
z_far_flag	u(1)
d_min_flag	u(1)
d_max_flag	u(1)
if(baseline_dist_flag)	
view_syn_rep_info_element(BdistanceSign, BdistanceExp, BdistanceMantissa, BdistanceManLen)	
if(focal_length_flag)	
view_syn_rep_info_element(FlengthSign, FlengthExp, FlengthMantissa, FlengthManLen)	
if(z_near_flag)	
view_syn_rep_info_element(ZNearSign, ZNearExp, ZNearMantissa, ZNearManLen)	
if(z_far_flag)	
view_syn_rep_info_element (ZFarSign, ZFarExp, ZFarMantissa, ZFarManLen)	
if(d_min_flag)	
view_syn_rep_info_element (DMinSign, DMinExp, DMinMantissa, DMinManLen)	
if(d_max_flag)	
view_syn_rep_info_element (DMaxSign, DMaxExp, DMaxMantissa, DMaxManLen)	
if(depth_representation_type == 3) {	
depth_nonlinear_representation_num_minus1	ue(v)
for(i = 1; i <= depth_nonlinear_representation_num_minus1 + 1; i++)	
depth_nonlinear_representation_model[i]	
centralized_texture-depth_packing_persistence_flag	u(1)
}	
}	

centralized_texture-depth_packing_content_interpretation_type

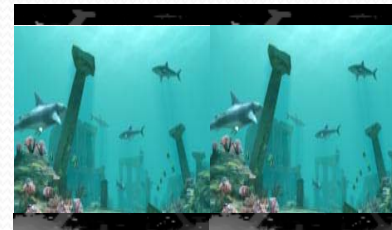
Value	Interpretation
0	Indicates that the packed frame is arranged in order of reduced_depth_top (RD_T), resized_texture (RT), and reduced_depth_bottom (RD_B) from top to bottom called as CTDP TB type as illustrated in Figure D-X1.
1	Indicates that the packed frame is arranged in order of reduced_depth_left (RD_L), resized_texture (RT), and reduced_depth_right (RD_R) from left to right called as CTDP LR type as illustrated in Figure D-X2.
2	Indicates that the packed frame, which provides two texture-plus-depth views, is arranged in order of reduced_depth_leftview_top (RDL_T), reduced_depth_rightview_top (RDR_T), resized_texture_leftview (RT_L), resized_texture_rightview (RT_R), reduced_depth_leftview_bottom (RDL_B), and reduced_depth_rightview_bottom (RDR_B), from upper left, upper right to lower right called as CTDP 2TB type as illustrated in Figure D-X3.
3	Indicates that the packed frame, which provides two texture-plus-depth views, is arranged in order of reduced_depth_topview_left (RDT_L), reduced_depth_bottomview_left (RDB_L), resized_texture_topview (RT_T), resized_texture_bottomview (RT_B), reduced_depth_topview_right (RDT_R) and reduced_depth_bottomview_right (RDB_R) from upper left, upper center to lower right called as CTDP 2LR type as illustrated in Figure D-X4.



CTDP-TB



CTDP-LR

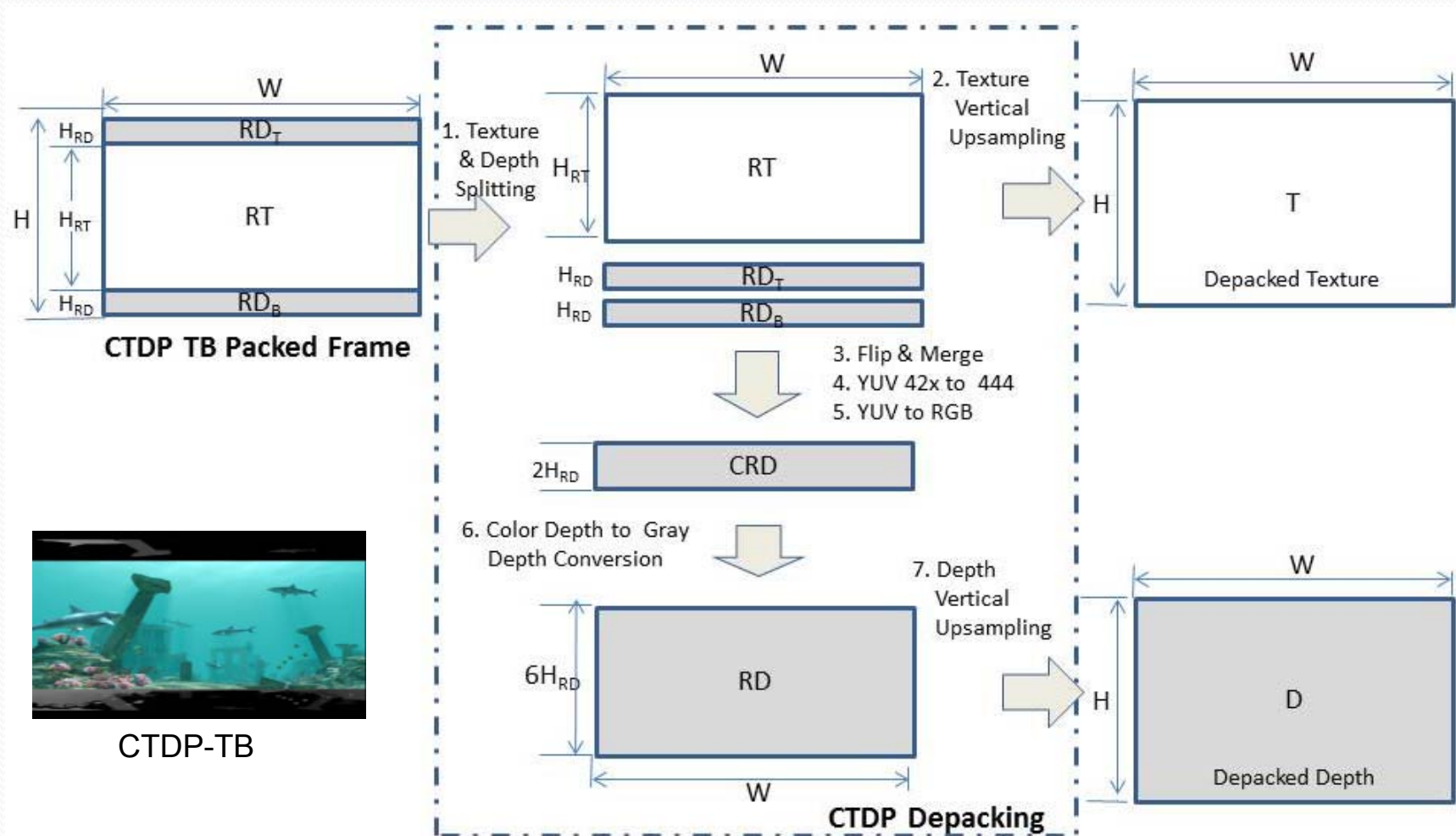


CTDP-2TB

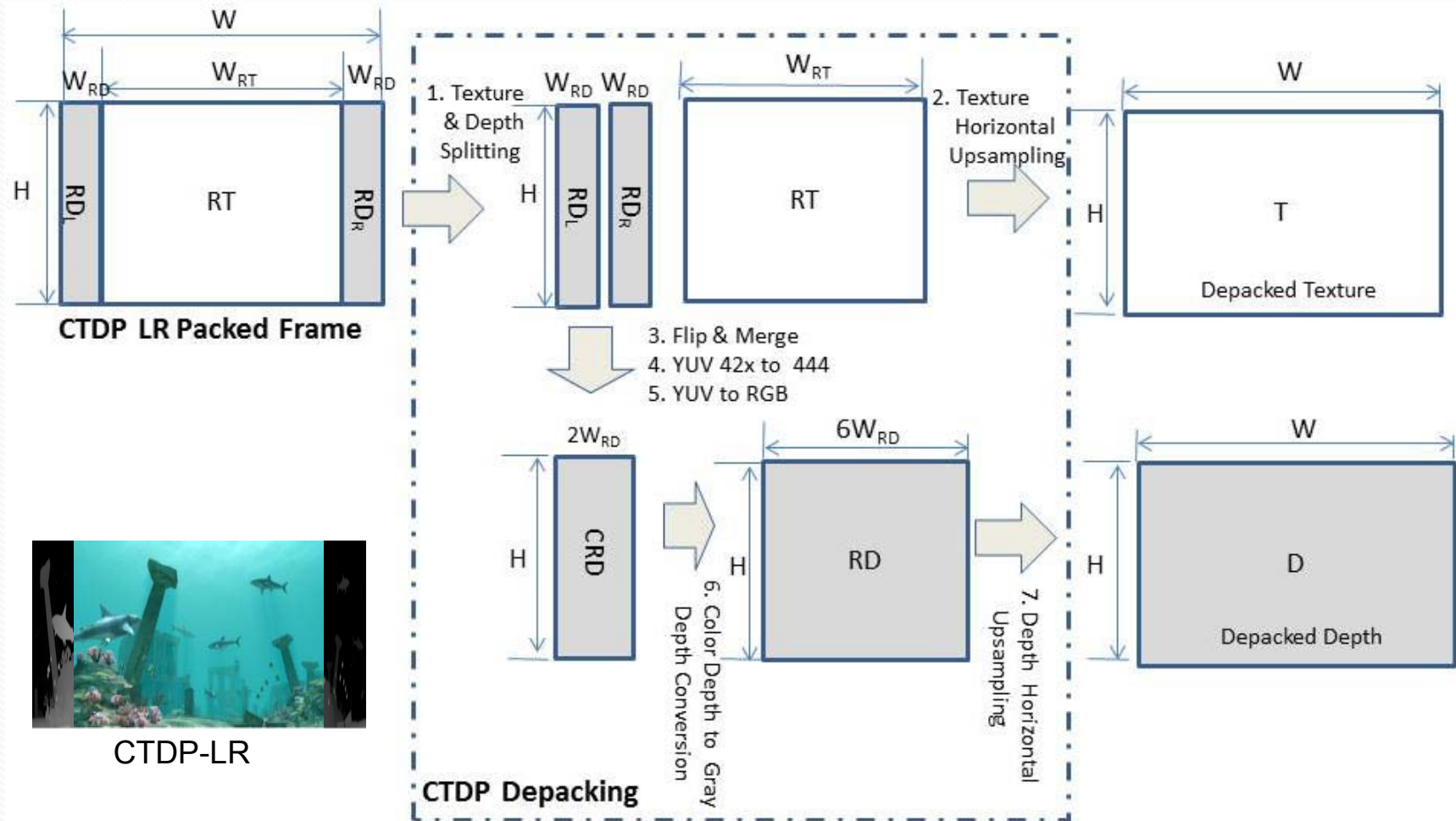


CTDP-2LR

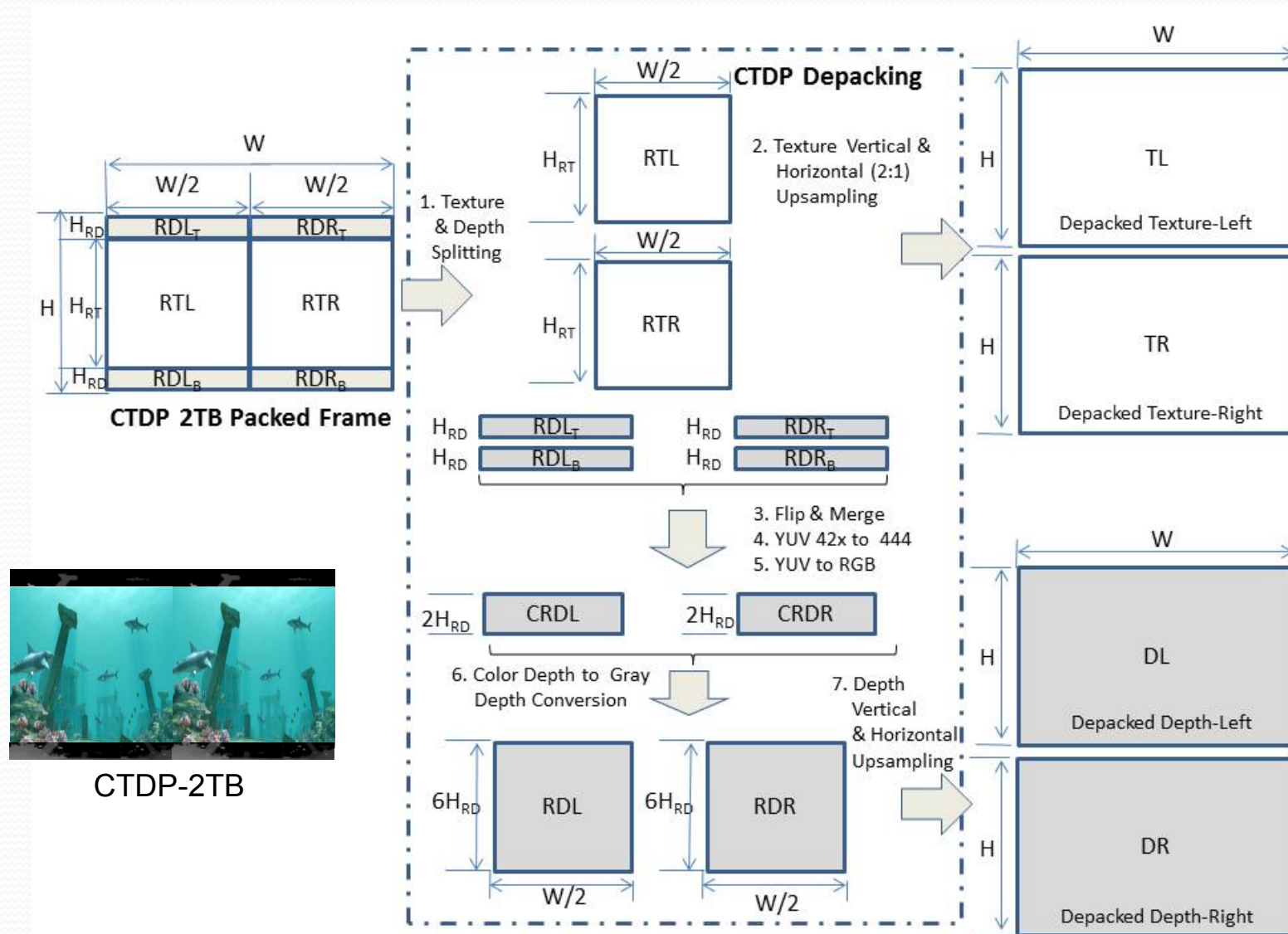
centralized_texture-depth_packing_content_interpretation_type = 0



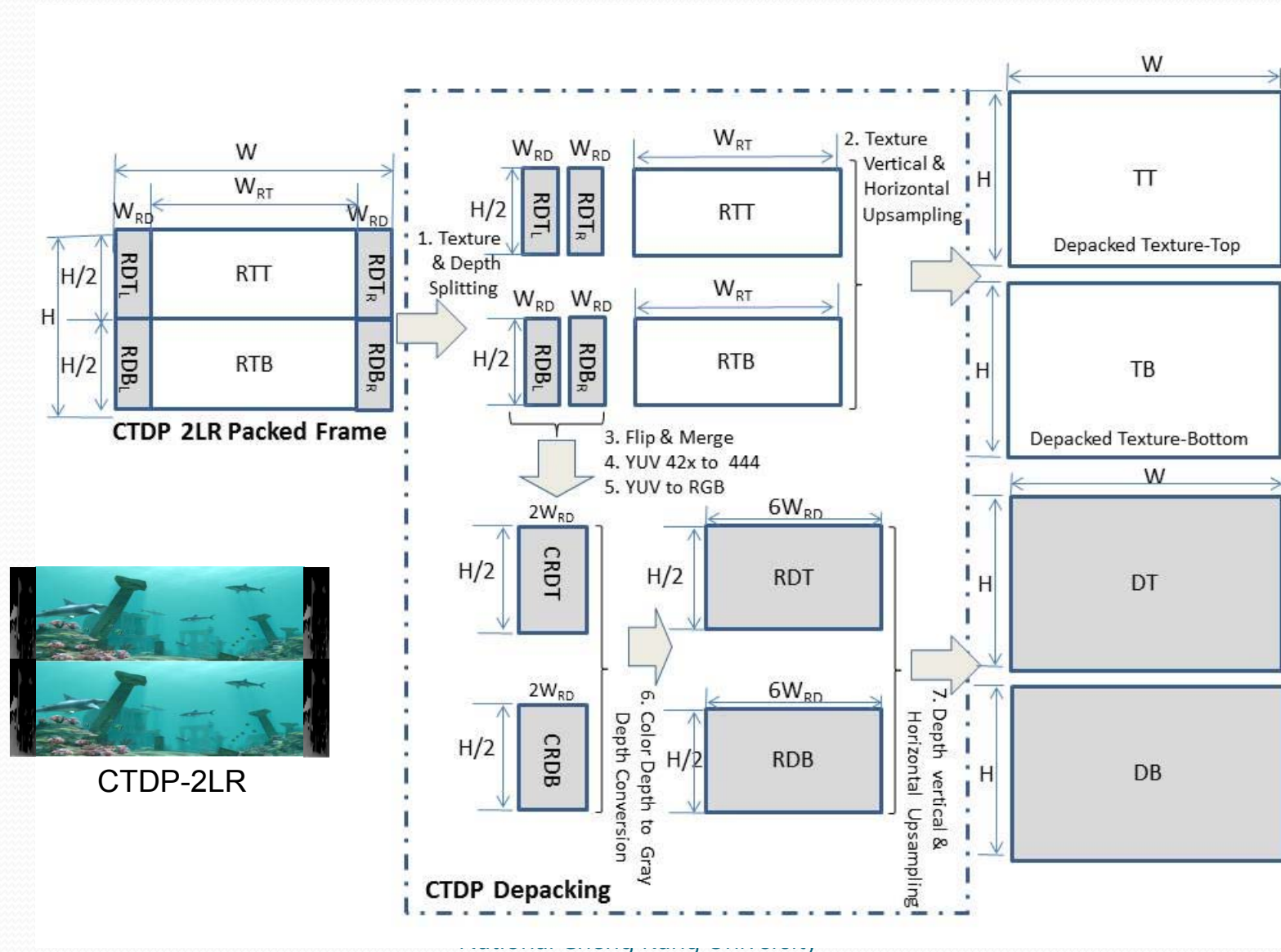
centralized_texture-depth_packing_content_interpretation_type = 1



centralized_texture-depth_packing_content_interpretation_type = 2



centralized_texture-depth_packing_content_interpretation_type = 3



half_depth_line_number

half_depth_line_number indicates the number of horizontal lines of the reduced depth top and bottom regions or the number of vertical lines of the reduced depth left and right regions. The numbers of horizontal and vertical lines of reduced texture regions can be derived accordingly. The detailed descriptions of sizes of reduced depth and reduced texture regions according to centralized_texture-depth_packing_content_interpretation_type.

Let W and H be the width and height as `pic_width_in_luma_samples` and `pic_height_in_luma_samples`, respectively, of the decoded frame output from the decoder in units of luma samples.

For CTDP-TB and CTDP-2TB packing types, the height of the reduced top and bottom depth regions is given as $H_{RD} = 2 \times \text{half_depth_line_number}$, for RD_T , RD_B , RDL_T , RDR_T , RDL_B , and RDR_B .

For CTDP-LR and CTDP-2LR packing types, the width of the reduced depth regions is defined by, $W_{RD} = 2 \times \text{half_depth_line_number}$, for RD_L , RD_R , RDT_L , RDT_R , RDB_L , or RDB_R .

The $16 \times \text{half_depth_line_number}$ should not be larger than the number of the original horizontal or vertical lines of the luma frame to achieve reasonable depth and texture packing.

depth_spatial_flipping_flag

- depth_spatial_flipping_flag indicates that the reduced depth region are spatially flipped relative to its intended orientation for display or other such purposes

Value	Interpretation
0	No flipping
1	Flipping

No flipping



Flipping



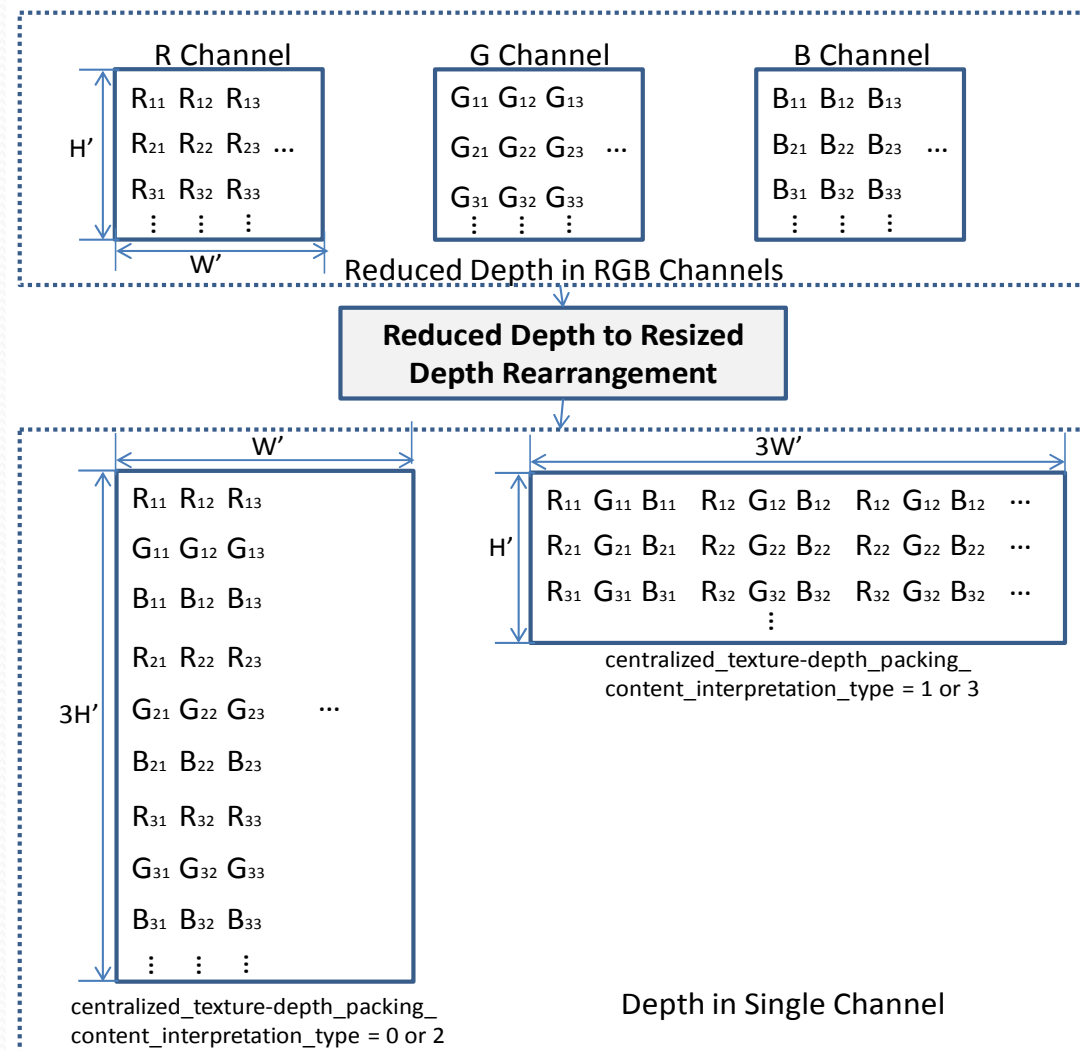
depth_chroma_sampling_type

- depth_chroma_sampling_type indicates that indicates that the depth chroma sampling method from 444 to 422 or 420 format is used by the CTDP packer as specified in Table D-X2. According to depth_chroma_sampling_type, YCbCr colour 422 or 420 format is converted to YCbCr colour 444 format.

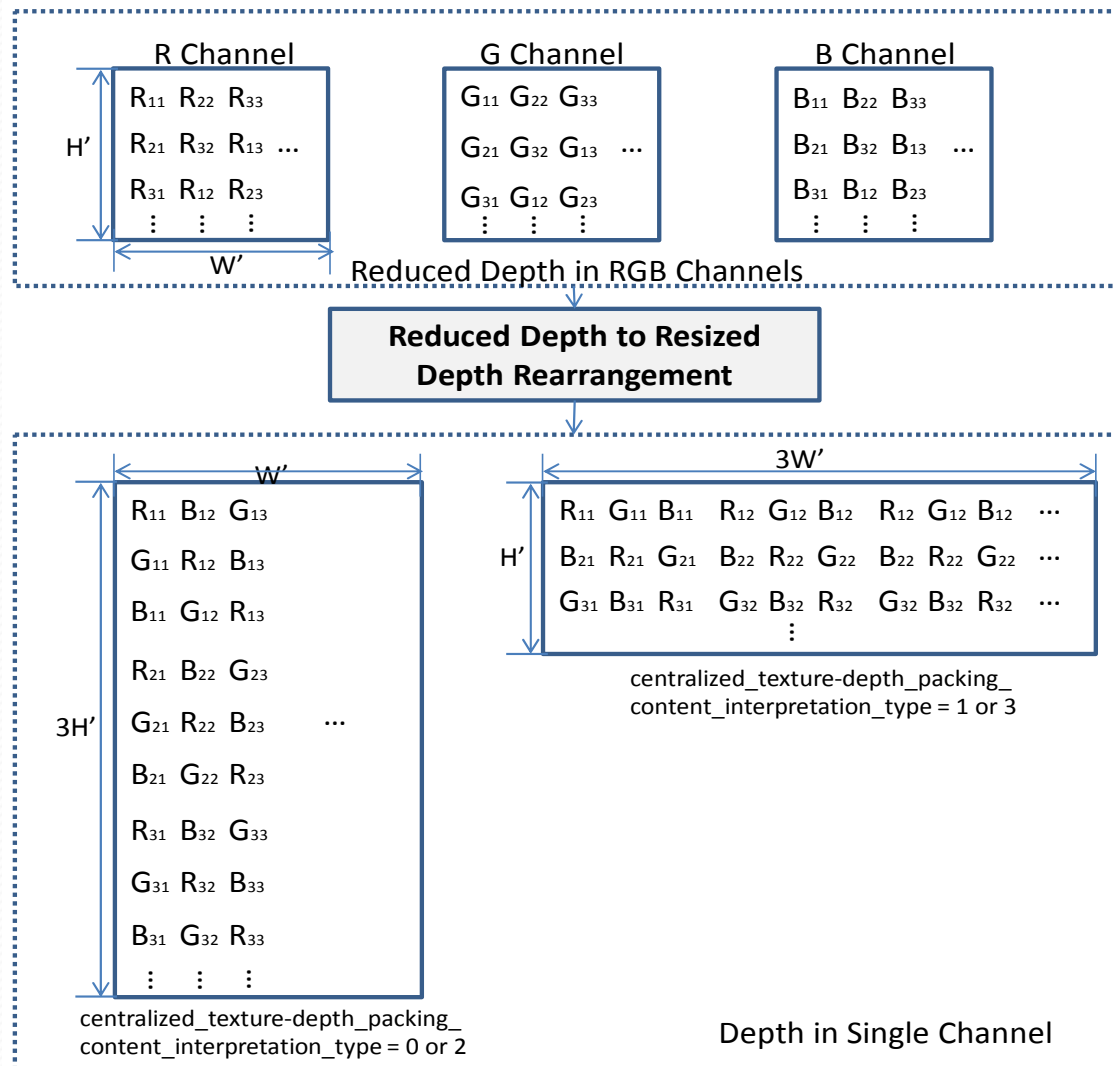
Value	Interpretation
0	CTDP depacker is informed that the direct sample is used to convert the chroma sample from 444 to 422 or 420 format according to marked chroma sample location..
1	CTDP depacker is informed that the mean of two (four) samples is used to convert the chroma sample from 444 to 422 (420) format.

Values of depth_chroma_sampling_type that do not appear in Table D X2 are reserved for future specification by ITU-T |ISO/IEC and shall not be present in bitstreams conforming to this version of this Specification. Decoders shall ignore centralized texture-depth packing SEI messages that contain reserved values of depth_chroma_sampling_type.

depth_subpixel_arrangement_type = 0



depth_subpixel_arrangement_type = 1



depth_representation_type

- depth_representation_type specifies the representation definition of decoded luma samples of auxiliary pictures. In the table, disparity specifies the horizontal displacement between two texture views and Z value specifies the distance from a camera.

Value	Interpretation
0	Each decoded luma sample value of an auxiliary picture represents an inverse of Z value that is uniformly quantized into the range of 0 to maxVal, inclusive. When z_far_flag is equal to 1, the luma sample value equal to 0 represents the inverse of ZFar (specified below). When z_near_flag is equal to 1, the luma sample value equal to maxVal represents the inverse of ZNear (specified below).
1	Each decoded luma sample value of an auxiliary picture represents disparity that is uniformly quantized into the range of 0 to maxVal, inclusive. When d_min_flag is equal to 1, the luma sample value equal to 0 represents DMin (specified below). When d_max_flag is equal to 1, the luma sample value equal to maxVal represents DMax (specified below).
2	Each decoded luma sample value of an auxiliary picture represents a Z value uniformly quantized into the range of 0 to maxVal, inclusive. When z_far_flag is equal to 1, the luma sample value equal to 0 corresponds to ZFar (specified below). When z_near_flag is equal to 1, the luma sample value equal to maxVal represents ZNear (specified below).
3	Each decoded luma sample value of an auxiliary picture represents a nonlinearly mapped disparity, normalized in range from 0 to maxVal, as specified by depth_nonlinear_representation_num_minus1 and depth_nonlinear_representation_model[i]. When d_min_flag is equal to 1, the luma sample value equal to 0 represents DMin (specified below). When d_max_flag is equal to 1, the luma sample value equal to maxVal represents DMax (specified below).
Other values	Reserved for future use

The variable maxVal is set equal to $(1 \ll (8 + \text{bit_depth_luma_minus8})) - 1$, where bit_depth_luma_minus8 is the value included in or inferred for the active SPS of the layer with nuh_layer_id equal to targetLayerId.

baseline_dist_flag equal to 0 specifies that the syntax elements specifying the baseline distance are not present in the syntax structure. **baseline_dist_flag** equal to 1 specifies that the syntax elements specifying the baseline distance value are present in the syntax structure.

focal_length_flag equal to 0 specifies that the syntax elements specifying the focal length are not present in the syntax structure. **focal_length_flag** equal to 1 specifies that the syntax elements specifying the focal length value are present in the syntax structure.

z_near_flag equal to 0 specifies that the syntax elements specifying the nearest depth value are not present in the syntax structure. **z_near_flag** equal to 1 specifies that the syntax elements specifying the nearest depth value are present in the syntax structure.

z_far_flag equal to 0 specifies that the syntax elements specifying the farthest depth value are not present in the syntax structure. **z_far_flag** equal to 1 specifies that the syntax elements specifying the farthest depth value are present in the syntax structure.

d_min_flag equal to 0 specifies that the syntax elements specifying the minimum disparity value are not present in the syntax structure. **d_min_flag** equal to 1 specifies that the syntax elements specifying the minimum disparity value are present in the syntax structure.

d_max_flag equal to 0 specifies that the syntax elements specifying the maximum disparity value are not present in the syntax structure. **d_max_flag** equal to 1 specifies that the syntax elements specifying the maximum disparity value are present in the syntax structure.

View synthesis representation information element syntax

view_syn_rep_info_element(OutSign, OutExp, OutMantissa, OutManLen) {	Descriptor
da_sign_flag	u(1)
da_exponent	u(7)
da_mantissa_len_minus1	u(5)
da_mantissa	u(v)
}	

The syntax structure specifies the value of an element in the view synthesis representation information SEI message.

The syntax structure sets the values of the OutSign, OutExp, OutMantissa and OutManLen variables that represent a floating-point value. When the syntax structure is included in another syntax structure, the variable names OutSign, OutExp, OutMantissa and OutManLen are to be interpreted as being replaced by the variable names used when the syntax structure is included.

da_sign_flag equal to 0 indicates that the sign of the floating-point value is positive. **da_sign_flag** equal to 1 indicates that the sign is negative. The variable OutSign is set equal to **da_sign_flag**.

da_exponent specifies the exponent of the floating-point value. The value of **da_exponent** shall be in the range of 0 to $2^7 - 2$, inclusive. The value $2^7 - 1$ is reserved for future use by ITU-T | ISO/IEC. Decoders shall treat the value $2^7 - 1$ as indicating an unspecified value. The variable OutExp is set equal to **da_exponent**.

da_mantissa_len_minus1 plus 1 specifies the number of bits in the **da_mantissa** syntax element. The value of **da_mantissa_len_minus1** shall be in the range of 0 to 31, inclusive. The variable OutManLen is set equal to **da_mantissa_len_minus1** + 1.

da_mantissa specifies the mantissa of the floating-point value. The variable OutMantissa is set equal to **da_mantissa**.

Association between depth parameter variables and syntax elements

x	s	e	n	v
Bdistance	BdistanceSign	BdistanceExp	BdistanceMantissa	BdistanceManLen
Flength	FlengthSign	FlengthExp	FlengthMantissa	FlengthManLen
ZNear	ZNearSign	ZNearExp	ZNearMantissa	ZNearManLen
ZFar	ZFarSign	ZFarExp	ZFarMantissa	ZFarManLen
DMax	DMaxSign	DMaxExp	DMaxMantissa	DMaxManLen
DMin	DMinSign	DMinExp	DMinMantissa	DMinManLen

The variables in the x column of table are derived from the respective variables in the s, e, n and v columns as follows:

- If the value of e is in the range of 0 to 127, exclusive, x is set equal to $(-1)^{s*} 2^{e-31} * (1 + n \div 2^v)$.
- Otherwise (e is equal to 0), x is set equal to $(-1)^{s*} 2^{-(30+v)} * n$.

The DMin and DMax values, when present, are specified in units of a luma sample width of the coded picture.

The units for the ZNear and ZFar, when present, are identical but unspecified.

When depth_representation_type is equal to 0 or 2, the disparity D can further be obtained from the value of Z, Bdistance, and Flength, where $D = Bdistance \times Flength \div Z$

depth_nonlinear_representation_num_minus1 plus 2 specifies the number of piecewise linear segments for mapping of depth values to a scale that is uniformly quantized in terms of disparity.

depth_nonlinear_representation_model[i] for i ranging from 0 to $\text{depth_nonlinear_representation_num_minus1} + 2$, inclusive, specify the piecewise linear segments for mapping of decoded luma sample values of an auxiliary picture to a scale that is uniformly quantized in terms of disparity. The values of **depth_nonlinear_representation_model[0]** and **depth_nonlinear_representation_model[depth_nonlinear_representation_num_minus1 + 2]** are both inferred to be equal to 0.

centralized_texture_depth_packing_persistence_flag specifies the persistence of the centralized texture-depth packing arrangement SEI message.

centralized_texture-depth_packing_persistence_flag equal to 0 specifies that the centralized texture-depth packing arrangement SEI message applies to the current decoded frame only.

centralized_texture-depth_packing_persistence_flag equal to 1 specifies that the centralized texture-depth packing arrangement SEI message persists in output order until any of the following conditions are true:

- A new CVS begins.
- The bitstream ends.
- A frame in an access unit containing a centralized texture-depth packing SEI message with the same

Experimental Results for 2V2D Format

1. Environment Settings
2. Coding performance in HEVC HM 13.0 (CTDP)
3. Coding performance in 3D-HEVC HTM 8.0

Test Sequences (Nature)

Sequence	Resolution	Frames	Coded View	Synthesized View
Poznan Hall	1920×1088	200	5, 6	5.5
Poznan Street	1920×1088	250	3, 4	3.5
Kendo	1024×768	300	3, 5	4
Balloons	1024×768	300	3, 5	4
Newspaper	1024×768	300	4, 6	5



Experimental Settings

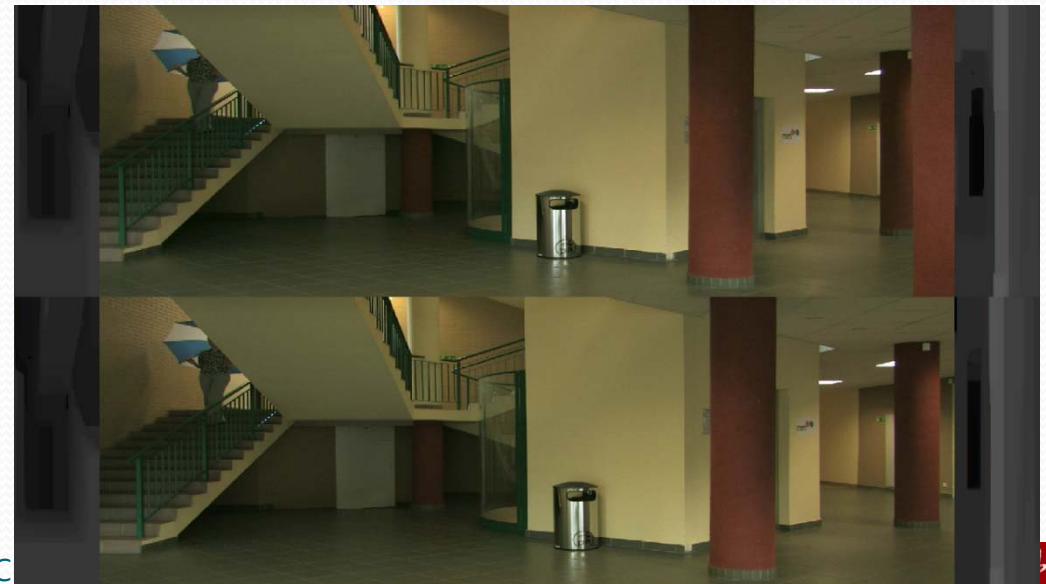
- **Encoding Mode:** All Intra, Low delay, Random access
- **QP:** 27,32,37,42
- **depth_sampling_factor:** 5/6, 11/12
- **CTDP_content_interpretation_type:** CTDP-2LR/TB
- **image resizing:** bicubic
- **depth resizing:** bicubic
- **depth spatial flipping:** flipped
- **depth subpixel arrangement:** sequential order
- **depth_chroma_sampling:** direct sample

2V2D Packing

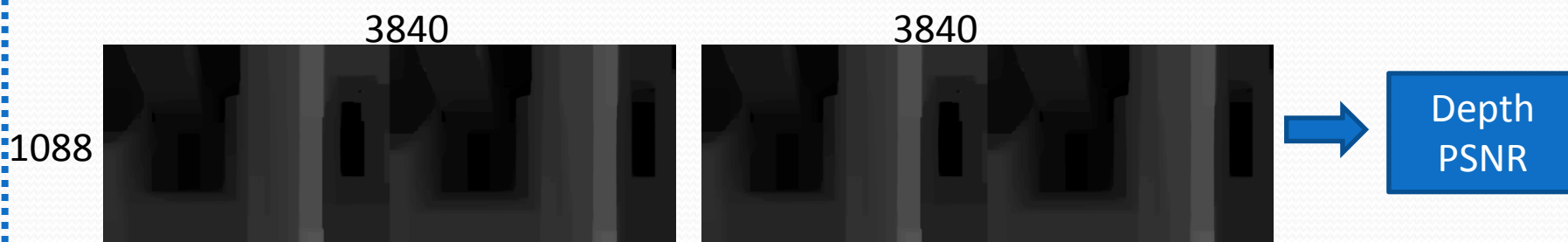
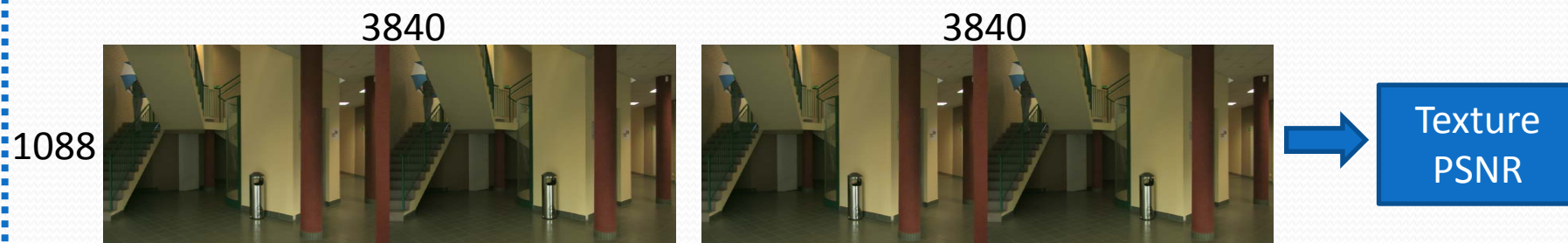
**CTDP-2TB
(SbS (V))**



**CTDP-2LR
(TaB (H))**



Texture and Depth PSNR



Original frame

Tested frame

Virtual View PSNR

1920

1088



Virtual view from 3D HEVC
decoded texture and depth
frames

1920

1088

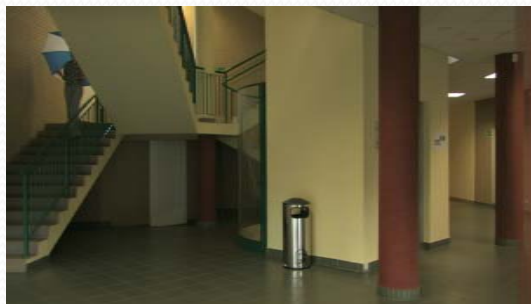


Virtual view from
uncompressed texture and
depth frames

Virtual View PSNR
From 3D HEVC

1920

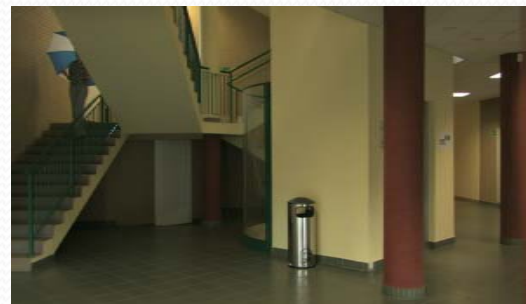
1088



Virtual view from HEVC
CTDTP depacked texture and
depth frames

1920

1088



Virtual view from
uncompressed texture and
depth frames

Virtual View PSNR
From HEVC-CTDP

Experimental Results (2-View 2-Depth)

HEVC + 5/6 CTDp-2TB/LR + DE with respect to 3D-HEVC

BDPSNR(dB)						
	Recovered Texture Performance		Synthesized Virtual View Performance			
	CTDP-2TB	CTDP-2LR	CTDP-2TB	CTDP-2TB_DE	CTDP-2LR	CTDP-2LR_DE
ra	-3.2246	-2.3655	-3.0609	-3.0357	-2.5295	-2.4968
ldp	-2.7805	-1.8393	-2.5832	-2.5566	-2.0257	-1.9902
ai	-2.2531	-1.3030	-2.4957	-2.4275	-2.0416	-2.0247
ave	-2.7528	-1.8359	-2.7133	-2.6733	-2.1989	-2.1706

BDBR(%)						
	Recovered Texture Performance		Synthesized Virtual View Performance			
	CTDP-2TB	CTDP-2LR	CTDP-2TB	CTDP-2TB_DE	CTDP-2LR	CTDP-2LR_DE
ra	287.2709	96.3334	195.3396	193.4488	110.1029	106.7463
ldp	174.5978	62.6553	133.8895	132.3841	73.4276	70.5789
ai	154.3944	29.5881	131.0232	129.1026	61.8585	60.5725
ave	205.4210	62.8589	153.4174	151.6452	81.7963	79.2992

_E : with depth enhancement

Experimental Results (2-View 2-Depth)

HEVC + 11/12 CTDP-2TB/LR + DE with respect to 3D-HEVC

BDPSNR(dB)						
	Recovered Texture Performance		Synthesized Virtual View Performance			
	CTDP-2TB	CTDP-2LR	CTDP-2TB	CTDP-2TB_DE	CTDP-2LR	CTDP-2LR_DE
ra	-3.1719	-2.3686	-3.2847	-3.2228	-3.0601	-3.0503
ldp	-2.7247	-1.8368	-2.8255	-2.7850	-2.5755	-2.5293
ai	-2.2739	-1.3779	-2.8424	-2.7736	-2.7285	-2.7192
ave	-2.7235	-1.8611	-2.9842	-2.9271	-2.7880	-2.7663

BDBR(%)						
	Recovered Texture Performance		Synthesized Virtual View Performance			
	CTDP-2TB	CTDP-2LR	CTDP-2TB	CTDP-2TB_DE	CTDP-2LR	CTDP-2LR_DE
ra	279.6604	97.4201	216.0882	209.0012	157.9155	162.8628
ldp	172.1685	62.0879	150.3217	137.5236	108.5160	102.6064
ai	157.9249	31.4725	157.4785	156.7524	110.4416	113.1468
ave	203.2513	63.6602	174.6295	167.7591	125.6244	126.2053

_DE : with depth enhancement

3D_HEVC (ra, Qp=27, view:5.5, bitrate : 767.505 Kbps



CTDP-2LR (ra, Qp=27, view:5.5, bitrate : 738.008 Kbps)



CTDP-2LR_DE (ra, Qp=27, view:5.5, bitrate : 738.008 Kbps)



3D_HEVC (ra, Qp=27, view:5.5, bitrate : 767.505 Kbps



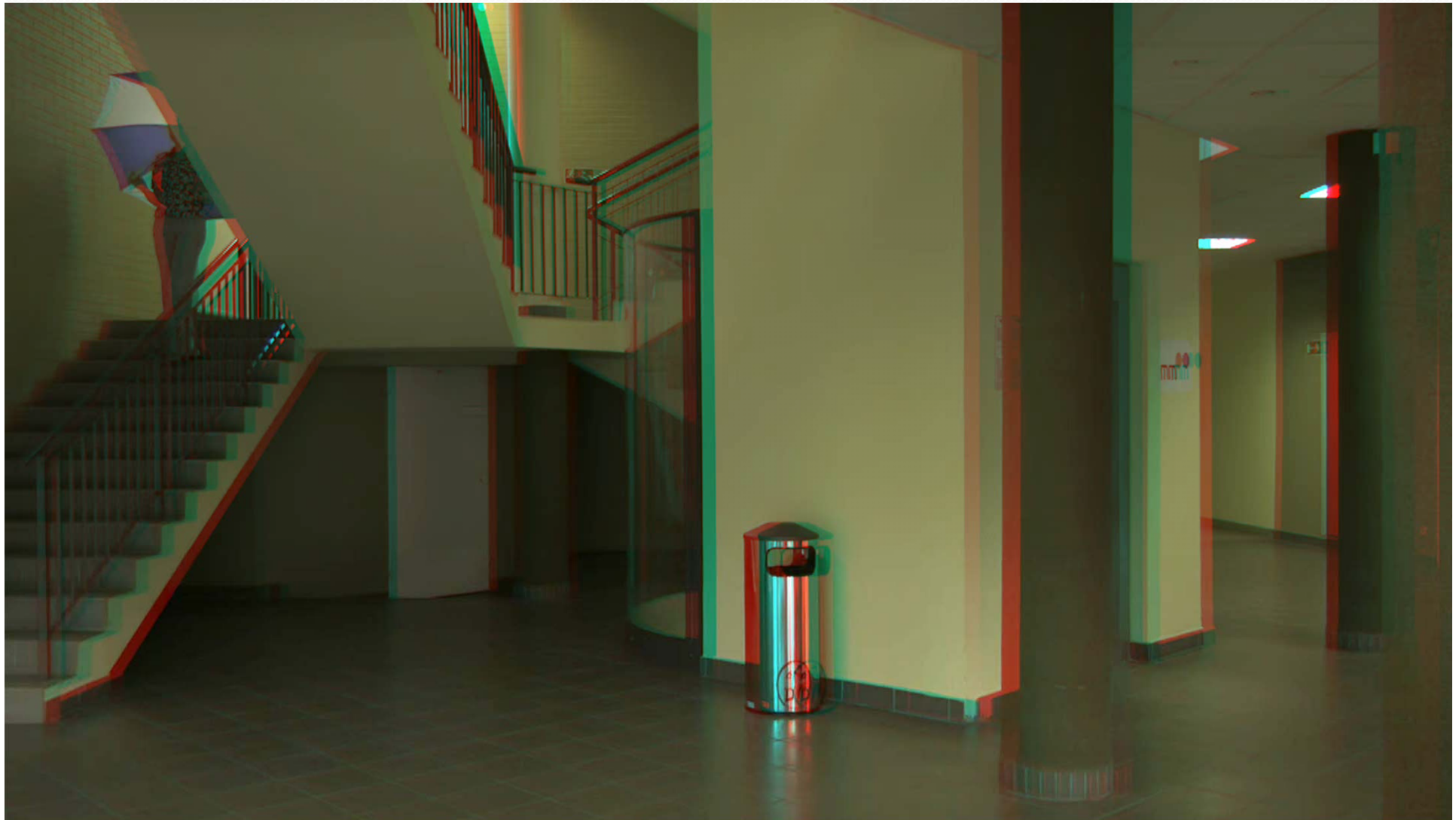
CTDP-2LR (ra, Qp=27, view:5.5, bitrate : 738.008 Kbps)



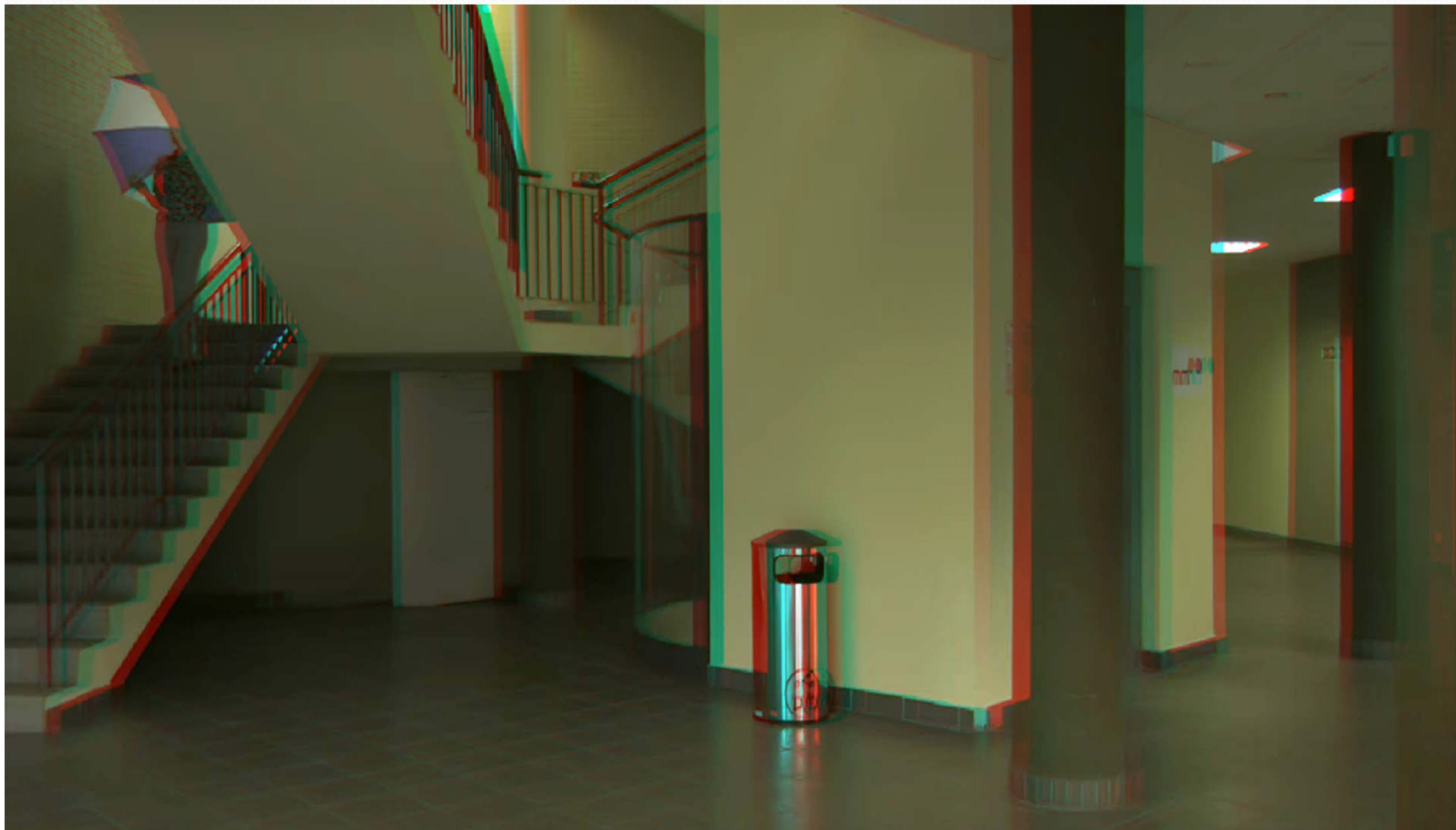
CTDP-2LR_DE (ra, Qp=27, view:5.5, bitrate : 738.008 Kbps)



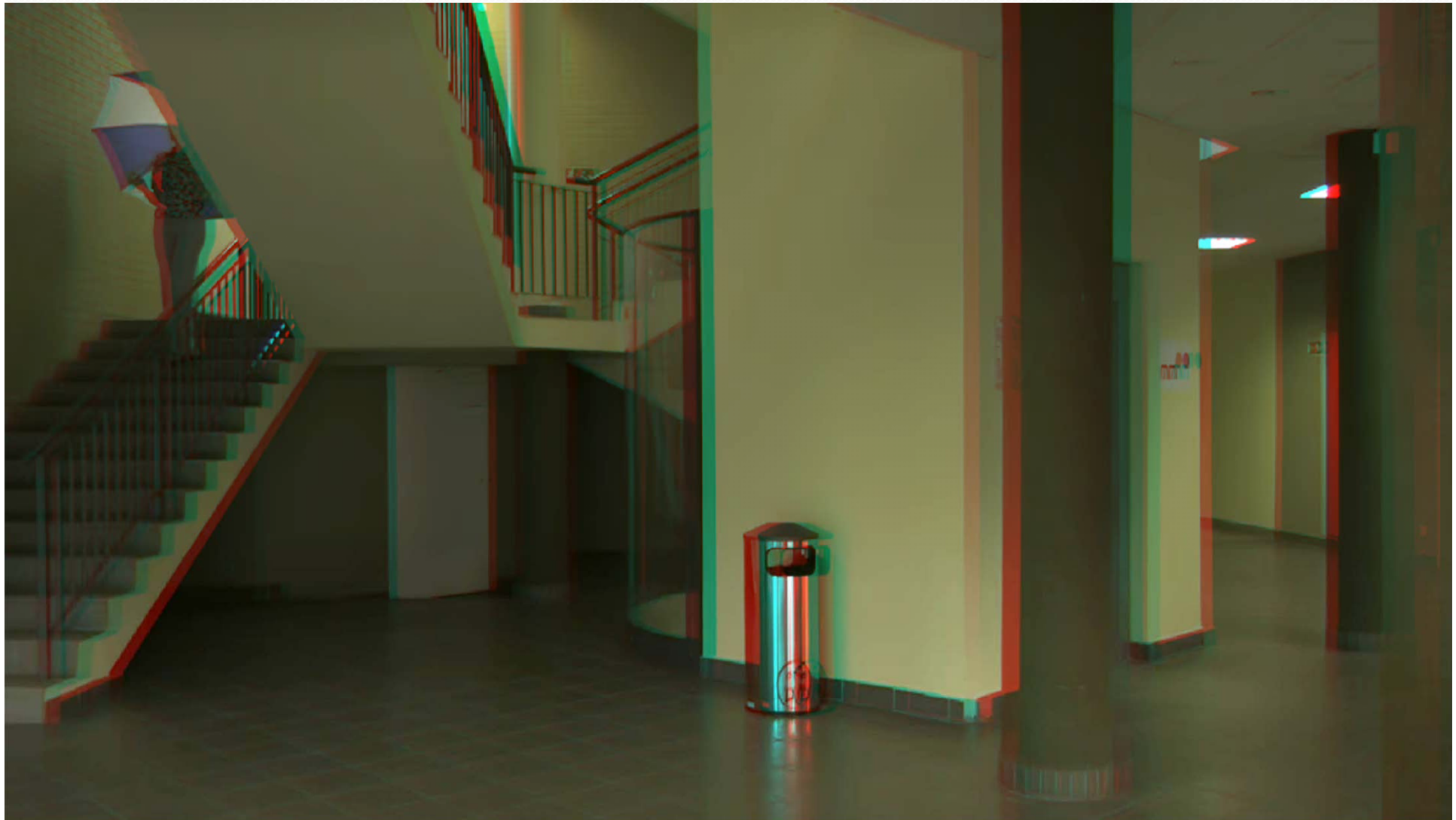
3D_HEVC (ra, Qp=27, L view:5, R view:5.5 bitrate : 767.505 Kbps)



CTDP-2LR (ra, Qp=27, L view:5, R view=5.5, bitrate : 738.008 Kbps)



CTDP-2LR_DE (ra, Qp=27, R view:5, L view: 5.5, bitrate : 738.008 Kbps)



Comparisons of 4:4:4 and 4:2:0 CTDP Format for 1V1D Format

Experimental Results (1V1D)

HEVC + CTDP-TB (420/444) with respect to 3D-HEVC

BDBR						
	Case 1 (without DIBR) %				Case 3 (ori rendering) %	
	Texture		Depth		Texture	
	5/6_TB_420	5/6_TB_444	5/6_TB_420	5/6_TB_444	5/6_TB_420	5/6_TB_444
ra	10.7136	19.2878	-42.4982	-43.4762	48.8943	56.3468
ldp	5.9081	11.7589	-60.5437	-61.3681	30.9208	34.7053
ai	1.0943	11.8642	-29.7676	-27.1510	34.1673	44.3117
ave	5.9053	14.3036	-44.2698	-43.9984	37.9941	45.1213

BDPSNR						
	Case 1 (without DIBR) %				Case 3 (ori rendering) %	
	Texture		Depth		Texture	
	5/6_TB_420	5/6_TB_444	5/6_TB_420	5/6_TB_444	5/6_TB_420	5/6_TB_444
ra	-0.3945	-0.6601	2.1916	2.2736	-1.0967	-1.1867
ldp	-0.2657	-0.4639	3.8679	3.9469	-0.7968	-0.8464
ai	-0.0574	-0.5075	1.7845	1.7381	-1.0646	-1.2950
ave	-0.2392	-0.5438	2.6147	2.6529	-0.9860	-1.1093

Adoption Plans of CTDP Formats

ChungHwa Telecom's Adoption Plan

Chunghwa Telecom (CHT) Company with about 1.4 million MOD users has signed an agreement to adopt CTDP format as the following:

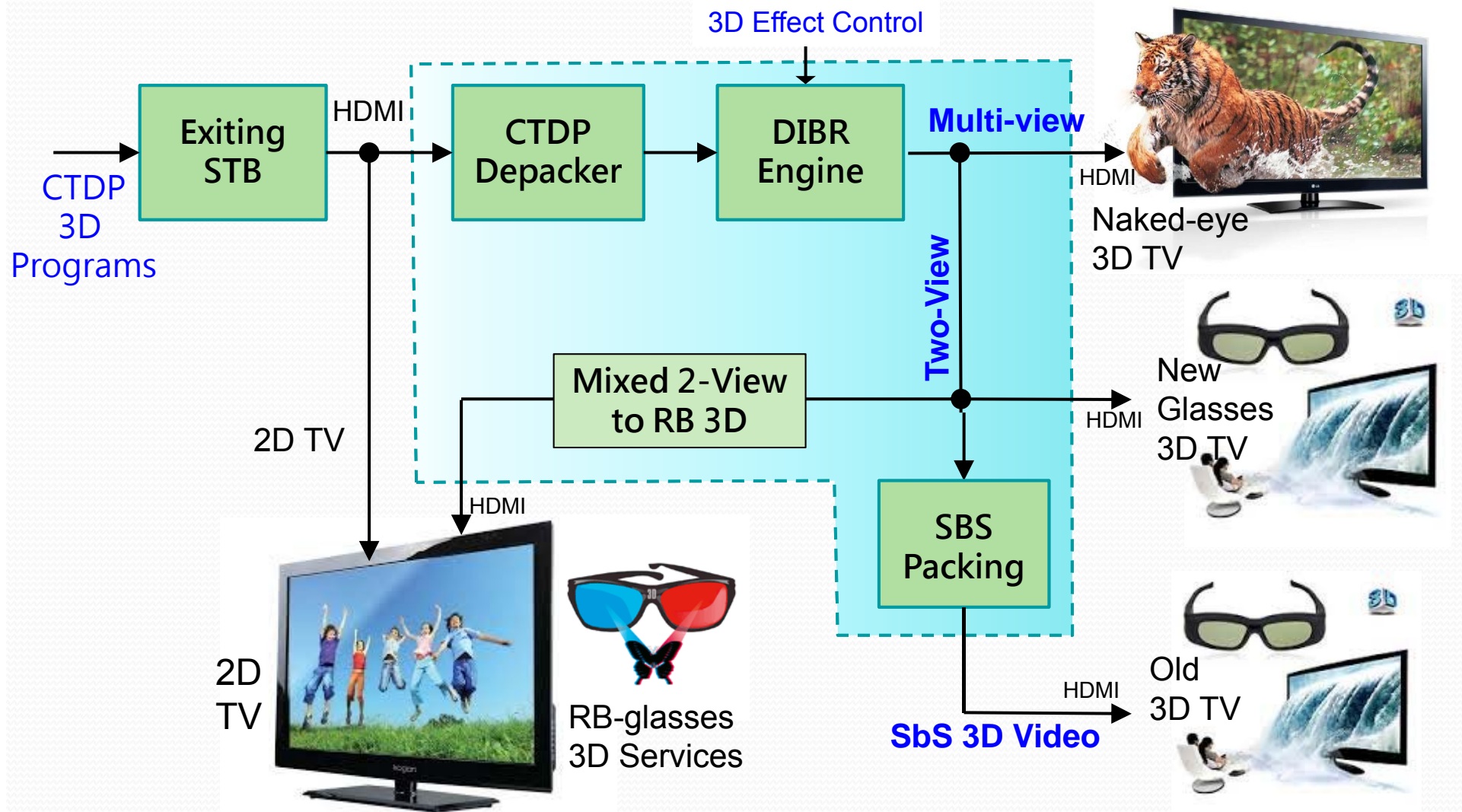
1. 01/01/2016: Propose and confirm the test and adoption detailed plan
2. 04/01/2016: Test of downloaded 3D CTDP services with computer clients
(Internal test in CHT and TOUCH Center only)
3. 11/01/2016: Services of 3D MOD services for computer clients
(Charge and open to the public and final CTDP format selection)
4. 11/01/2017: Test of 3D MOD services through Set-top-Boxes with separated CTDP depacking module (Open for selected users)
5. 11/01/2018 : Test of 3D MOD services through Set-top-Boxes with Integrated CTDP depacking module (charged 3D services)

Hsin Yeong An's Adoption Plan

Hsin Yeong An (HYA) Cable TV Company with about 145 thousand users is a local cable company near the National Cheng Kung University. The test and adoption plan with time lines are designed as the following:

1. 01/01/2016: Propose and confirm the test and adoption detailed plan
2. 04/01/2016: Test of downloaded 3D CTDP services with computer clients
(Internal test in HYA and TOUCH Center only)
3. 11/01/2016: Services of 3D CATV services for computer clients
(Charge and open to the public and final CTDP format selection)
4. 11/01/2017: Test of 3D CATV services through Set-top-Boxes with separated CTDP depacking module (Open for selected users)
5. 11/01/2018 : Test of 3D CATV services through Set-top-Boxes with Integrated CTDP depacking module (charged 3D services)

First Stage of 3D Service Delivery in Taiwan



Conclusions

- This contribution proposes modified CTDP SEI Message which is an update of the prior contribution JCT3V-L0022 by adding depth related syntax.
- Once CTDP SEI Message is **accepted by MPEG**, ChungHwa Telecom MOD System and Hsin-Yeong An Cable TV Company will adopt CTDP formats for their 3D video services in Taiwan.
- Not limited to HEVC, the CTDP formats can be applied to all video coders, such as MPEG-2, H.264/AVC..

Thanks for your kind attention

Q&A

Experimental Results (2-View 2-Depth)

HEVC + 5/6 CTDP-2TB/LR + DE with respect to 3D-HEVC

BDBR												
	Case 1 (without DIBR) %								Case 3 (ori rendering) %			
	Texture				Depth				Texture			
	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E
ra	287.2709	287.2709	96.3334	96.3334	-34.9031	-38.1313	-34.5742	-39.7607	195.3396	193.4488	110.1029	106.7463
ldp	174.5978	174.5978	62.6553	62.6553	-54.5490	-56.6863	-55.0800	-58.8807	133.8895	132.3841	73.4276	70.5789
ai	154.3944	154.3944	29.5881	29.5881	-38.9754	-41.5132	-35.9028	-40.3118	131.0232	129.1026	61.8585	60.5725
ave	205.4210	205.4210	62.8589	62.8589	-42.8092	-45.4436	-41.8524	-46.3178	153.4174	151.6452	81.7963	79.2992

BDPSNR												
	Case 1 (without DIBR) %								Case 3 (ori rendering) %			
	Texture				Depth				Texture			
	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E
ra	-3.2246	-3.2246	-2.3655	-2.3655	1.5892	1.7286	1.5399	1.7918	-3.0609	-3.0357	-2.5295	-2.4968
ldp	-2.7805	-2.7805	-1.8393	-1.8393	2.8921	3.0416	2.9616	3.2371	-2.5832	-2.5566	-2.0257	-1.9902
ai	-2.2531	-2.2531	-1.3030	-1.3030	2.1670	2.3043	1.8803	2.1126	-2.4957	-2.4275	-2.0416	-2.0247
ave	-2.7528	-2.7528	-1.8359	-1.8359	2.2161	2.3582	2.1272	2.3805	-2.7133	-2.6733	-2.1989	-2.1706

_E : with depth enhancement

Experimental Results (2-View 2-Depth)

HEVC + 11/12 CTDP-2TB/LR + DE with respect to 3D-HEVC

BDBR												
	Case 1 (without DIBR) %								Case 3 (ori rendering) %			
	Texture				Depth				Texture			
	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E
ra	279.6604	279.6604	97.4201	97.4201	8.8343	-3.4145	19.8375	9.2278	216.0882	209.0012	157.9155	162.8628
ldp	172.1685	172.1685	62.0879	62.0879	-26.1173	-34.4909	-19.7195	-28.6743	150.3217	137.5236	108.5160	102.6064
ai	157.9249	157.9249	31.4725	31.4725	-8.2774	-16.3966	4.8733	-4.8441	157.4785	156.7524	110.4416	113.1468
ave	203.2513	203.2513	63.6602	63.6602	-8.5201	-18.1006	1.6638	-8.0969	174.6295	167.7591	125.6244	126.2053

BDPSNR												
	Case 1 (without DIBR) %								Case 3 (ori rendering) %			
	Texture				Depth				Texture			
	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E	SbS(V)	SbS(V)_E	TaB(H)	TaB(H)_E
ra	-3.1719	-3.1719	-2.3686	-2.3686	-0.1744	0.0176	-0.1386	-0.3136	-3.2847	-3.2228	-3.0601	-3.0503
ldp	-2.7247	-2.7247	-1.8368	-1.8368	1.0001	1.4213	0.7198	1.0196	-2.8255	-2.7850	-2.5755	-2.5293
ai	-2.2739	-2.2739	-1.3779	-1.3779	0.0204	0.4172	-0.5901	-0.4207	-1.7951	-2.7736	-2.7285	-2.7192
ave	-2.7235	-2.7235	-1.8611	-1.8611	0.2820	0.6187	-0.0030	0.0951	-2.6351	-2.9271	-2.7880	-2.7663

_E : with depth enhancement