

JVET-Q0272

AHG17: Compact Region-Wise Packing SEI message



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Background

- The region-wise packing (RWP) SEI message was adopted (copied from HEVC) to the draft *VUI and SEI for coded video bitstreams* specification at the 16th meeting in Geneva
- The RWP SEI message is used to map packed regions in a decoded picture to projected regions in a projected picture
- Not very bit cost efficient to code the sizes and positions of the regions (192 bits per region)
 - For 24 regions the cost is 4608 bits
 - For 96 regions the cost is 18432 bits
- A compact version of the RWP structure was proposed to OMAF v2 and adopted to the OMAF v2 TuC at the MPEG meeting in Ljubljana

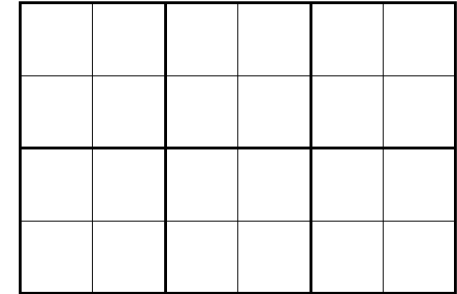
	Descriptor
regionwise_packing(payloadSize) {	
rwp_cancel_flag	u(1)
if(!rwp_cancel_flag) {	
rwp_persistence_flag	u(1)
constituent_picture_matching_flag	u(1)
rwp_reserved_zero_5bits	u(5)
num_packed_regions	u(8)
proj_picture_width	u(32)
proj_picture_height	u(32)
packed_picture_width	u(16)
packed_picture_height	u(16)
for(i = 0; i < num_packed_regions; i++) {	
rwp_reserved_zero_4bits[i]	u(4)
rwp_transform_type[i]	u(3)
rwp_guard_band_flag[i]	u(1)
proj_region_width[i]	u(32)
proj_region_height[i]	u(32)
proj_region_top[i]	u(32)
proj_region_left[i]	u(32)
packed_region_width[i]	u(16)
packed_region_height[i]	u(16)
packed_region_top[i]	u(16)
packed_region_left[i]	u(16)
if(rwp_guard_band_flag[i]) {	
rwp_left_guard_band_width[i]	u(8)
rwp_right_guard_band_width[i]	u(8)
rwp_top_guard_band_height[i]	u(8)
rwp_bottom_guard_band_height[i]	u(8)
rwp_guard_band_not_used_for_pred_flag[i]	u(1)
for(j = 0; j < 4; j++)	
rwp_guard_band_type[i][j]	u(3)
rwp_guard_band_reserved_zero_3bits[i]	u(3)
}	
}	
}	
}	

Proposal

- It is proposed to compress the region coding in the RWP SEI message using three methods, which may be used independently or could be combined:
- **Scaling method:** Signal a 16 bit scale factor value and 8 bit, instead of 16 or 32 bit, scaled values for the width, height, top and left offsets for each of the projected and packed regions in the RWP SEI message. To reproduce the width, height, top offset and left offset of each region, the scaled versions are multiplied with the scale factor.
- **Copy method:** Signal the region width and height only for the first region if all regions have the same size. The width and height of the remaining regions are then copied from the first region.
- **Raster scan order method:** This method does not signal the top and left offsets of the regions if all regions are ordered in raster scan order. The offsets can be derived on the receiver side using the picture width and the widths and heights of the regions.
- Five flags indicate if the methods are used or not. The five flags are gated with a compress_regions_flag. If compress_regions_flag is equal to 0, the coded SEI message is the same as the HEVC version of the RWP SEI message
- It is also proposed to rename the RWP SEI message compact RWP (CRWP) SEI message to differentiate it from the HEVC version

compact_regionwise_packing(payloadSize) {	Descriptor
rwp_cancel_flag	u(1)
if(!rwp_cancel_flag) {	
rwp_persistence_flag	u(1)
constituent_picture_matching_flag	u(1)
compress_regions_flag	u(1)
rwp_reserved_zero_4bits	u(4)
if (compress_regions_flag) {	
scale_factor_flag	u(1)
proj_regions_copy_size_flag	u(1)
packed_regions_copy_size_flag	u(1)
proj_regions_raster_scan_flag	u(1)
packed_regions_raster_scan_flag	u(1)
rwp_reserved_zero_3bits	u(3)
if (scale_factor_flag) {	
proj_regions_scale_factor	u(16)
packed_regions_scale_factor	u(16)
}	
}	
num_packed_regions	u(8)
proj_picture_width	u(32)
proj_picture_height	u(32)
packed_picture_width	u(16)
packed_picture_height	u(16)
for(i = 0; i < num_packed_regions; i++) {	
rwp_reserved_zero_4bits[i]	u(4)
rwp_transform_type[i]	u(3)
rwp_guard_band_flag[i]	u(1)
if (i == 0 !proj_regions_copy_size_flag) {	
proj_region_width[i]	u(n-32)
proj_region_height[i]	u(n-32)
}	
if (!proj_regions_raster_scan_flag) {	
proj_region_top[i]	u(n-32)
proj_region_left[i]	u(n-32)
}	
if (i == 0 !packed_regions_copy_size_flag) {	
packed_region_width[i]	u(n-16)
packed_region_height[i]	u(n-16)
}	
if (!packed_regions_raster_scan_flag) {	
packed_region_top[i]	u(n-16)
packed_region_left[i]	u(n-16)
}	
... }	
}	

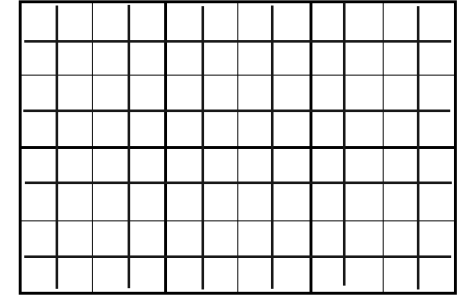
Bit cost example 24 regions



	Video with 24 equal size regions in raster scan order in both projected and packed picture						
	RWP	CRWP-s	CRWP-c	CRWP-r	CRWP-sr	CRWP-cr	CRWP-scr
bits proj_region_width	768	192	32	768	192	32	8
bits proj_region_height	768	192	32	768	192	32	8
bits packed_region_width	384	192	16	384	192	16	8
bits packed_region_height	384	192	16	384	192	16	8
bits proj_region_top	768	192	768	0	0	0	0
bits proj_region_left	768	192	768	0	0	0	0
bits packed_region_top	384	192	384	0	0	0	0
bits packed_region_left	384	192	384	0	0	0	0
bits compressed regions flags		8	8	8	8	8	8
bits proj_regions_scale_factor		16			16		16
bits packed_regions_scale_factor		16			16		16
Tot bits	4608	1576	2408	2312	808	104	72
Tot bytes	576	197	301	289	101	13	9

s – scaling method
c – copy method
r – raster scan order method

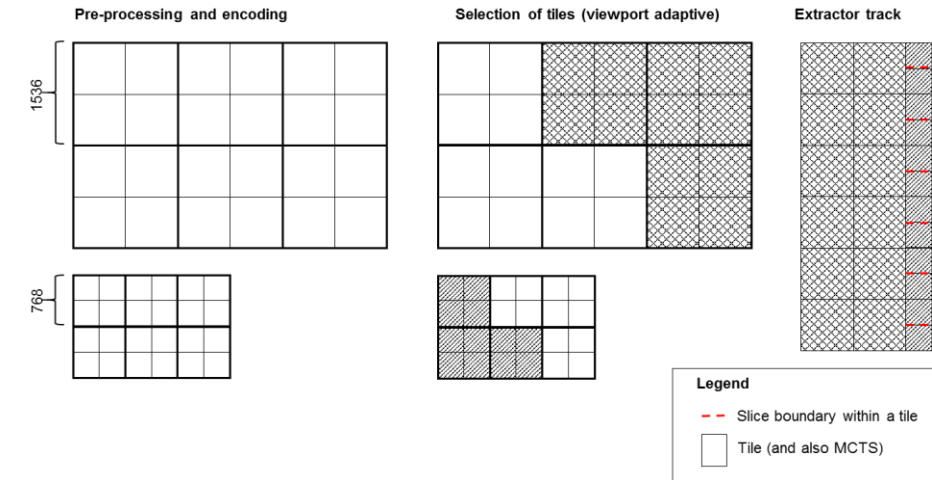
Bit cost example 96 regions



	Video with 96 equal size regions in raster scan order in both projected and packed picture						
	RWP	CRWP-s	CRWP-c	CRWP-r	CRWP-sr	CRWP-cr	CRWP-scr
bits proj_region_width	3072	768	32	3072	768	32	8
bits proj_region_height	3072	768	32	3072	768	32	8
bits packed_region_width	1536	768	16	1536	768	16	8
bits packed_region_height	1536	768	16	1536	768	16	8
bits proj_region_top	3072	768	3072	0	0	0	0
bits proj_region_left	3072	768	3072	0	0	0	0
bits packed_region_top	1536	768	1536	0	0	0	0
bits packed_region_left	1536	768	1536	0	0	0	0
bits compressed regions flags		8	8	8	8	8	8
bits proj_regions_scale_factor		16			16		16
bits packed_regions_scale_factor		16			16		16
Tot bits	18432	6184	9320	9224	3112	104	72
Tot bytes	2304	773	1165	1153	389	13	9

s – scaling method
c – copy method
r – raster scan order method

Bit cost example OMAF 24 regions



	OMAF example: Projected and packed picture with 24 non-equal size regions, raster scan order in projected picture only						
	RWP	CRWP-s	CRWP-c	CRWP-r	CRWP-sr	CRWP-cr	CRWP-scr
bits proj_region_width	768	192	N/A	768	192	N/A	N/A
bits proj_region_height	768	192	N/A	768	192	N/A	N/A
bits packed_region_width	384	192	N/A	384	192	N/A	N/A
bits packed_region_height	384	192	N/A	384	192	N/A	N/A
bits proj_region_top	768	192	N/A	0	0	N/A	N/A
bits proj_region_left	768	192	N/A	0	0	N/A	N/A
bits packed_region_top	384	192	N/A	384	192	N/A	N/A
bits packed_region_left	384	192	N/A	384	192	N/A	N/A
bits compressed regions flags		8	N/A	8	8	N/A	N/A
bits proj_regions_scale_factor		16			16		N/A
bits packed_regions_scale_factor		16			16		N/A
Tot bits	4608	1576	N/A	3080	1192	N/A	N/A
Tot bytes	576	197	N/A	385	149	N/A	N/A

s – scaling method
c – copy method
r – raster scan order method

Summary



- It is proposed to compress the region coding in the RWP SEI message using three methods, which may be used independently or could be combined:
 - Scaling method
 - Copy method
 - Raster scan order method
- It is also proposed to rename the RWP SEI message compact RWP (CRWP) SEI message to differentiate it from the HEVC version
- It is claimed that bit cost examples show that the bit cost for coding the size and locations of the regions in the RWP SEI message can be reduced by 75% to over 99%

