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(71) Applicant: TENCENT AMERICA LLC [US/US]; 2747
Park Boulevard, Palo Alto, California 94306 (US).

(72) Inventor; and

(71) Applicant: LI, Aura [US/US]; c/o Tencent America LLC,
2747 Park Boulevard, Palo Alto, California 94306 (US).

(72) Inventors: XU, Xiaozhong; c/o Tencent America LLC,
2747 Park Boulevard, Palo Alto, California 94306 (US).
CHOI, Byeongdoo; c/o Tencent America LLC, 2747 Park
Boulevard, Palo Alto, California 94306 (US). LI, Xiang; c/

o Tencent America LLC, 2747 Park Boulevard, Palo Alto,
California 94306 (US). WENGER, Stephan; c/o Tencent
America LLC, 2747 Park Boulevard, Palo Alto, California
94306 (US). LIU, Shan; c/o Tencent America LLC, 2747
Park Boulevard, Palo Alto, California 94306 (US).

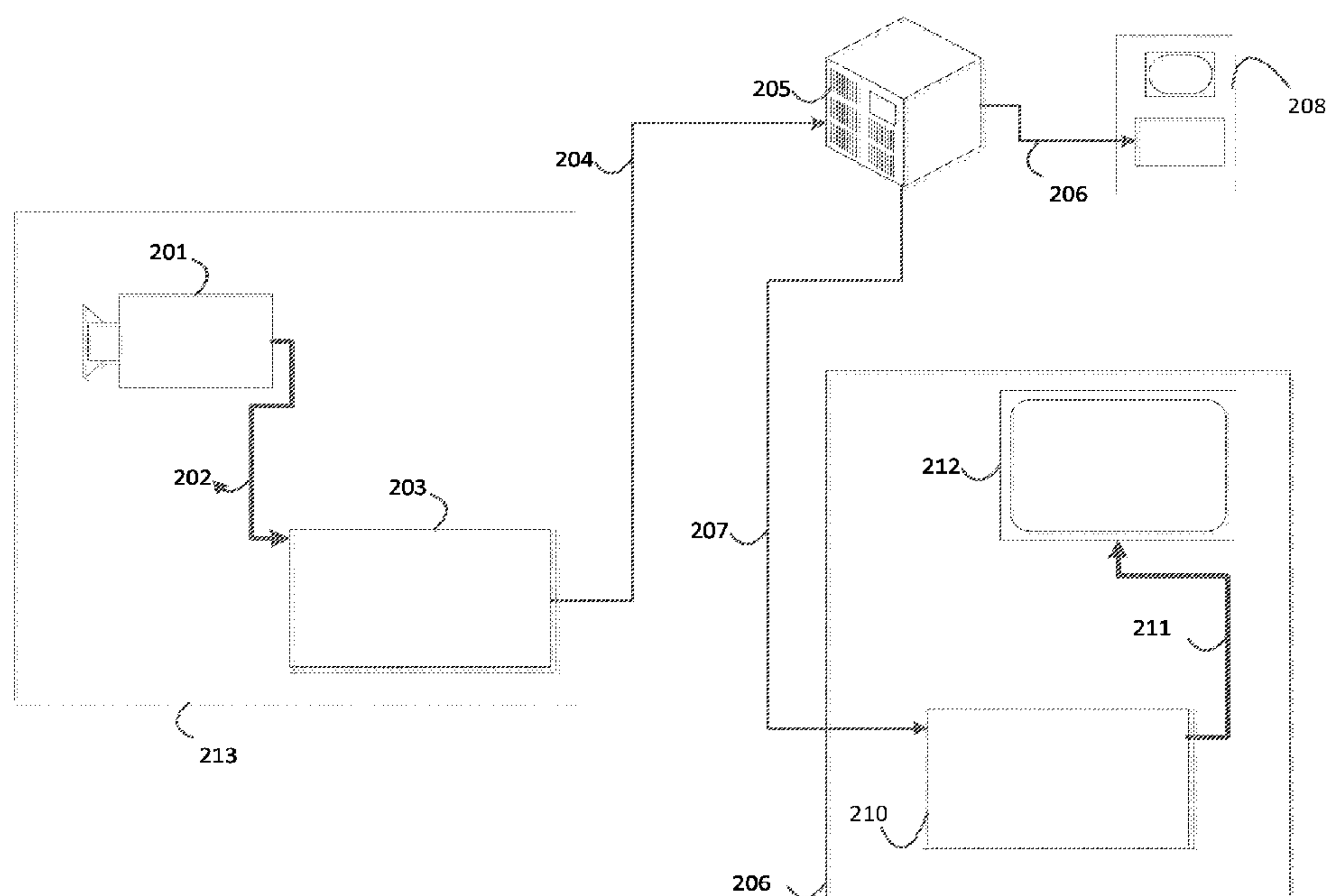
(74) Agent: RABENA, John F. et al.; Sughrue Mion, PLLC,
2000 Pennsylvania Ave., N.W., Suite 900, Washington,
District of Columbia 20006 (US).

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FIG. 2



(57) Abstract: A method, computer program, and computer system for encoding or decoding video data, and indicating, with a syntax element, types of slices for all slices of a coded picture, the syntax element being coded using an unsigned integer.

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SIGNALING OF PICTURE HEADER PARAMETERS**CROSS-REFERENCE TO RELATED APPLICATION**

[0001] This application claims priority from U.S. Provisional Patent Application No. 62/950,453, filed December 19, 2019, and U.S. Patent Application No. 17/026,748, filed September 21, 2020, the entirety of which are incorporated herein.

FIELD

[0002] This disclosure relates generally to video encoding/decoding, and generally describes next-generation video coding technologies beyond HEVC (High Efficiency Video Coding), e.g., Versatile Video Coding (VVC). More specifically, this disclosure relates generally to methods and apparatuses related to picture header handling.

BACKGROUND

[0003] Proposed VVC Draft 7 includes a HLS (High Level Syntax) called picture header that contains syntax elements applying to all slices of a coded picture, e.g., to avoid signalling syntax elements in slice header(s) that are constrained to have the same values for all slices of a picture.

Picture Parameter Set

[0004] HLS specifies syntax elements that may be applied to lower level coding tools. For example, CTU (Coding Tree Unit) size may be specified at the sequence level, or SPS (Sequence Parameter Set), and is not generally changed from picture to picture. Typical HLS includes SPS, PPS (Picture Parameter Set), PH (Picture Header), SH (Slice Header), and APS (Adaptive Parameter Set).

[0005] Different HLS includes levels of applications, such that commonly used syntax elements do not need to be coded repeatedly. For instance, SPS specifies general syntax elements applicable to sequence levels. PH specifies general syntax elements applicable to a coded picture, which may consist of one or more slices.

[0006] Syntax elements included in PPS in VVC Draft 7 are described as follows:

Table 1: Syntax Elements Included in PPS in VVC Draft 7.

Syntax Element	Descriptor
<code>pic_parameter_set_rbsp() {</code>	
<code>pps_pic_parameter_set_id</code>	<code>ue(v)</code>
<code>pps_seq_parameter_set_id</code>	<code>u(4)</code>
<code>pic_width in luma samples</code>	<code>ue(v)</code>
<code>pic_height in luma samples</code>	<code>ue(v)</code>
<code>conformance_window_flag</code>	<code>u(1)</code>
<code>if(conformance_window_flag) {</code>	
<code>conf_win_left_offset</code>	<code>ue(v)</code>
<code>conf_win_right_offset</code>	<code>ue(v)</code>
<code>conf_win_top_offset</code>	<code>ue(v)</code>
<code>conf_win_bottom_offset</code>	<code>ue(v)</code>
<code>}</code>	
<code>scaling_window_flag</code>	<code>u(1)</code>
<code>if(scaling_window_flag) {</code>	
<code>scaling_win_left_offset</code>	<code>ue(v)</code>
<code>scaling_win_right_offset</code>	<code>ue(v)</code>
<code>scaling_win_top_offset</code>	<code>ue(v)</code>
<code>scaling_win_bottom_offset</code>	<code>ue(v)</code>
<code>}</code>	
<code>output_flag_present_flag</code>	<code>u(1)</code>
<code>mixed_nalu_types_in_pic_flag</code>	<code>u(1)</code>
<code>pps_subpic_id_signalling_present_flag</code>	<code>u(1)</code>
<code>if(pps_subpics_id_signalling_present_flag) {</code>	
<code>pps_num_subpics_minus1</code>	<code>ue(v)</code>
<code>pps_subpic_id_len_minus1</code>	<code>ue(v)</code>
<code>for(i = 0; i <= pps_num_subpic_minus1; i++)</code>	
<code>pps_subpic_id[i]</code>	<code>u(v)</code>
<code>}</code>	
<code>no_pic_partition_flag</code>	<code>u(1)</code>
<code>if(!no_pic_partition_flag) {</code>	

pps_log2_ctu_size_minus5	u(2)
num_exp_tile_columns_minus1	ue(v)
num_exp_tile_rows_minus1	ue(v)
for(i = 0; i <= num_exp_tile_columns_minus1; i++)	
tile_column_width_minus1[i]	ue(v)
for(i = 0; i <= num_exp_tile_rows_minus1; i++)	
tile_row_height_minus1[i]	ue(v)
rect_slice_flag	u(1)
if(rect_slice_flag)	
single_slice_per_subpic_flag	u(1)
if(rect_slice_flag && !single_slice_per_subpic_flag) {	
num_slices_in_pic_minus1	ue(v)
tile_idx_delta_present_flag	u(1)
for(i = 0; i < num_slices_in_pic_minus1; i++) {	
slice_width_in_tiles_minus1[i]	ue(v)
slice_height_in_tiles_minus1[i]	ue(v)
if(slice_width_in_tiles_minus1[i] == 0	
&&	
slice_height_in_tiles_minus1[i] == 0) {	
num_slices_in_tile_minus1[i]	ue(v)
numSlicesInTileMinus1 =	
num_slices_in_tile_minus1[i]	
for(j = 0; j <	
numSlicesInTileMinus1; j++)	
	ue(v)
slice_height_in_ctu_minus1[i++]	
}	
if(tile_idx_delta_present_flag && i <	
num_slices_in_pic_minus1)	
tile_idx_delta[i]	se(v)
}	
}	
loop_filter_across_tiles_enabled_flag	u(1)
loop_filter_across_slices_enabled_flag	u(1)
}	
entropy_coding_sync_enabled_flag	u(1)
if(!no_pic_partition_flag	
entropy_coding_sync_enabled_flag)	
entry_point_offsets_present_flag	u(1)
cabac_init_present_flag	u(1)
for(i = 0; i < 2; i++)	
num_ref_idx_default_active_minus1[i]	ue(v)

rpl1_idx_present_flag	u(1)
init_qp_minus26	se(v)
log2_transform_skip_max_size_minus2	ue(v)
cu_qp_delta_enabled_flag	u(1)
pps_cb_qp_offset	se(v)
pps_cr_qp_offset	se(v)
pps_joint_cbr_qp_offset_present_flag	u(1)
if(pps_joint_cbr_qp_offset_present_flag)	
pps_joint_cbr_qp_offset_value	se(v)
pps_slice_chroma_qp_offsets_present_flag	u(1)
pps_cu_chroma_qp_offset_list_enabled_flag	u(1)
if(pps_cu_chroma_qp_offset_list_enabled_flag) {	
chroma_qp_offset_list_len_minus1	ue(v)
for(i = 0; i <= chroma_qp_offset_list_len_minus1; i++) {	
cb_qp_offset_list[i]	se(v)
cr_qp_offset_list[i]	se(v)
if(pps_joint_cbr_qp_offset_present_flag)	
joint_cbr_qp_offset_list[i]	se(v)
}	
}	
pps_weighted_pred_flag	u(1)
pps_weighted_bipred_flag	u(1)
deblocking_filter_control_present_flag	u(1)
if(deblocking_filter_control_present_flag) {	
deblocking_filter_override_enabled_flag	u(1)
pps_deblocking_filter_disabled_flag	u(1)
if(!pps_deblocking_filter_disabled_flag) {	
pps_beta_offset_div2	se(v)
pps_tc_offset_div2	se(v)
}	
}	
constant_slice_header_params_enabled_flag	u(1)
if(constant_slice_header_params_enabled_flag) {	
pps_dep_quant_enabled_idc	u(2)
for(i = 0; i < 2; i++)	
pps_ref_pic_list_sps_idc[i]	u(2)
pps_mvd_l1_zero_idc	u(2)
pps_collocated_from_l0_idc	u(2)
pps_six_minus_max_num_merge_cand_plus1	ue(v)
pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1	ue(v)
}	

picture_header_extension_present_flag	u(1)
slice_header_extension_present_flag	u(1)
pps_extension_flag	u(1)
if(pps_extension_flag)	
while(more_rbsp_data())	
pps_extension_data_flag	u(1)
rbbsp_trailing_bits()	
}	

[0007] As illustrated in Table 1, above, num_slices_in_pic_minus1 plus 1 specifies the number of rectangular slices in each picture referring to the PPS. The value of num_slices_in_pic_minus1 is in the range of 0 to MaxSlicesPerPicture – 1, inclusive. When the no_pic_partition_flag is equal to 1, the value of num_slices_in_pic_minus1 may be inferred to be equal to 0.

[0008] As illustrated in Table 1, above, pps_mvd_11_zero_idc equal to 0 specifies that the syntax element mvd_11_zero_flag is present in PHs referring to the PPS. Also, pps_mvd_11_zero_idc equal to 1 or 2 specifies that mvd_11_zero_flag is not present in PHs referring to the PPS. Further, pps_mvd_11_zero_idc equal to 3 is reserved for future use by ITU-T | ISO/IEC.

[0009] As illustrated in Table 1, above, pps_collocated_from_10_idc equal to 0 specifies that the syntax element collocated_from_10_flag is present in a slice header of slices referring to the PPS. Also, pps_collocated_from_10_idc equal to 1 or 2 specifies that the syntax element collocated_from_10_flag is not present in a slice header of slices referring to the PPS. Further, pps_collocated_from_10_idc equal to 3 is reserved for future use by ITU-T | ISO/IEC.

[0010] As illustrated in Table 1, above, pps_six_minus_max_num_merge_cand_plus1 equal to 0 specifies that pic_six_minus_max_num_merge_cand is present in PHs referring to the

PPS. Also, pps_six_minus_max_num_merge_cand_plus1 greater than 0 specifies that pic_six_minus_max_num_merge_cand is not present in PHs referring to the PPS. The value of pps_six_minus_max_num_merge_cand_plus1 is in the range of 0 to 6, inclusive.

[0011] As illustrated in Table 1, above, pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1 equal to 0 specifies that pic_max_num_merge_cand_minus_max_num_triangle_cand is present in PHs of slices referring to the PPS. Also, pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1 greater than 0 specifies that pic_max_num_merge_cand_minus_max_num_triangle_cand is not present in PHs referring to the PPS. The value of pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1 is in the range of 0 to MaxNumMergeCand – 1.

Slice Layer RBSP

[0012] A slice layer RBSP may consist of a slice header and slice data.

Table 2: Slice Layer RBSP.

Syntax Element	Descriptor
slice_layer_rbsp() {	
slice_header()	
slice_data()	
rbsp_slice_trailing_bits()	
}	

Picture Header and Slice Header

[0013] Syntax elements coded in PPS, where a current picture refers to, might be overridden in PH and SH such, that a pic_deblocking_filter_override_flag in the PH, referring to the PPS, or the slice_deblocking_filter_override_flag in the SH, referring to the PPS, is set.

Those syntax elements not present in PH may be present in SH instead. For instance, when the value of the `pic_sao_enabled_present_flag`, in PH, specifying the presence of SAO related syntax elements, is 0, `slice_sao_luma_flag` and `slice_sao_chroma_flag` may be coded in SH to indicate SAO usage on luma and chroma.

[0014] With the use of PH, syntax elements that are already constrained to be the same in all slices of a picture may be transmitted in PH once per picture to avoid signaling overhead, especially when there are a handful of slices in a picture. Still, syntax elements that often vary from slice to slice may be transmitted in SH to provide flexibility.

[0015] Syntax elements included in PH and SH in VVC Draft 7 are described in Tables 3 and 5, below.

Table 3: General Slice Header Syntax

Syntax Element	Descriptor
<code>picture_header_rbsp() {</code>	
<code>non_reference_picture_flag</code>	<code>u(1)</code>
<code>gdr_pic_flag</code>	<code>u(1)</code>
<code>no_output_of_prior_pics_flag</code>	<code>u(1)</code>
<code>if(gdr_pic_flag)</code>	
<code>recovery_poc_cnt</code>	<code>ue(v)</code>
<code>ph_pic_parameter_set_id</code>	<code>ue(v)</code>
<code>if(sps_poc_msb_flag) {</code>	
<code>ph_poc_msb_present_flag</code>	<code>u(1)</code>
<code>if(ph_poc_msb_present_flag)</code>	
<code>poc_msb_val</code>	<code>u(v)</code>
<code>}</code>	
<code>if(sps_subpic_id_present_flag && !sps_subpic_id_signalling_flag)</code>	
<code>{</code>	
<code>ph_subpic_id_signalling_present_flag</code>	<code>u(1)</code>
<code>if(ph_subpics_id_signalling_present_flag) {</code>	
<code>ph_subpic_id_len_minus1</code>	<code>ue(v)</code>
<code>for(i = 0; i <= sps_num_subpics_minus1; i++)</code>	
<code>ph_subpic_id[i]</code>	<code>u(v)</code>
<code>}</code>	
<code>}</code>	

if(!sps_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_loop_filter_across_virtual_boundaries_disabled_present_flag	u(1)
if(ph_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_num_ver_virtual_boundaries	u(2)
for(i = 0; i < ph_num_ver_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_x[i]	u(13)
ph_num_hor_virtual_boundaries	u(2)
for(i = 0; i < ph_num_hor_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_y[i]	u(13)
}	
}	
if(separate_colour_plane_flag == 1)	
colour_plane_id	u(2)
if(output_flag_present_flag)	
pic_output_flag	u(1)
pic_rpl_present_flag	u(1)
if(pic_rpl_present_flag) {	
for(i = 0; i < 2; i++) {	
if(num_ref_pic_lists_in_sps[i] > 0	
&& !pps_ref_pic_list_sps_idx[i] &&	
(i == 0 (i == 1 &&	
rpl1_idx_present_flag))	
pic_rpl_sps_flag[i]	u(1)
if(pic_rpl_sps_flag[i]) {	
if(num_ref_pic_lists_in_sps[i] > 1 &&	
(i == 0 (i == 1	
&& rpl1_idx_present_flag))	
pic_rpl_idx[i]	u(v)
} else	
ref_pic_list_struct(i,	
num_ref_pic_lists_in_sps[i])	
for(j = 0; j < NumLtrpEntries[i][RplIdx[i]]; j++)	
{	
if(ltrp_in_slice_header_flag[i][RplIdx[i]])	
pic_poc_lsb_lt[i][j]	u(v)
pic_delta_poc_msb_present_flag[i][j]	u(1)
if(pic_delta_poc_msb_present_flag[i][j])	
pic_delta_poc_msb_cycle_lt[i][j]	ue(v)
}	

}	
}	
if(partition_constraints_override_enabled_flag) {	
partition_constraints_override_flag	u(1)
if(partition_constraints_override_flag) {	
pic_log2_diff_min_qt_min_cb_intra_slice_luma	ue(v)
pic_log2_diff_min_qt_min_cb_inter_slice	ue(v)
pic_max_mtt_hierarchy_depth_inter_slice	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_luma	ue(v)
if(pic_max_mtt_hierarchy_depth_intra_slice_luma !=	
0) {	
	ue(v)
pic_log2_diff_max_bt_min_qt_intra_slice_luma	
	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_luma	
}	
if(pic_max_mtt_hierarchy_depth_inter_slice != 0) {	
pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
if(qtbt_dual_tree_intra_flag) {	
	ue(v)
pic_log2_diff_min_qt_min_cb_intra_slice_chroma	
	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_chroma	
if(pic_max_mtt_hierarchy_depth_intra_slice_chroma != 0) {	
	ue(v)
pic_log2_diff_max_bt_min_qt_intra_slice_chroma	
	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_chroma	
}	
}	
}	
if(cu_qp_delta_enabled_flag) {	
pic_cu_qp_delta_subdiv_intra_slice	ue(v)
pic_cu_qp_delta_subdiv_inter_slice	ue(v)
}	
if(pps_cu_chroma_qp_offset_list_enabled_flag) {	
pic_cu_chroma_qp_offset_subdiv_intra_slice	ue(v)
pic_cu_chroma_qp_offset_subdiv_inter_slice	ue(v)
}	

if(sps temporal mvp enabled flag)	
pic temporal mvp enabled flag	u(1)
if(!pps mvd ll zero ide)	
mvd ll zero flag	u(1)
if(!pps six minus max num merge cand plus1)	
pic six minus max num merge cand	ue(v)
if(sps affine enabled flag)	
pic five minus max num subblock merge cand	ue(v)
if(sps fpel mmvd enabled flag)	
pic fpel mmvd enabled flag	u(1)
if(sps bdof pic present flag)	
pic disable bdof flag	u(1)
if(sps dmvr pic present flag)	
pic disable dmvr flag	u(1)
if(sps prof pic present flag)	
pic disable prof flag	u(1)
if(sps triangle enabled flag && MaxNumMergeCand >= 2 && !pps max num merge cand minus max num triangle cand plus1)	
pic max num merge cand minus max num triangle cand	ue(v)
if(sps ibc enabled flag)	
pic six minus max num ibc merge cand	ue(v)
if(sps joint cber enabled flag)	
pic joint cber sign flag	u(1)
if(sps sao enabled flag) {	
pic sao enabled present flag	u(1)
if(pic sao enabled present flag) {	
pic sao luma enabled flag	u(1)
if(ChromaArrayType != 0)	
pic sao chroma enabled flag	u(1)
}	
}	
if(sps alf enabled flag) {	
pic alf enabled present flag	u(1)
if(pic alf enabled present flag) {	
pic alf enabled flag	u(1)
if(pic alf enabled flag) {	
pic num alf aps ids luma	u(3)
for(i = 0; i < pic num alf aps ids luma; i++)	
pic alf aps id luma[i]	u(3)
if(ChromaArrayType != 0)	
pic alf chroma ide	u(2)

if(pic_alf_chroma_idc)	
pic_alf_aps_id_chroma	u(3)
}	
}	
if(!pps_dep_quant_enabled_idc)	
pic_dep_quant_enabled_flag	u(1)
if(!pic_dep_quant_enabled_flag)	
sign_data_hiding_enabled_flag	u(1)
if(deblocking_filter_override_enabled_flag) {	
pic_deblocking_filter_override_present_flag	u(1)
if(pic_deblocking_filter_override_present_flag) {	
pic_deblocking_filter_override_flag	u(1)
if(pic_deblocking_filter_override_flag) {	
pic_deblocking_filter_disabled_flag	u(1)
if(!pic_deblocking_filter_disabled_flag) {	
pic_beta_offset_div2	se(v)
pic_tc_offset_div2	se(v)
}	
}	
if(sps_lmcs_enabled_flag) {	
pic_lmcs_enabled_flag	u(1)
if(pic_lmcs_enabled_flag) {	
pic_lmcs_aps_id	u(2)
if(ChromaArrayType != 0)	
pic_chroma_residual_scale_flag	u(1)
}	
if(sps_scaling_list_enabled_flag) {	
pic_scaling_list_present_flag	u(1)
if(pic_scaling_list_present_flag)	
pic_scaling_list_aps_id	u(3)
}	
if(picture_header_extension_present_flag) {	
ph_extension_length	ue(v)
for(i = 0; i < ph_extension_length; i++)	
ph_extension_data_byte[i]	u(8)
}	
rbsp_trailing_bits()	
}	

slice_header()	
slice_pic_order_ent_lsb	u(v)
if(subpics_present_flag)	
slice_subpic_id	u(v)
if(rect_slice_flag NumTilesInPic > 1)	
slice_address	u(v)
if(!rect_slice_flag && NumTilesInPic > 1)	
num_files_in_slice_minus1	ue(v)
slice_type	ue(v)
if(!pic_rpl_present_flag &&((nal_unit_type != IDR_W_RADL && nal_unit_type != IDR_N_LP) sps_idr_rpl_present_flag)) {	
for(i = 0; i < 2; i++) {	
if(num_ref_pic_lists_in_sps[i] > 0 && !pps_ref_pic_list_sps_idx[i] && (i == 0 (i == 1 && rpl1_idx_present_flag)))	
slice_rpl_sps_flag[i]	u(1)
if(slice_rpl_sps_flag[i]) {	
if(num_ref_pic_lists_in_sps[i] > 1 && (i == 0 (i == 1 && rpl1_idx_present_flag)))	
slice_rpl_idx[i]	u(v)
} else	
ref_pic_list_struct(i, num_ref_pic_lists_in_sps[i])	
for(j = 0; j < NumLtrpEntries[i][RplIdx[i]]; j++) {	
if(ltrp_in_slice_header_flag[i][RplIdx[i]])	
slice_poc_lsb_lt[i][j]	u(v)
slice_delta_poc_msb_present_flag[i][j]	u(1)
if(slice_delta_poc_msb_present_flag[i][j])	
slice_delta_poc_msb_cycle_lt[i][j]	ue(v)
}	
}	
}	
} if(pic_rpl_present_flag ((nal_unit_type != IDR_W_RADL && nal_unit_type != IDR_N_LP) sps_idr_rpl_present_flag)) {	
if((slice_type != I && num_ref_entries[0][RplIdx[0]] > 1) (slice_type == B && num_ref_entries[1][RplIdx[1]] > 1)) {	

num_ref_idx_active_override_flag	u(1)
if(num_ref_idx_active_override_flag)	
for(i = 0; i < (slice_type == B ? 2: 1); i++)	
if(num_ref_entries[i][RplIdx[i]] >	
1)	
num_ref_idx_active_minus1[i]	ue(v)
}	
}	
if(slice_type != 1) {	
if(cabac_init_present_flag)	
cabac_init_flag	u(1)
if(pic_temporal_mvp_enabled_flag) {	
if(slice_type == B && !pps_collocated_from_l0_idc)	
collocated_from_l0_flag	u(1)
if((collocated_from_l0_flag &&	
NumRefIdxActive[0] > 1)	
(!collocated_from_l0_flag &&	
NumRefIdxActive[1] > 1))	
collocated_ref_idx	ue(v)
}	
if((pps_weighted_pred_flag && slice_type == P)	
(pps_weighted_bipred_flag && slice_type == B))	
pred_weight_table()	
}	
slice_qp_delta	se(v)
if(pps_slice_chroma_qp_offsets_present_flag) {	
slice_cb_qp_offset	se(v)
slice_cr_qp_offset	se(v)
if(sps_joint_cbr_enabled_flag)	
slice_joint_cbr_qp_offset	se(v)
}	
if(pps_cu_chroma_qp_offset_list_enabled_flag)	
cu_chroma_qp_offset_enabled_flag	u(1)
if(sps_sao_enabled_flag && !pic_sao_enabled_present_flag) {	
slice_sao_luma_flag	u(1)
if(ChromaArrayType != 0)	
slice_sao_chroma_flag	u(1)
}	
if(sps_alf_enabled_flag && !pic_alf_enabled_present_flag) {	
slice_alf_enabled_flag	u(1)
if(slice_alf_enabled_flag) {	
slice_num_alf_aps_ids_luma	u(3)
for(i = 0; i < slice_num_alf_aps_ids_luma; i++)	

slice_alf_aps_id_luma[i]	u(3)
if(ChromaArrayType != 0)	
slice_alf_chroma_idc	u(2)
if(slice_alf_chroma_idc)	
slice_alf_aps_id_chroma	u(3)
}	
}	
if(deblocking_filter_override_enabled_flag &&	
!pic_deblocking_filter_override_present_flag)	
slice_deblocking_filter_override_flag	u(1)
if(slice_deblocking_filter_override_flag) {	
slice_deblocking_filter_disabled_flag	u(1)
if(!slice_deblocking_filter_disabled_flag) {	
slice_beta_offset_div2	se(v)
slice_tc_offset_div2	se(v)
}	
}	
if(entry_point_offsets_present_flag && NumEntryPoints > 0) {	
offset_len_minus1	ue(v)
for(i = 0; i < NumEntryPoints; i++)	
entry_point_offset_minus1[i]	u(v)
}	
if(slice_header_extension_present_flag) {	
slice_header_extension_length	ue(v)
for(i = 0; i < slice_header_extension_length; i++)	
slice_header_extension_data_byte[i]	u(8)
}	
byte_alignment()	
}	

[0016] As indicated above and below, slice_type may specify the coding type of the slice according to Table 4, below:

Table 4: slice_type

slice_type	Name of slice_type
0	B (B slice)
1	P (P slice)
2	I (I slice)

Access Unit Delimiter

[0017] An AU (Access Unit) delimiter is used to indicate the start of an AU and the type of slices present in coded pictures in the AU containing the AU delimiter NAL (Network Abstraction Layer) unit. Presently, there is no normative decoding process associated with the AU delimiter.

[0018] Also, `pic_type` indicates that the `slice_type` values for all slices of coded pictures in the AU containing the AU delimiter NAL unit are members of the set listed in Table 4 for the given value of `pic_type`. The value of `pic_type` may be equal to 0, 1 or 2 in bitstreams. Other values of `pic_type` are reserved for future use by ITU-T | ISO/IEC. Decoders conforming to this version of this may ignore reserved values of `pic_type`.

Table 5: Interpretation of `pic_type`

<code>pic_type</code>	<code>slice_type</code> values that may be present in the AU
0	I
1	P, I
2	B, P, I

[0019] Non-patent literature [1] (“NPL 1”) proposes a high-level control flag to indicate that a set of parameters are needed for covered low-level coding layers.

[0020] NPL 1 describes a method wherein all inter-prediction related syntax elements or parameters only need to be signaled when there is at least one inter coded slice, or when a sub-partition exists inside a picture. Otherwise, those syntax elements or parameter are not signaled.

[0021] In one embodiment described in NPL 1, a control flag in a picture header, referred to as `pic_intra_only_flag`, is signaled to indicate if all slices (or any kind of sub-partitions of this picture) inside the picture will have intra prediction (or non-inter related prediction) only. When

this flag is true, only intra coding related syntax elements or parameters are signaled later in the picture header. Otherwise, when this flag is false, inter prediction related syntax elements or parameters are signaled. A syntax table reflecting this embodiment is provided below:

Table 6: First Embodiment of NPL 1

Syntax Element	Descriptor
pic_intra_only_flag	u(1)
if(!pic_intra_only_flag){	
if(sps_temporal_mvp_enabled_flag && !pps_temporal_mvp_enabled_idc)	
pic_temporal_mvp_enabled_flag	u(1)
if(!pps_mv_l1_zero_idc)	
mv_l1_zero_flag	u(1)
if(!pps_six_minus_max_num_merge_cand_plus1)	
pic_six_minus_max_num_merge_cand	ue(v)
if(sps_affine_enabled_flag && !pps_five_minus_max_num_subblock_merge_cand_plus1)	
pic_five_minus_max_num_subblock_merge_cand	ue(v)
if(sps_fpel_mmvd_enabled_flag)	
pic_fpel_mmvd_enabled_flag	u(1)
if(sps_bdof_dmvr_slice_present_flag)	
pic_disable_bdof_dmvr_flag	u(1)
if(sps_triangle_enabled_flag && MaxNumMergeCand >= 2 && !pps_max_num_merge_cand_minus_max_num_triangle_cand_minus 1)	
pic_max_num_merge_cand_minus_max_num_triangle_cand	ue(v)
}	

[0022] In another method of NPL 1, all related syntax elements or parameters that are used only for intra slice or intra sub-partition need to be signaled when there is no inter coded slice or when a sub-partition exists inside the picture. Otherwise, those syntax elements or parameter are not signaled.

[0023] In another embodiment of NPL 1, a control flag in picture header, referred as `pic_inter_only_flag`, is signaled to indicate if all the slices (or any kind of sub-partition of this picture) inside the picture will have inter prediction (or non-intra related prediction). When this flag is true, intra slice related syntax elements or parameters are not signaled later in the picture header. Otherwise, when this flag is false, intra slice may be used in at least one of the slice(s) or sub-partition(s) in the picture. The related syntax elements or parameters for intra slice or sub-partitions will be signaled. A syntax table reflecting this embodiment is provided below:

Table 7: Second Embodiment of NPL 1

Syntax Element	Descriptor
<code>pic_inter_only_flag</code>	u(1)
<code>if(!pic_inter_only_flag){</code>	
<code> if(qtbt_dual_tree_intra_flag) {</code>	
<code> pic_log2_diff_min_qt_min_cb_chroma</code>	ue(v)
<code> pic_max_mtt_hierarchy_depth_chroma</code>	ue(v)
<code> if(pic_max_mtt_hierarchy_depth_chroma !=</code>	
<code>0) {</code>	
<code> pic_log2_diff_max_bt_min_qt_chroma</code>	ue(v)
<code> pic_log2_diff_max_tt_min_qt_chroma</code>	ue(v)
<code> }</code>	
<code> }</code>	
<code>}</code>	

[0024] In the above methods described in NPL 1, if a picture has its own type, such as being an intra picture or inter picture, the above control flags `pic_intra_only_flag` and `pic_inter_only_flag` need not be signaled, and their values can be derived from the picture type.

[0025] Also, if current picture has a picture type as intra-only picture (all slices in the picture are I slices), then a `pic_intra_only_flag` may be inferred as true. In another example, if the current picture has a picture type as inter-only picture (all slices in the picture are P or B slices),

the `pic_inter_only_flag` may be inferred as true. In yet another example in NPL 1, if a current picture has a picture type indicating both intra-slices and inter-slices are possible in the picture, both the `pic_intra_only_flag` and the `pic_inter_only_flag` can be inferred as false.

Problem

[0026] Although PH may be signalled once per picture to avoid signalling syntax elements that are common to slices within a picture, this signalling may introduce overhead instead, without considering syntax elements only used for intra slices (I slices) or inter slices (B, P slices).

SUMMARY

[0027] Embodiments relate to a method, system, and computer readable medium for video encoding/decoding, and more specifically to picture header handling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] These and other objects, features and advantages will become apparent from the following detailed description of illustrative embodiments, which are to be read in connection with the accompanying drawings. The various features of the drawings are not to scale as the illustrations are for clarity in facilitating the understanding of one skilled in the art in conjunction with the detailed description. In the drawings:

[0029] FIG. 1 is a schematic illustration of a simplified block diagram of a communication system in accordance with an embodiment.

[0030] FIG. 2 is a schematic illustration of a simplified block diagram of a communication system in accordance with an embodiment.

[0031] FIG. 3 is a schematic illustration of a computer system in accordance with an embodiment.

DETAILED DESCRIPTION

[0032] FIG. 1 illustrates a simplified block diagram of a communication system (100) according to an embodiment of the present disclosure. The system (100) may include at least two terminals (110-120) interconnected via a network (150). For unidirectional transmission of data, a first terminal (110) may code video data at a local location for transmission to the other terminal (120) via the network (150). The second terminal (120) may receive the coded video data of the other terminal from the network (150), decode the coded data and display the recovered video data. Unidirectional data transmission may be common in media serving applications and the like.

[0033] FIG. 1 illustrates a second pair of terminals (130, 140) provided to support bidirectional transmission of coded video that may occur, for example, during videoconferencing. For bidirectional transmission of data, each terminal (130, 140) may code video data captured at a local location for transmission to the other terminal via the network (150). Each terminal (130, 140) also may receive the coded video data transmitted by the other terminal, may decode the coded data and may display the recovered video data at a local display device.

[0034] In FIG. 1, the terminals (110-140) may be illustrated as servers, personal computers and smart phones but the principles of the present disclosure may be not so limited. Embodiments of the present disclosure find application with laptop computers, tablet computers, media players and/or dedicated video conferencing equipment. The network (150) represents any

number of networks that convey coded video data among the terminals (110-140), including for example wireline and/or wireless communication networks. The communication network (150) may exchange data in circuit-switched and/or packet-switched channels. Representative networks include telecommunications networks, local area networks, wide area networks and/or the Internet. For the purposes of the present discussion, the architecture and topology of the network (150) may be immaterial to the operation of the present disclosure unless explained herein below.

[0035] FIG. 2 illustrates, as an example for an application for the disclosed subject matter, the placement of a video encoder and decoder in a streaming environment. The disclosed subject matter can be equally applicable to other video enabled applications, including, for example, video conferencing, digital TV, storing of compressed video on digital media including CD, DVD, memory stick and the like, and so on.

[0036] A streaming system may include a capture subsystem (213), that can include a video source (201), for example a digital camera, creating a for example uncompressed video sample stream (202). That sample stream (202), depicted as a bold line to emphasize a high data volume when compared to encoded video bitstreams, can be processed by an encoder (203) coupled to the camera (201). The encoder (203) can include hardware, software, or a combination thereof to enable or implement aspects of the disclosed subject matter as described in more detail below. The encoded video bitstream (204), depicted as a thin line to emphasize the lower data volume when compared to the sample stream, can be stored on a streaming server (205) for future use. One or more streaming clients (206, 208) can access the streaming server (205) to retrieve copies (207, 209) of the encoded video bitstream (204). A client (206) can

include a video decoder (210) which decodes the incoming copy of the encoded video bitstream (207) and creates an outgoing video sample stream (211) that can be rendered on a display (212) or other rendering device (not depicted). In some streaming systems, the video bitstreams (204, 207, 209) can be encoded according to certain video coding/compression standards. Examples of those standards include ITU-T Recommendation H.265. Under development is a video coding standard informally known as Versatile Video Coding or VVC. The disclosed subject matter may be used in the context of VVC.

[0037] In embodiments, the syntax element `pic_type_idc` may be used to indicate the slice types for all slices of a coded picture.

[0038] In one embodiment, `pic_type_idc` may be coded using an unsigned integer 0-th order Exp-Golomb-coded syntax element with the left bit first. Here, `pic_type_idc` may have three value 0, 1 and 2, and three statuses such as I slice only, B, P, I slices, and B, P slices. The value may be mapped to statuses in any order. Table 8, below shows examples of possible `pic_type_idc` semantics.

Table 8: Example of Possible `pic_type_idc` Semantics

<code>pic_type_idc</code>	slice_type that present in a coded picture
0	B, P, I
1	I
2	B, P

[0039] In an embodiment, `pic_type_idc` may be coded using an unsigned integer using 2 bits. Here, `pic_type_idc` may have, but is not necessarily limited to three values 0, 1 and 2, and three statuses, such as: I slice only, B, P, I slices, and B, P slices. Other values of `pic_type_idc` may be reserved for further definition.

Table 9 – Examples of Possible pic_type_idc Semantics

pic_type_idc	slice_type that present in a coded picture
0	B, P, I
1	I
2	B, P
3	reserved

[0040] In an embodiment, the reserved pic_type_idc value 3 may indicate only P, I slices present in a coded picture.

[0041] In an example, pic_type_idc may be coded using an unsigned integer using 2 bits. Also, pic_type_idc may have four value 0, 1, 2 and 3, and four statuses such as I slice only, B, P, I slices and B slices, and P slices.

Table 10 – Examples of Possible pic_type_idc Semantics

pic_type_idc	slice_type that present in a coded picture
0	B, P, I
1	I
2	B
3	P

[0042] It is proposed to signal pic_type_idc in HLS, such that only related syntax elements are coded or present to reduce signaling overhead. For example, when pic_type_idc indicating the picture is intra only, no inter related syntax elements are signaled.

[0043] In one example, pic_type_idc may be signaled in PPS such that it specifies the slice types for all slices of each coded picture referring to the PPS. Detailed syntax and semantics are given as follow. In the below Table, as well as other Tables in this disclosure, changes compared to VVC Draft 7 are italicized.

Table 11: Detailed Syntax and Semantics

Syntax Element	Descriptor
pic_parameter_set_rbsp() {	
pps_pic_parameter_set_id	ue(v)
pps_seq_parameter_set_id	u(4)
pic_width_in_luma_samples	ue(v)
pic_height_in_luma_samples	ue(v)
<i>pic_type_idc</i>	ue(v)
conformance_window_flag	u(1)
if(conformance_window_flag) {	
conf_win_left_offset	ue(v)
conf_win_right_offset	ue(v)
conf_win_top_offset	ue(v)
conf_win_bottom_offset	ue(v)
}	
scaling_window_flag	u(1)
if(scaling_window_flag) {	
scaling_win_left_offset	ue(v)
scaling_win_right_offset	ue(v)
scaling_win_top_offset	ue(v)
scaling_win_bottom_offset	ue(v)
}	
output_flag_present_flag	u(1)
mixed_nalu_types_in_pic_flag	u(1)
pps_subpic_id_signalling_present_flag	u(1)
if(pps_subpics_id_signalling_present_flag) {	
pps_num_subpics_minus1	ue(v)
pps_subpic_id_len_minus1	ue(v)
for(i = 0; i <= pps_num_subpic_minus1; i++)	
pps_subpic_id[i]	u(v)
}	
no_pic_partition_flag	u(1)
if(!no_pic_partition_flag) {	
pps_log2_ctu_size_minus5	u(2)
num_exp_tile_columns_minus1	ue(v)
num_exp_tile_rows_minus1	ue(v)
for(i = 0; i <= num_exp_tile_columns_minus1; i++)	
tile_column_width_minus1[i]	ue(v)
for(i = 0; i <= num_exp_tile_rows_minus1; i++)	
tile_row_height_minus1[i]	ue(v)
rect_slice_flag	u(1)
if(rect_slice_flag)	

single_slice_per_subpic_flag	u(1)
if(rect_slice_flag && !single_slice_per_subpic_flag) {	
num_slices_in_pic_minus1	ue(v)
tile_idx_delta_present_flag	u(1)
for(i = 0; i < num_slices_in_pic_minus1; i++) {	
slice_width_in_tiles_minus1[i]	ue(v)
slice_height_in_tiles_minus1[i]	ue(v)
if(slice_width_in_tiles_minus1[i] == 0	
&&	
slice_height_in_tiles_minus1[i] == 0) {	
num_slices_in_tile_minus1[i]	ue(v)
numSlicesInTileMinus1 =	
num_slices_in_tile_minus1[i]	
for(j = 0; j < numSlicesInTileMinus1;	
j++)	
slice_height_in_ctu_minus1[i++]	ue(v)
}	
if(tile_idx_delta_present_flag && i <	
num_slices_in_pic_minus1)	
tile_idx_delta[i]	se(v)
}	
}	
loop_filter_across_tiles_enabled_flag	u(1)
loop_filter_across_slices_enabled_flag	u(1)
}	
entropy_coding_sync_enabled_flag	u(1)
if(!no_pic_partition_flag entropy_coding_sync_enabled_flag)	
entry_point_offsets_present_flag	u(1)
cabac_init_present_flag	u(1)
for(i = 0; i < 2; i++)	
num_ref_idx_default_active_minus1[i]	ue(v)
rpl1_idx_present_flag	u(1)
init_qp_minus26	se(v)
log2_transform_skip_max_size_minus2	ue(v)
cu_qp_delta_enabled_flag	u(1)
pps_cb_qp_offset	se(v)
pps_cr_qp_offset	se(v)
pps_joint_cbr_qp_offset_present_flag	u(1)
if(pps_joint_cbr_qp_offset_present_flag)	
pps_joint_cbr_qp_offset_value	se(v)
pps_slice_chroma_qp_offsets_present_flag	u(1)

pps_cu_chroma_qp_offset_list_enabled_flag	u(1)
if(pps_cu_chroma_qp_offset_list_enabled_flag) {	
chroma_qp_offset_list_len_minus1	ue(v)
for(i = 0; i <= chroma_qp_offset_list_len_minus1; i++) {	
cb_qp_offset_list[i]	se(v)
cr_qp_offset_list[i]	se(v)
if(pps_joint_cbr_qp_offset_present_flag)	
joint_cbr_qp_offset_list[i]	se(v)
}	
}	
pps_weighted_pred_flag	u(1)
pps_weighted_bipred_flag	u(1)
deblocking_filter_control_present_flag	u(1)
if(deblocking_filter_control_present_flag) {	
deblocking_filter_override_enabled_flag	u(1)
pps_deblocking_filter_disabled_flag	u(1)
if(!pps_deblocking_filter_disabled_flag) {	
pps_beta_offset_div2	se(v)
pps_tc_offset_div2	se(v)
}	
}	
constant_slice_header_params_enabled_flag	u(1)
if(constant_slice_header_params_enabled_flag) {	
pps_dep_quant_enabled_idc	u(2)
for(i = 0; i < 2; i++)	
pps_ref_pic_list_sps_idc[i]	u(2)
if(<i>pic_type_idc != 1</i>) {	
pps_mvd_l1_zero_idc	u(2)
pps_collocated_from_l0_idc	u(2)
pps_six_minus_max_num_merge_cand_plus1	ue(v)
pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1	ue(v)
}	
}	
}	
picture_header_extension_present_flag	u(1)
slice_header_extension_present_flag	u(1)
pps_extension_flag	u(1)
if(pps_extension_flag)	
while(more_rbsp_data())	
pps_extension_data_flag	u(1)
rbsp_trailing_bits()	
}	

[0044] Here, `pic_type_idc` specifies the slice types for all slices of each coded picture referring to the PPS.

[0045] In one embodiment, `pic_type_idc` set equal to 1 indicates each coded picture referring to the PPS has only one or more I slices. In such cases, inter slices (B, P slice) related to syntax elements `pps_mvd_11_zero_idc`, `pps_collocated_from_l0_idc`, `pps_six_minus_max_num_merge_cand_plus1` and `pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1` are inferred to be equal to 0.

[0046] Here, `pps_mvd_11_zero_idc` equal to 0 specifies that the syntax element `mvd_11_zero_flag` is present in PHs referring to the PPS. Also, `pps_mvd_11_zero_idc` equal to 1 or 2 specifies that `mvd_11_zero_flag` is not present in PHs referring to the PPS. Further, `pps_mvd_11_zero_idc` equal to 3 is reserved for future use by ITU-T | ISO/IEC. When not present, `pps_mvd_11_zero_idc` may be inferred to be 0.

[0047] Additionally, `pps_collocated_from_l0_idc` equal to 0 specifies that the syntax element `collocated_from_l0_flag` is present in a slice header of slices referring to the PPS. Also, `pps_collocated_from_l0_idc` equal to 1 or 2 specifies that the syntax element `collocated_from_l0_flag` is not present in a slice header of slices referring to the PPS. Further, `pps_collocated_from_l0_idc` equal to 3 is reserved for future use by ITU-T | ISO/IEC. When not present, `pps_collocated_from_l0_idc` may be inferred to be equal to 0.

[0048] Also, `pps_six_minus_max_num_merge_cand_plus1` equal to 0 specifies that `pic_six_minus_max_num_merge_cand` is present in PHs referring to the PPS. Additionally, `pps_six_minus_max_num_merge_cand_plus1` greater than 0 specifies that

`pic_six_minus_max_num_merge_cand` is not present in PHs referring to the PPS. The value of `pps_six_minus_max_num_merge_cand_plus1` is be in the range of 0 to 6, inclusive. When not present, `pps_six_minus_max_num_merge_cand_plus1` can be inferred to be equal to 0

[0049] As illustrated,

`pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1` equal to 0 specifies that `pic_max_num_merge_cand_minus_max_num_triangle_cand` is present in PHs of slices referring to the PPS. Also, `pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1` greater than 0 specifies that `pic_max_num_merge_cand_minus_max_num_triangle_cand` is not present in PHs referring to the PPS. The value of `pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1` is in the range of 0 to $\text{MaxNumMergeCand} - 1$. When not present,

`pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1` can be inferred to be equal to 0.

Table 12: Proposed Picture Header RBSP syntax

Syntax Element	Descriptor
<code>picture_header_rbsp() {</code>	
<code>non_reference_picture_flag</code>	<code>u(1)</code>
<code>gdr_pic_flag</code>	<code>u(1)</code>
<code>no_output_of_prior_pics_flag</code>	<code>u(1)</code>
<code>if(gdr_pic_flag)</code>	
<code>recovery_poc_cnt</code>	<code>ue(v)</code>
<code>ph_pic_parameter_set_id</code>	<code>ue(v)</code>
<code>if(sps_poc_msb_flag) {</code>	
<code>ph_poc_msb_present_flag</code>	<code>u(1)</code>
<code>if(ph_poc_msb_present_flag)</code>	
<code>poc_msb_val</code>	<code>u(v)</code>
<code>}</code>	
<code>if(sps_subpic_id_present_flag</code> <code>&& !sps_subpic_id_signalling_flag) {</code>	
<code>ph_subpic_id_signalling_present_flag</code>	<code>u(1)</code>

if(ph_subpics_id_signalling_present_flag) {	
ph_subpic_id_len_minus1	ue(v)
for(i = 0; i <= sps_num_subpics_minus1; i++)	
ph_subpic_id[i]	u(v)
}	
}	
if(!sps_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_loop_filter_across_virtual_boundaries_disabled_present_flag	u(1)
if(ph_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_num_ver_virtual_boundaries	u(2)
for(i = 0; i < ph_num_ver_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_x[i]	u(13)
ph_num_hor_virtual_boundaries	u(2)
for(i = 0; i < ph_num_hor_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_y[i]	u(13)
}	
}	
if(separate_colour_plane_flag == 1)	
colour_plane_id	u(2)
if(output_flag_present_flag)	
pic_output_flag	u(1)
pic_rpl_present_flag	u(1)
if(pic_rpl_present_flag) {	
for(i = 0; i < 2; i++) {	
if(num_ref_pic_lists_in_sps[i] > 0	
&& !pps_ref_pic_list_sps_idc[i] &&	
(i == 0 (i == 1 &&	
rpl1_idx_present_flag))	
pic_rpl_sps_flag[i]	u(1)
if(pic_rpl_sps_flag[i]) {	
if(num_ref_pic_lists_in_sps[i] > 1 &&	
(i == 0 (i ==	
1 && rpl1_idx_present_flag))	
pic_rpl_idx[i]	u(v)
} else	

ref_pic_list_struct(i, num_ref_pic_lists_in_sps[i])	
for(j = 0; j < NumLtrpEntries[i][RplIdx[i]]; j++) {	
if(ltrp_in_slice_header_flag[i][RplIdx[i]])	
pic_poc_lsb_lt[i][j]	u(v)
pic_delta_poc_msb_present_flag[i][j]	u(1)
if(pic_delta_poc_msb_present_flag[i][j])	
pic_delta_poc_msb_cycle_lt[i][j]	ue(v)
}	
}	
if(partition_constraints_override_enabled_flag) {	
partition_constraints_override_flag	u(1)
if(partition_constraints_override_flag) {	
if(pic_type_idc != 2) {	
pic_log2_diff_min_qt_min_cb_intra_slice_luma	ue(v)
pic_log2_diff_min_qt_min_cb_inter_slice	ue(v)
pic_max_mtt_hierarchy_depth_inter_slice	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_luma	ue(v)
if(pic_max_mtt_hierarchy_depth_intra_slice_luma != 0) {	
pic_log2_diff_max_bt_min_qt_intra_slice_luma	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_luma	ue(v)
}	
if(pic_max_mtt_hierarchy_depth_inter_slice != 0) {	
pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
if(qtbt_dual_tree_intra_flag) {	
pic_log2_diff_min_qt_min_cb_intra_slice_chroma	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_chroma	ue(v)
if(pic_max_mtt_hierarchy_depth_intra_slice_chroma != 0) {	

pic_log2_diff_max_bt_min_qt_intra_slice_chroma	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_chroma	ue(v)
}	
}	
}	
if (pic_type_idc != 1) {	
pic_log2_diff_min_qt_min_cb_inter_slice	
pic_max_mtt_hierarchy_depth_inter_slice	
if (pic_max_mtt_hierarchy_depth_inter_slice != 0) {	
pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
}	
}	
if (cu_qp_delta_enabled_flag) {	
if (pic_type_idc != 2)	
pic_cu_qp_delta_subdiv_intra_slice	ue(v)
if (pic_type_idc != 1)	
pic_cu_qp_delta_subdiv_inter_slice	ue(v)
}	
if (pps_cu_chroma_qp_offset_list_enabled_flag) {	
if (pic_type_idc != 2)	
pic_cu_chroma_qp_offset_subdiv_intra_slice	ue(v)
if (pic_type_idc != 1)	
pic_cu_chroma_qp_offset_subdiv_inter_slice	ue(v)
}	
if (pic_type_idc != 1) {	
if (sps_temporal_mvp_enabled_flag)	
pic_temporal_mvp_enabled_flag	u(1)
if (!pps_mvd_l1_zero_idc)	
mvd_l1_zero_flag	u(1)
if (!pps_six_minus_max_num_merge_cand_plus1)	
pic_six_minus_max_num_merge_cand	ue(v)
if (sps_affine_enabled_flag)	
pic_five_minus_max_num_subblock_merge_cand	ue(v)

if(sps fpel mmvd enabled flag)	
pic fpel mmvd enabled flag	u(1)
if(sps bdof pic present flag)	
pic disable bdof flag	u(1)
if(sps dmvr pic present flag)	
pic disable dmvr flag	u(1)
if(sps prof pic present flag)	
pic disable prof flag	u(1)
if(sps triangle enabled flag && MaxNumMergeCand >= 2 && !pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1)	
pic_max_num_merge_cand_minus_max_num_triangle_cand /	ue(v)
if(sps ibc enabled flag)	
pic six_minus_max_num_ibc_merge_cand	ue(v)
if(sps joint_cbr enabled flag)	
pic joint_cbr_sign_flag	u(1)
if(sps sao enabled flag) {	
pic sao enabled present flag	u(1)
if(pic sao enabled present flag) {	
pic sao luma enabled flag	u(1)
if(ChromaArrayType != 0)	
pic sao chroma enabled flag	u(1)
}	
}	
if(sps alf enabled flag) {	
pic alf enabled present flag	u(1)
if(pic alf enabled present flag) {	
pic alf enabled flag	u(1)
if(pic alf enabled flag) {	
pic_num_alf_aps_ids_luma	u(3)
for(i = 0; i < pic_num_alf_aps_ids_luma;	
i++)	
pic_alf_aps_id_luma[i]	u(3)
if(ChromaArrayType != 0)	
pic_alf_chroma_idc	u(2)
if(pic_alf_chroma_idc)	
pic_alf_aps_id_chroma	u(3)
}	
}	

}	
if(! pps_dep_quant_enabled_idc)	
pic_dep_quant_enabled_flag	u(1)
if(! pic_dep_quant_enabled_flag)	
sign_data_hiding_enabled_flag	u(1)
if(deblocking_filter_override_enabled_flag) {	
pic_deblocking_filter_override_present_flag	u(1)
if(pic_deblocking_filter_override_present_flag) {	
pic_deblocking_filter_override_flag	u(1)
if(pic_deblocking_filter_override_flag) {	
pic_deblocking_filter_disabled_flag	u(1)
if(! pic_deblocking_filter_disabled_flag) {	
pic_beta_offset_div2	se(v)
pic_tc_offset_div2	se(v)
}	
}	
}	
if(sps_lmcs_enabled_flag) {	
pic_lmcs_enabled_flag	u(1)
if(pic_lmcs_enabled_flag) {	
pic_lmcs_aps_id	u(2)
if(ChromaArrayType != 0)	
pic_chroma_residual_scale_flag	u(1)
}	
if(sps_scaling_list_enabled_flag) {	
pic_scaling_list_present_flag	u(1)
if(pic_scaling_list_present_flag)	
pic_scaling_list_aps_id	u(3)
}	
if(picture_header_extension_present_flag) {	
ph_extension_length	ue(v)
for(i = 0; i < ph_extension_length; i++)	
ph_extension_data_byte[i]	u(8)
}	
rbsp_trailing_bits()	
}	

[0050] For each coded picture referring, to the PPS, pic_type_idc is used to determine whether to parse syntax elements related to intra slices (I slices) and inter slices (B, P slices). For

instance, intra slice related syntax elements `pic_log2_diff_min_qt_min_cb_intra_slice_luma`, `pic_max_mtt_hierarchy_depth_intra_slice_luma`, `pic_log2_diff_max_bt_min_qt_intra_slice_luma`, `pic_log2_diff_max_tt_min_qt_intra_slice_luma`, `pic_log2_diff_min_qt_min_cb_intra_slice_chroma`, `pic_max_mtt_hierarchy_depth_intra_slice_chroma`, `pic_log2_diff_max_bt_min_qt_intra_slice_chroma` and `pic_log2_diff_max_tt_min_qt_intra_slice_chroma` are decoded only whenever there are only I slices associated to the PH. On the other hand, inter slice related syntax elements are decoded whenever there exists inter slices.

[0051] In one example, `pic_type_idc` is signaled in PH such that it specifies the slice types for all slices of a coded picture associated to the PH. Detailed syntax and semantic are given as follow. Changes compared to VVC Draft 7 are italicized.

Table 13: Proposed Picture Header RBSP Syntax

Syntax Element	Descriptor
<code>picture_header_rbsp() {</code>	
<code>non_reference_picture_flag</code>	<code>u(1)</code>
<code>gdr_pic_flag</code>	<code>u(1)</code>
<code>no_output_of_prior_pics_flag</code>	<code>u(1)</code>
<code>if(gdr_pic_flag)</code>	
<code>recovery_poc_cnt</code>	<code>ue(v)</code>
<code>ph_pic_parameter_set_id</code>	<code>ue(v)</code>
<code>pic_type_idc</code>	<i><code>ue(v)</code></i>
<code>if(sps_poc_msb_flag) {</code>	
<code>ph_poc_msb_present_flag</code>	<code>u(1)</code>
<code>if(ph_poc_msb_present_flag)</code>	
<code>poc_msb_val</code>	<code>u(v)</code>
<code>}</code>	
<code>if(sps_subpic_id_present_flag</code> && <code>!sps_subpic_id_signalling_flag) {</code>	

ph_subpic_id_signalling_present_flag	u(1)
if(ph_subpics_id_signalling_present_flag) {	
ph_subpic_id_len_minus1	ue(v)
for(i = 0; i <= sps_num_subpics_minus1; i++)	
ph_subpic_id[i]	u(v)
}	
}	
if(!sps_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_loop_filter_across_virtual_boundaries_disabled_present_flag	u(1)
if(ph_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_num_ver_virtual_boundaries	u(2)
for(i = 0; i < ph_num_ver_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_x[i]	u(13)
ph_num_hor_virtual_boundaries	u(2)
for(i = 0; i < ph_num_hor_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_y[i]	u(13)
}	
}	
if(separate_colour_plane_flag == 1)	
colour_plane_id	u(2)
if(output_flag_present_flag)	
pic_output_flag	u(1)
pic_rpl_present_flag	u(1)
if(pic_rpl_present_flag) {	
for(i = 0; i < 2; i++) {	
if(num_ref_pic_lists_in_sps[i] > 0	
&& !pps_ref_pic_list_sps_idc[i] &&	
(i == 0 (i == 1 &&	
rpl1_idx_present_flag))	
pic_rpl_sps_flag[i]	u(1)
if(pic_rpl_sps_flag[i]) {	
if(num_ref_pic_lists_in_sps[i] > 1 &&	
(i == 0 (i == 1	
&& rpl1_idx_present_flag))	
pic_rpl_idx[i]	u(v)
} else	
ref_pic_list_struct(i,	
num_ref_pic_lists_in_sps[i])	

for(j = 0; j < NumLtrpEntries[i][RplIdx[i]];	
j++) {	
if(ltrp_in_slice_header_flag[i][RplIdx[i]])	
pic_poc_lsb_lt[i][j]	u(v)
pic_delta_poc_msb_present_flag[i][j]	u(1)
if(pic_delta_poc_msb_present_flag[i][j])	
pic_delta_poc_msb_cycle_lt[i][j]	ue(v)
}	
}	
}	
if(partition_constraints_override_enabled_flag) {	
partition_constraints_override_flag	u(1)
if(partition_constraints_override_flag) {	
if(pic_type_idc != 2) {	
	ue(v)
pic_log2_diff_min_qt_min_cb_intra_slice_luma	
pic_log2_diff_min_qt_min_cb_inter_slice	ue(v)
pic_max_mtt_hierarchy_depth_inter_slice	ue(v)
	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_luma	
if(pic_max_mtt_hierarchy_depth_intra_slice_luma != 0) {	
	ue(v)
pic_log2_diff_max_bt_min_qt_intra_slice_luma	
	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_luma	
}	
if(pic_max_mtt_hierarchy_depth_inter_slice != 0)	
{	
pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
if(qtbtt_dual_tree_intra_flag) {	
	ue(v)
pic_log2_diff_min_qt_min_cb_intra_slice_chroma	
	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_chroma	
if(pic_max_mtt_hierarchy_depth_intra_slice_chroma != 0) {	
	ue(v)
pic_log2_diff_max_bt_min_qt_intra_slice_chroma	

pic_log2_diff_max_tt_min_qt_intra_slice_chroma	ue(v)
}	
}	
}	
<i>if (pic_type_idc != 1) {</i>	
pic_log2_diff_min_qt_min_cb_inter_slice	
pic_max_mtt_hierarchy_depth_inter_slice	
<i>if (pic_max_mtt_hierarchy_depth_inter_slice != 0) {</i>	
pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
}	
}	
}	
<i>if (cu_qp_delta_enabled_flag) {</i>	
<i>if (pic_type_idc != 2)</i>	
pic_cu_qp_delta_subdiv_intra_slice	ue(v)
<i>if (pic_type_idc != 1)</i>	
pic_cu_qp_delta_subdiv_inter_slice	ue(v)
}	
<i>if (pps_cu_chroma_qp_offset_list_enabled_flag) {</i>	
<i>if (pic_type_idc != 2)</i>	
pic_cu_chroma_qp_offset_subdiv_intra_slice	ue(v)
<i>if (pic_type_idc != 1)</i>	
pic_cu_chroma_qp_offset_subdiv_inter_slice	ue(v)
}	
<i>if (pic_type_idc != 1) {</i>	
<i>if (sps_temporal_mvp_enabled_flag)</i>	
pic_temporal_mvp_enabled_flag	u(1)
<i>if (!pps_mvd_l1_zero_idc)</i>	
mvd_l1_zero_flag	u(1)
<i>if (!pps_six_minus_max_num_merge_cand_plus1)</i>	
pic_six_minus_max_num_merge_cand	ue(v)
<i>if (sps_affine_enabled_flag)</i>	
pic_five_minus_max_num_subblock_merge_cand	ue(v)
<i>if (sps_fpel_mmvd_enabled_flag)</i>	
pic_fpel_mmvd_enabled_flag	u(1)
<i>if (sps_bdof_pic_present_flag)</i>	
pic_disable_bdof_flag	u(1)

if(sps dmvr pic present flag)	
pic_disable_dmvr_flag	u(1)
if(sps prof pic present flag)	
pic_disable_prof_flag	u(1)
if(sps_triangle_enabled_flag && MaxNumMergeCand >=	
2 &&	
!pps_max_num_merge_cand_minus_max_num_triangle_cand_plus	
1)	
pic_max_num_merge_cand_minus_max_num_triangle_cand	ue(v)
}	
if(sps ibc enabled flag)	
pic_six_minus_max_num_ibc_merge_cand	ue(v)
if(sps joint cbr enabled flag)	
pic_joint_cbr_sign_flag	u(1)
if(sps sao enabled flag) {	
pic_sao_enabled_present_flag	u(1)
if(pic_sao_enabled_present_flag) {	
pic_sao_luma_enabled_flag	u(1)
if(ChromaArrayType != 0)	
pic_sao_chroma_enabled_flag	u(1)
}	
}	
if(sps alf enabled flag) {	
pic_alf_enabled_present_flag	u(1)
if(pic_alf_enabled_present_flag) {	
pic_alf_enabled_flag	u(1)
if(pic_alf_enabled_flag) {	
pic_num_alf_aps_ids_luma	u(3)
for(i = 0; i < pic_num_alf_aps_ids_luma;	
i++)	
pic_alf_aps_id_luma[i]	u(3)
if(ChromaArrayType != 0)	
pic_alf_chroma_idc	u(2)
if(pic_alf_chroma_idc)	
pic_alf_aps_id_chroma	u(3)
}	
}	
}	
}	
if(!pps_dep_quant_enabled_idc)	
pic_dep_quant_enabled_flag	u(1)
if(!pic_dep_quant_enabled_flag)	

sign_data_hiding_enabled_flag	u(1)
if(deblocking_filter_override_enabled_flag) {	
pic_deblocking_filter_override_present_flag	u(1)
if(pic_deblocking_filter_override_present_flag) {	
pic_deblocking_filter_override_flag	u(1)
if(pic_deblocking_filter_override_flag) {	
pic_deblocking_filter_disabled_flag	u(1)
if(!pic_deblocking_filter_disabled_flag) {	
pic_beta_offset_div2	se(v)
pic_tc_offset_div2	se(v)
}	
}	
}	
}	
if(sps_lmcs_enabled_flag) {	
pic_lmcs_enabled_flag	u(1)
if(pic_lmcs_enabled_flag) {	
pic_lmcs_aps_id	u(2)
if(ChromaArrayType != 0)	
pic_chroma_residual_scale_flag	u(1)
}	
}	
if(sps_scaling_list_enabled_flag) {	
pic_scaling_list_present_flag	u(1)
if(pic_scaling_list_present_flag)	
pic_scaling_list_aps_id	u(3)
}	
if(picture_header_extension_present_flag) {	
ph_extension_length	ue(v)
for(i = 0; i < ph_extension_length; i++)	
ph_extension_data_byte[i]	u(8)
}	
rbsp_trailing_bits()	
}	

[0052] For each coded picture, `pic_type_idc` is used to determine whether to parse syntax elements related to intra slices (I slice) and inter slices (B, P slice). For instance, intra slice related syntax elements `pic_log2_diff_min_qt_min_cb_intra_slice_luma`, `pic_max_mtt_hierarchy_depth_intra_slice_luma`,

`pic_log2_diff_max_bt_min_qt_intra_slice_luma`,
`pic_log2_diff_max_tt_min_qt_intra_slice_luma`,
`pic_log2_diff_min_qt_min_cb_intra_slice_chroma`,
`pic_max_mtt_hierarchy_depth_intra_slice_chroma`,
`pic_log2_diff_max_bt_min_qt_intra_slice_chroma` and
`pic_log2_diff_max_tt_min_qt_intra_slice_chroma` are decoded only whenever there are only I
slices associated to the PH. On the other hand, inter slice related syntax elements are decoded
whenever there exists inter slices.

[0053] In one embodiment, `pic_type_idc` may be present in both PPS and PH referring to the PPS as `pps_pic_type_idc` and `ph_pic_type_idc` respectively.

Table 14: Proposed Picture Parameter Set RBSP Syntax

Syntax Element	Descriptor
<code>pic_parameter_set_rbsp() {</code>	
<code>pps_pic_parameter_set_id</code>	<code>ue(v)</code>
<code>pps_seq_parameter_set_id</code>	<code>u(4)</code>
<code>pic_width_in_luma_samples</code>	<code>ue(v)</code>
<code>pic_height_in_luma_samples</code>	<code>ue(v)</code>
<code>pps_pic_type_idc</code>	<code>ue(v)</code>
<code>conformance_window_flag</code>	<code>u(1)</code>
<code>if(conformance_window_flag) {</code>	
<code>conf_win_left_offset</code>	<code>ue(v)</code>
<code>conf_win_right_offset</code>	<code>ue(v)</code>
<code>conf_win_top_offset</code>	<code>ue(v)</code>
<code>conf_win_bottom_offset</code>	<code>ue(v)</code>
<code>}</code>	
<code>scaling_window_flag</code>	<code>u(1)</code>
<code>if(scaling_window_flag) {</code>	
<code>scaling_win_left_offset</code>	<code>ue(v)</code>
<code>scaling_win_right_offset</code>	<code>ue(v)</code>
<code>scaling_win_top_offset</code>	<code>ue(v)</code>
<code>scaling_win_bottom_offset</code>	<code>ue(v)</code>
<code>}</code>	
<code>output_flag_present_flag</code>	<code>u(1)</code>

mixed_nalu_types_in_pic_flag	u(1)
pps_subpic_id_signalling_present_flag	u(1)
if(pps_subpics_id_signalling_present_flag) {	
pps_num_subpics_minus1	ue(v)
pps_subpic_id_len_minus1	ue(v)
for(i = 0; i <= pps_num_subpic_minus1; i++)	
pps_subpic_id[i]	u(v)
}	
no_pic_partition_flag	u(1)
if(!no_pic_partition_flag) {	
pps_log2_ctu_size_minus5	u(2)
num_exp_tile_columns_minus1	ue(v)
num_exp_tile_rows_minus1	ue(v)
for(i = 0; i <= num_exp_tile_columns_minus1; i++)	
tile_column_width_minus1[i]	ue(v)
for(i = 0; i <= num_exp_tile_rows_minus1; i++)	
tile_row_height_minus1[i]	ue(v)
rect_slice_flag	u(1)
if(rect_slice_flag)	
single_slice_per_subpic_flag	u(1)
if(rect_slice_flag && !single_slice_per_subpic_flag) {	
num_slices_in_pic_minus1	ue(v)
tile_idx_delta_present_flag	u(1)
for(i = 0; i < num_slices_in_pic_minus1; i++) {	
slice_width_in_tiles_minus1[i]	ue(v)
slice_height_in_tiles_minus1[i]	ue(v)
if(slice_width_in_tiles_minus1[i] == 0	
&&	
slice_height_in_tiles_minus1[i] == 0) {	
num_slices_in_tile_minus1[i]	ue(v)
numSlicesInTileMinus1 =	
num_slices_in_tile_minus1[i]	
for(j = 0; j <	
numSlicesInTileMinus1; j++)	
	ue(v)
slice_height_in_ctu_minus1[i++]	
}	
if(tile_idx_delta_present_flag && i <	
num_slices_in_pic_minus1)	
tile_idx_delta[i]	se(v)
}	
}	
}	

loop_filter_across_tiles_enabled_flag	u(1)
loop_filter_across_slices_enabled_flag	u(1)
}	
entropy_coding_sync_enabled_flag	u(1)
if(!no_pic_partition_flag entropy_coding_sync_enabled_flag)	
entry_point_offsets_present_flag	u(1)
cabac_init_present_flag	u(1)
for(i = 0; i < 2; i++)	
num_ref_idx_default_active_minus1[i]	ue(v)
rpl1_idx_present_flag	u(1)
init_qp_minus26	se(v)
log2_transform_skip_max_size_minus2	ue(v)
cu_qp_delta_enabled_flag	u(1)
pps_cb_qp_offset	se(v)
pps_cr_qp_offset	se(v)
pps_joint_cbr_qp_offset_present_flag	u(1)
if(pps_joint_cbr_qp_offset_present_flag)	
pps_joint_cbr_qp_offset_value	se(v)
pps_slice_chroma_qp_offsets_present_flag	u(1)
pps_cu_chroma_qp_offset_list_enabled_flag	u(1)
if(pps_cu_chroma_qp_offset_list_enabled_flag) {	
chroma_qp_offset_list_len_minus1	ue(v)
for(i = 0; i <= chroma_qp_offset_list_len_minus1; i++) {	
cb_qp_offset_list[i]	se(v)
cr_qp_offset_list[i]	se(v)
if(pps_joint_cbr_qp_offset_present_flag)	
joint_cbr_qp_offset_list[i]	se(v)
}	
}	
pps_weighted_pred_flag	u(1)
pps_weighted_bipred_flag	u(1)
deblocking_filter_control_present_flag	u(1)
if(deblocking_filter_control_present_flag) {	
deblocking_filter_override_enabled_flag	u(1)
pps_deblocking_filter_disabled_flag	u(1)
if(!pps_deblocking_filter_disabled_flag) {	
pps_beta_offset_div2	se(v)
pps_tc_offset_div2	se(v)
}	
}	
constant_slice_header_params_enabled_flag	u(1)
if(constant_slice_header_params_enabled_flag) {	
pps_dep_quant_enabled_idc	u(2)

for(i = 0; i < 2; i++)	
pps_ref_pic_list_sps_idc[i]	u(2)
if (pps_pic_type_idc != 1) {	
pps_mvd_11_zero_idc	u(2)
pps_collocated_from_l0_idc	u(2)
pps_six_minus_max_num_merge_cand_plus1	ue(v)
pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1	ue(v)
}	
}	
picture_header_extension_present_flag	u(1)
slice_header_extension_present_flag	u(1)
pps_extension_flag	u(1)
if(pps_extension_flag)	
while(more_rbsp_data())	
pps_extension_data_flag	u(1)
rbsp_trailing_bits()	
}	

[0054] Here, pps_pic_type_idc specifies the slice types for all slices of each coded picture referring to the PPS.

[0055] Also, pps_mvd_11_zero_idc equal to 0 specifies that the syntax element mvd_11_zero_flag is present in PHs referring to the PPS. Further, pps_mvd_11_zero_idc equal to 1 or 2 specifies that mvd_11_zero_flag is not present in PHs referring to the PPS. Additionally, pps_mvd_11_zero_idc equal to 3 is reserved for future use by ITU-T | ISO/IEC. When not present, pps_mvd_11_zero_idc may be inferred to be equal to 0.

[0056] Also, pps_collocated_from_l0_idc equal to 0 specifies that the syntax element collocated_from_l0_flag is present in slice headers of slices referring to the PPS. Further, pps_collocated_from_l0_idc equal to 1 or 2 specifies that the syntax element collocated_from_l0_flag is not present in slice headers of slices referring to the PPS. Further,

pps_collocated_from_l0_idc equal to 3 is reserved for future use by ITU-T | ISO/IEC. When not present, pps_collocated_from_l0_idc may be inferred to be equal to 0.

[0057] Also, pps_six_minus_max_num_merge_cand_plus1 equal to 0 specifies that pic_six_minus_max_num_merge_cand is present in PHs referring to the PPS. Further, pps_six_minus_max_num_merge_cand_plus1 greater than 0 specifies that pic_six_minus_max_num_merge_cand is not present in PHs referring to the PPS. The value of pps_six_minus_max_num_merge_cand_plus1 shall be in the range of 0 to 6, inclusive. When not present, pps_six_minus_max_num_merge_cand_plus1 may be inferred to be equal to 0.

[0058] Also, pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1 equal to 0 specifies that pic_max_num_merge_cand_minus_max_num_triangle_cand is present in PHs of slices referring to the PPS. Further, pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1 greater than 0 specifies that pic_max_num_merge_cand_minus_max_num_triangle_cand is not present in PHs referring to the PPS. The value of pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1 shall be in the range of 0 to MaxNumMergeCand – 1. When not present, pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1 can be inferred to be equal to 0.

[0059] In one example, when the value of pps_pic_type_idc indicates presence of one type of slice (I or B or P slice as in Table 10 value 1, 2 and 3), the value of ph_pic_type_idc may be inferred from the value of pps_pic_type_idc.

Table 15: Proposed Picture Header RBSP Syntax

Syntax Element	Descriptor
picture_header_rbsp() {	
non_reference_picture_flag	u(1)
gdr_pic_flag	u(1)
no_output_of_prior_pics_flag	u(1)
if(gdr_pic_flag)	
recovery_poc_cnt	ue(v)
ph_pic_parameter_set_id	ue(v)
<i>ph_pic_type_idc</i>	<i>ue(v)</i>
if(sps_poc_msb_flag) {	
ph_poc_msb_present_flag	u(1)
if(ph_poc_msb_present_flag)	
poc_msb_val	u(v)
}	
if(sps_subpic_id_present_flag && !sps_subpic_id_signalling_flag) {	
ph_subpic_id_signalling_present_flag	u(1)
if(ph_subpics_id_signalling_present_flag) {	
ph_subpic_id_len_minus1	ue(v)
for(i = 0; i <= sps_num_subpics_minus1; i++)	
ph_subpic_id[i]	u(v)
}	
}	
if(!sps_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_loop_filter_across_virtual_boundaries_disabled_present_flag	u(1)
if(ph_loop_filter_across_virtual_boundaries_disabled_present_flag)	
{	
ph_num_ver_virtual_boundaries	u(2)
for(i = 0; i < ph_num_ver_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_x[i]	u(13)
ph_num_hor_virtual_boundaries	u(2)
for(i = 0; i < ph_num_hor_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_y[i]	u(13)
}	
}	

if(separate_colour_plane_flag == 1)	
colour_plane_id	u(2)
if(output_flag_present_flag)	
pic_output_flag	u(1)
pic_rpl_present_flag	u(1)
if(pic_rpl_present_flag) {	
for(i = 0; i < 2; i++) {	
if(num_ref_pic_lists_in_sps[i] > 0 && !pps_ref_pic_list_sps_idx[i] && (i == 0 (i == 1 && rpl1_idx_present_flag)))	
pic_rpl_sps_flag[i]	u(1)
if(pic_rpl_sps_flag[i]) {	
if(num_ref_pic_lists_in_sps[i] > 1 && (i == 0 (i == 1 && rpl1_idx_present_flag)))	
pic_rpl_idx[i]	u(v)
} else	
ref_pic_list_struct(i, num_ref_pic_lists_in_sps[i])	
for(j = 0; j < NumLtrpEntries[i][RplIdx[i]]; j++) {	
if(ltrp_in_slice_header_flag[i][RplIdx[i]])	
pic_poc_lsb_lt[i][j]	u(v)
pic_delta_poc_msb_present_flag[i][j]	u(1)
if(pic_delta_poc_msb_present_flag[i][j])	
pic_delta_poc_msb_cycle_lt[i][j]	ue(v)
}	
}	
}	
if(partition_constraints_override_enabled_flag) {	
partition_constraints_override_flag	u(1)
if(partition_constraints_override_flag) {	
if(ph_pic_type_idc != 2) {	
pic_log2_diff_min_qt_min_cb_intra_slice_luma	ue(v)
pic_log2_diff_min_qt_min_cb_inter_slice	ue(v)
pic_max_mtt_hierarchy_depth_inter_slice	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_luma	ue(v)
if(pic_max_mtt_hierarchy_depth_intra_slice_luma != 0) {	
pic_log2_diff_max_bt_min_qt_intra_slice_luma	ue(v)

pic_log2_diff_max_tt_min_qt_intra_slice_luma	ue(v)
}	
<i>if(pic_max_mtt_hierarchy_depth_inter_slice != 0) {</i>	
pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
<i>if(qtbtt_dual_tree_intra_flag) {</i>	
pic_log2_diff_min_qt_min_cb_intra_slice_chroma	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_chroma	ue(v)
<i>if(pic_max_mtt_hierarchy_depth_intra_slice_chroma != 0) {</i>	
pic_log2_diff_max_bt_min_qt_intra_slice_chroma	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_chroma	ue(v)
}	
}	
}	
<i>if(ph_pic_type_idc != 1) {</i>	
pic_log2_diff_min_qt_min_cb_inter_slice	
pic_max_mtt_hierarchy_depth_inter_slice	
<i>if(pic_max_mtt_hierarchy_depth_inter_slice != 0) {</i>	
pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
<i>/</i>	
}	
}	
<i>if(cu_qp_delta_enabled_flag) {</i>	
<i>if(ph_pic_type_idc != 2)</i>	
pic_cu_qp_delta_subdiv_intra_slice	ue(v)
<i>if(ph_pic_type_idc != 1)</i>	
pic_cu_qp_delta_subdiv_inter_slice	ue(v)
}	
<i>if(pps_cu_chroma_qp_offset_list_enabled_flag) {</i>	
<i>if(ph_pic_type_idc != 2)</i>	
pic_cu_chroma_qp_offset_subdiv_intra_slice	ue(v)
<i>if(ph_pic_type_idc != 1)</i>	

pic_cu_chroma_qp_offset_subdiv_inter_slice	ue(v)
}	
<i>if (ph_pic_type_idc != 1) {</i>	
<i>if (sps_temporal_mvp_enabled_flag)</i>	
pic_temporal_mvp_enabled_flag	u(1)
<i>if (!pps_mvd_l1_zero_idc)</i>	
mvd_l1_zero_flag	u(1)
<i>if (!pps_six_minus_max_num_merge_cand_plus1)</i>	
pic_six_minus_max_num_merge_cand	ue(v)
<i>if (sps_affine_enabled_flag)</i>	
pic_five_minus_max_num_subblock_merge_cand	ue(v)
<i>if (sps_fpel_mmvd_enabled_flag)</i>	
pic_fpel_mmvd_enabled_flag	u(1)
<i>if (sps_bdof_pic_present_flag)</i>	
pic_disable_bdof_flag	u(1)
<i>if (sps_dmvr_pic_present_flag)</i>	
pic_disable_dmvr_flag	u(1)
<i>if (sps_prof_pic_present_flag)</i>	
pic_disable_prof_flag	u(1)
<i>if (sps_triangle_enabled_flag && MaxNumMergeCand >= 2 && !pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1)</i>	
pic_max_num_merge_cand_minus_max_num_triangle_cand	ue(v)
}	
<i>if (sps_ibc_enabled_flag)</i>	
pic_six_minus_max_num_ibc_merge_cand	ue(v)
<i>if (sps_joint_cbr_enabled_flag)</i>	
pic_joint_cbr_sign_flag	u(1)
<i>if (sps_sao_enabled_flag) {</i>	
pic_sao_enabled_present_flag	u(1)
<i>if (pic_sao_enabled_present_flag) {</i>	
pic_sao_luma_enabled_flag	u(1)
<i>if (ChromaArrayType != 0)</i>	
pic_sao_chroma_enabled_flag	u(1)
}	
}	

if(sps_alf_enabled_flag) {	
pic_alf_enabled_present_flag	u(1)
if(pic_alf_enabled_present_flag) {	
pic_alf_enabled_flag	u(1)
if(pic_alf_enabled_flag) {	
pic_num_alf_aps_ids_luma	u(3)
for(i = 0; i < pic_num_alf_aps_ids_luma; i++)	
pic_alf_aps_id_luma[i]	u(3)
if(ChromaArrayType != 0)	
pic_alf_chroma_idc	u(2)
if(pic_alf_chroma_idc)	
pic_alf_aps_id_chroma	u(3)
}	
}	
}	
}	
if(! pps_dep_quant_enabled_idc)	
pic_dep_quant_enabled_flag	u(1)
if(! pic_dep_quant_enabled_flag)	
sign_data_hiding_enabled_flag	u(1)
if(deblocking_filter_override_enabled_flag) {	
pic_deblocking_filter_override_present_flag	u(1)
if(pic_deblocking_filter_override_present_flag) {	
pic_deblocking_filter_override_flag	u(1)
if(pic_deblocking_filter_override_flag) {	
pic_deblocking_filter_disabled_flag	u(1)
if(! pic_deblocking_filter_disabled_flag) {	
pic_beta_offset_div2	se(v)
pic_tc_offset_div2	se(v)
}	
}	
}	
}	
if(sps_lmcs_enabled_flag) {	
pic_lmcs_enabled_flag	u(1)
if(pic_lmcs_enabled_flag) {	

pic_lmcs_aps_id	u(2)
if(ChromaArrayType != 0)	
pic_chroma_residual_scale_flag	u(1)
}	
}	
if(sps_scaling_list_enabled_flag) {	
pic_scaling_list_present_flag	u(1)
if(pic_scaling_list_present_flag)	
pic_scaling_list_aps_id	u(3)
}	
if(picture_header_extension_present_flag) {	
ph_extension_length	ue(v)
for(i = 0; i < ph_extension_length; i++)	
ph_extension_data_byte[i]	u(8)
}	
rbsp_trailing_bits()	
}	

[0060] Here, ph_pic_type_idc specifies the slice types for all slices of each coded picture associated to the PH.

[0061] In one embodiment, ph_pic_type_idc equal to 1 indicates each coded picture associated to the PH has only one or more I slices.

Table 16: Examples of Possible pic_type_idc Semantics

ph_pic_type_idc	slice_type that present in a coded picture
0	B, P, I
1	I
2	B, P

[0062] If pps_pic_type_idc equal to 0 (B, P, I slices as in Table 10), the value of ph_pic_type_idc has a range from 0 to 2, inclusive. Otherwise, the value of ph_pic_type_idc can

be inferred from pps_pic_type_idc (e.g., an identical one). In such a case, it is a requirement of bitstream conformance that the values of ph_pic_type_idc be equal to those of pps_pic_type_idc.

[0063] In one example, the signaling of syntax ph_pic_type_idc depends on (e.g., is constrained by) the value of pps_pic_type_idc. When the value of pps_pic_type_idc indicates the presence of both intra slices (I slice) and inter slices (B, P slice) in coded pictures, ph_pic_type_idc may need to be signaled/parsed to indicate slice types present in that picture associated with the picture header. In other cases, when pps_pic_type_idc indicates the presence of only one slice type, ph_pic_type_idc is not signaled/parsed, and it is inferred to be equal to (e.g., have the same) the slice type of pps_pic_type_idc. It is a bitstream conforming requirement that the range of ph_pic_type_idc is no larger than the range of pps_pic_type_idc.

Table 17: Proposed Picture Header RBSP Syntax

Syntax Element	Descriptor
picture_header_rbsp() {	
non_reference_picture_flag	u(1)
gdr_pic_flag	u(1)
no_output_of_prior_pics_flag	u(1)
if(gdr_pic_flag)	
recovery_poc_cnt	ue(v)
ph_pic_parameter_set_id	ue(v)
if(pps_pic_type_idc == 0)	
ph_pic_type_idc	ue(v)
if(sps_poc_msb_flag) {	
ph_poc_msb_present_flag	u(1)
if(ph_poc_msb_present_flag)	
poc_msb_val	u(v)
}	
if(sps_subpic_id_present_flag && !sps_subpic_id_signalling_flag) {	
ph_subpic_id_signalling_present_flag	u(1)
if(ph_subpics_id_signalling_present_flag) {	

ph_subpic_id_len_minus1	ue(v)
for(i = 0; i <= sps_num_subpics_minus1; i++)	
ph_subpic_id[i]	u(v)
}	
}	
if(!sps_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_loop_filter_across_virtual_boundaries_disabled_present_flag	u(1)
if(ph_loop_filter_across_virtual_boundaries_disabled_present_flag) {	
ph_num_ver_virtual_boundaries	u(2)
for(i = 0; i < ph_num_ver_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_x[i]	u(13)
ph_num_hor_virtual_boundaries	u(2)
for(i = 0; i < ph_num_hor_virtual_boundaries; i++)	
ph_virtual_boundaries_pos_y[i]	u(13)
}	
}	
if(separate_colour_plane_flag == 1)	
colour_plane_id	u(2)
if(output_flag_present_flag)	
pic_output_flag	u(1)
pic_rpl_present_flag	u(1)
if(pic_rpl_present_flag) {	
for(i = 0; i < 2; i++) {	
if(num_ref_pic_lists_in_sps[i] > 0 && !pps_ref_pic_list_sps_idc[i] && (i == 0 (i == 1 && rpl1_idx_present_flag)))	
pic_rpl_sps_flag[i]	u(1)
if(pic_rpl_sps_flag[i]) {	
if(num_ref_pic_lists_in_sps[i] > 1 && (i == 0 (i == 1 && rpl1_idx_present_flag)))	
pic_rpl_idx[i]	u(v)
} else	
ref_pic_list_struct(i, num_ref_pic_lists_in_sps[i])	
for(j = 0; j < NumLtrpEntries[i][RplIdx[i]]; j++) {	
if(ltrp_in_slice_header_flag[i][RplIdx[i]])	
pic_poc_lsb_lt[i][j]	u(v)

pic_delta_poc_msb_present_flag[i][j]	u(1)
if(pic_delta_poc_msb_present_flag[i][j])	
pic_delta_poc_msb_cycle_it[i][j]	ue(v)
}	
}	
}	
if(partition_constraints_override_enabled_flag) {	
partition_constraints_override_flag	u(1)
if(partition_constraints_override_flag) {	
<i>if(ph_pic_type_idc != 2) {</i>	
pic_log2_diff_min_qt_min_cb_intra_slice_luma	ue(v)
<i>pic_log2_diff_min_qt_min_cb_inter_slice</i>	ue(v)
<i>pic_max_mtt_hierarchy_depth_inter_slice</i>	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_luma	ue(v)
if(pic_max_mtt_hierarchy_depth_intra_slice_luma != 0) {	
pic_log2_diff_max_bt_min_qt_intra_slice_luma	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_luma	ue(v)
}	
<i>if(pic_max_mtt_hierarchy_depth_inter_slice != 0) {</i>	
<i>pic_log2_diff_max_bt_min_qt_inter_slice</i>	ue(v)
<i>pic_log2_diff_max_tt_min_qt_inter_slice</i>	ue(v)
}	
if(qtbt_dual_tree_intra_flag) {	
pic_log2_diff_min_qt_min_cb_intra_slice_chroma	ue(v)
pic_max_mtt_hierarchy_depth_intra_slice_chroma	ue(v)
if(pic_max_mtt_hierarchy_depth_intra_slice_chroma != 0) {	
pic_log2_diff_max_bt_min_qt_intra_slice_chroma	ue(v)
pic_log2_diff_max_tt_min_qt_intra_slice_chroma	ue(v)
}	
}	
}	
<i>if(ph_pic_type_idc != 1) {</i>	
pic_log2_diff_min_qt_min_cb_inter_slice	
pic_max_mtt_hierarchy_depth_inter_slice	
if(pic_max_mtt_hierarchy_depth_inter_slice != 0) {	

pic_log2_diff_max_bt_min_qt_inter_slice	ue(v)
pic_log2_diff_max_tt_min_qt_inter_slice	ue(v)
}	
}	
}	
}	
if(cu_qp_delta_enabled_flag) {	
if(ph_pic_type_idc != 2)	
pic_cu_qp_delta_subdiv_intra_slice	ue(v)
if(ph_pic_type_idc != 1)	
pic_cu_qp_delta_subdiv_inter_slice	ue(v)
}	
if(pps_cu_chroma_qp_offset_list_enabled_flag) {	
if(ph_pic_type_idc != 2)	
pic_cu_chroma_qp_offset_subdiv_intra_slice	ue(v)
if(ph_pic_type_idc != 1)	
pic_cu_chroma_qp_offset_subdiv_inter_slice	ue(v)
}	
if(ph_pic_type_idc != 1) {	
if(sps_temporal_mvp_enabled_flag)	
pic_temporal_mvp_enabled_flag	u(1)
if(!pps_mvd_l1_zero_idc)	
mvd_l1_zero_flag	u(1)
if(!pps_six_minus_max_num_merge_cand_plus1)	
pic_six_minus_max_num_merge_cand	ue(v)
if(sps_affine_enabled_flag)	
pic_five_minus_max_num_subblock_merge_cand	ue(v)
if(sps_fpel_mmvd_enabled_flag)	
pic_fpel_mmvd_enabled_flag	u(1)
if(sps_bdof_pic_present_flag)	
pic_disable_bdof_flag	u(1)
if(sps_dmv_r_pic_present_flag)	
pic_disable_dmv_r_flag	u(1)
if(sps_prof_pic_present_flag)	
pic_disable_prof_flag	u(1)

if(sps_triangle_enabled_flag && MaxNumMergeCand >= 2 && !pps_max_num_merge_cand_minus_max_num_triangle_cand_plus1)	
pic_max_num_merge_cand_minus_max_num_triangle_cand	ue(v)
}	
if(sps_ibc_enabled_flag)	
pic_six_minus_max_num_ibc_merge_cand	ue(v)
if(sps_joint_cbr_enabled_flag)	
pic_joint_cbr_sign_flag	u(1)
if(sps_sao_enabled_flag) {	
pic_sao_enabled_present_flag	u(1)
if(pic_sao_enabled_present_flag) {	
pic_sao_luma_enabled_flag	u(1)
if(ChromaArrayType != 0)	
pic_sao_chroma_enabled_flag	u(1)
}	
}	
if(sps_alf_enabled_flag) {	
pic_alf_enabled_present_flag	u(1)
if(pic_alf_enabled_present_flag) {	
pic_alf_enabled_flag	u(1)
if(pic_alf_enabled_flag) {	
pic_num_alf_aps_ids_luma	u(3)
for(i = 0; i < pic_num_alf_aps_ids_luma; i++)	
pic_alf_aps_id_luma[i]	u(3)
if(ChromaArrayType != 0)	
pic_alf_chroma_idc	u(2)
if(pic_alf_chroma_idc)	
pic_alf_aps_id_chroma	u(3)
}	
}	
}	
if(!pps_dep_quant_enabled_idc)	
pic_dep_quant_enabled_flag	u(1)
if(!pic_dep_quant_enabled_flag)	
sign_data_hiding_enabled_flag	u(1)
if(deblocking_filter_override_enabled_flag) {	

pic_deblocking_filter_override_present_flag	u(1)
if(pic_deblocking_filter_override_present_flag) {	
pic_deblocking_filter_override_flag	u(1)
if(pic_deblocking_filter_override_flag) {	
pic_deblocking_filter_disabled_flag	u(1)
if(!pic_deblocking_filter_disabled_flag) {	
pic_beta_offset_div2	se(v)
pic_tc_offset_div2	se(v)
}	
}	
}	
}	
if(sps_lmcs_enabled_flag) {	
pic_lmcs_enabled_flag	u(1)
if(pic_lmcs_enabled_flag) {	
pic_lmcs_aps_id	u(2)
if(ChromaArrayType != 0)	
pic_chroma_residual_scale_flag	u(1)
}	
}	
if(sps_scaling_list_enabled_flag) {	
pic_scaling_list_present_flag	u(1)
if(pic_scaling_list_present_flag)	
pic_scaling_list_aps_id	u(3)
}	
if(picture_header_extension_present_flag) {	
ph_extension_length	ue(v)
for(i = 0; i < ph_extension_length; i++)	
ph_extension_data_byte[i]	u(8)
}	
rbsp_trailing_bits()	
}	

[0064] Here, *ph_pic_type_idc* specifies the slice types for all slices of each coded picture associated to the PH. Also, *ph_pic_type_idc* may only be present in the bitstream when *pps_pic_type_idc* is equal to 0.

[0065] Further, *ph_pic_type_idc* equal to 1 indicates each coded picture associated to the PH has only one or more I slices. If *pps_pic_type_idc* equal to 0 (B, P, I slices as in Table 8), the value of *ph_pic_type_idc* has a range from 0 to 2, inclusive. Otherwise, when *ph_pic_type_idc* is not present, it is inferred to be equal to *pps_ph_type_idc* as in Table 8.

[0066] In one embodiment, PH related syntax elements are included in the slice layer RBSP NAL unit, and *ph_present_flag* is used to indicate the presence of PH related syntax in the slice layer RBSP NAL unit. Repetition of PH related syntax signaling may have an advantage of error resilience and error recovery. When the PH NAL unit is corrupted during transmission in any kind of network, slice layer RBSP NAL units are able to recover from the error with presence of PH in slice layer RBSP NAL units. Changes compared to VVC Draft 7 are italicizes.

Table 18: Proposed Slice Layer RBSP Syntax

Syntax Element	Descriptor
<i>slice_layer_rbsp() {</i>	
<i> ph_present_flag</i>	<i>u(1)</i>
<i> if (ph_present_flag)</i>	
<i> picture_header_rbsp()</i>	
<i> slice_header()</i>	
<i> slice_data()</i>	
<i> rbsp_slice_trailing_bits()</i>	
<i>}</i>	

[0067] Here, *ph_present_flag* may be used to specify the presence of PH related syntax in the slice layer RBSP. When *ph_present_flag* equal to 1, PH related syntax is present. When *ph_present_flag* equal to 0, PH related syntax is not present in slice layer RBSP.

[0068] In one embodiment, when `pic_type` decoded in the AU delimiter as described above presents, `pic_type_idc`, signalling in HLS may be inferred from or constrained by the `pic_type` value.

[0069] In one example, when the `pic_type` is equal to 0 as in Table 5, indicating I slice, it is a requirement of bitstream conformance that the values of `pic_type_idc` specify that there are only intra slices in each picture. For instance, when `pic_type_idc` is conformed to be 1, there are intra slices only.

[0070] In one example, when `pic_type_idc` is constrained by the `pic_type` value, the range of `pic_type_idc` value may depend on the value of `pic_type`. For instance, `pic_type_idc` has values as described in Table 10, and if `pic_type` is equal to 1, the value of `pic_type_idc` may have 1 or 3. In other cases, when the `pic_type` is equal to 2, the value of `pic_type_idc` ranges from 0 to 3.

[0071] In one embodiment, when `pic_type_idc`, signaled in HLS, as per the abovementioned method(s), `slice_type` may be inferred.

[0072] In one example, when `pic_type_idc` has value indicating that there are only intra slices, `slice_type` may be inferred to be 2.

[0073] In one example, when `pic_type_idc` has a value indicating that there are only inter slices, the value of `slice_type` has a range from 0 to 1, inclusive. For instance, when `pic_type_idc` has a value of 2 (B, P slice), then possible values for `slice_type` are 0 and 1.

[0074] In one embodiment, the value of `slice_type` may be inferred from the value `pic_type_idc` and `num_slices_in_pic_minus1`.

[0075] It is a requirement of bitstream conformance that the values of `num_slices_in_pic_minus1` is greater than or equal to 1, when the value of `pic_type_idc` indicates that there are both intra slices and inter slices.

[0076] There may be cases when the value of `pic_type_idc` indicates there are both intra slices and inter slices exist in a coded picture, and the value of `num_slices_in_pic_minus1` is greater than or equal to 1.

[0077] When all the previously coded slices are inter slices, then the last slice may be an intra slice with `slice_type` equal to 2 (I slice).

[0078] When all the previously coded slices are intra slices, then the last slice may be an inter slice with `slice_type` value ranging from 0 to 1, inclusive.

[0079] The above proposed methods may be implemented by processing circuitry (e.g., one or more processors or one or more integrated circuits). In one example, the one or more processors execute a program that is stored in a non-transitory computer-readable medium to perform one or more of the proposed methods.

[0080] The techniques described above can be implemented as computer software using computer-readable instructions and physically stored in one or more computer-readable media. For example, FIG. 3 shows a computer system 300 suitable for implementing certain embodiments of the disclosed subject matter.

[0081] The computer software can be coded using any suitable machine code or computer language, that may be subject to assembly, compilation, linking, or like mechanisms to create code comprising instructions that can be executed directly, or through interpretation,

micro-code execution, and the like, by computer central processing units (CPUs), Graphics Processing Units (GPUs), and the like.

[0082] The instructions can be executed on various types of computers or components thereof, including, for example, personal computers, tablet computers, servers, smartphones, gaming devices, internet of things devices, and the like.

[0083] The components shown in FIG. 3 for computer system 300 are exemplary in nature and are not intended to suggest any limitation as to the scope of use or functionality of the computer software implementing embodiments of the present disclosure. Neither should the configuration of components be interpreted as having any dependency or requirement relating to any one or combination of components illustrated in the exemplary embodiment of a computer system 300.

[0084] Computer system 300 may include certain human interface input devices. Such a human interface input device may be responsive to input by one or more human users through, for example, tactile input (such as: keystrokes, swipes, data glove movements), audio input (such as: voice, clapping), visual input (such as: gestures), olfactory input (not depicted). The human interface devices can also be used to capture certain media not necessarily directly related to conscious input by a human, such as audio (such as: speech, music, ambient sound), images (such as: scanned images, photographic images obtain from a still image camera), video (such as two-dimensional video, three-dimensional video including stereoscopic video).

[0085] Input human interface devices may include one or more of (only one of each depicted): keyboard 301, mouse 302, trackpad 303, touch screen 310 and associated graphics adapter 350, data-glove, joystick 305, microphone 306, scanner 307, camera 308.

[0086] Computer system 300 may also include certain human interface output devices. Such human interface output devices may be stimulating the senses of one or more human users through, for example, tactile output, sound, light, and smell/taste. Such human interface output devices may include tactile output devices (for example tactile feedback by the touch-screen 310, data-glove, or joystick 305, but there can also be tactile feedback devices that do not serve as input devices), audio output devices (such as: speakers 309, headphones (not depicted)), visual output devices (such as screens 310 to include cathode ray tube (CRT) screens, liquid-crystal display (LCD) screens, plasma screens, organic light-emitting diode (OLED) screens, each with or without touch-screen input capability, each with or without tactile feedback capability—some of which may be capable to output two dimensional visual output or more than three dimensional output through means such as stereographic output; virtual-reality glasses (not depicted), holographic displays and smoke tanks (not depicted)), and printers (not depicted).

[0087] Computer system 300 can also include human accessible storage devices and their associated media such as optical media including CD/DVD ROM/RW 920 with CD/DVD or the like media 321, thumb-drive 322, removable hard drive or solid state drive 323, legacy magnetic media such as tape and floppy disc (not depicted), specialized ROM/ASIC/PLD based devices such as security dongles (not depicted), and the like.

[0088] Those skilled in the art should also understand that term “computer readable media” as used in connection with the presently disclosed subject matter does not encompass transmission media, carrier waves, or other transitory signals.

[0089] Computer system 300 can also include interface(s) to one or more communication networks (355). Networks can for example be wireless, wireline, optical. Networks can further

be local, wide-area, metropolitan, vehicular and industrial, real-time, delay-tolerant, and so on. Examples of networks include local area networks such as Ethernet, wireless LANs, cellular networks to include global systems for mobile communications (GSM), third generation (3G), fourth generation (4G), fifth generation (5G), Long-Term Evolution (LTE), and the like, TV wireline or wireless wide area digital networks to include cable TV, satellite TV, and terrestrial broadcast TV, vehicular and industrial to include CANBus, and so forth. Certain networks commonly require external network interface adapters (354) that attached to certain general purpose data ports or peripheral buses (349) (such as, for example universal serial bus (USB) ports of the computer system 300; others are commonly integrated into the core of the computer system 300 by attachment to a system bus as described below (for example Ethernet interface into a PC computer system or cellular network interface into a smartphone computer system). As an example, network 355 may be connected to peripheral bus 349 using network interface 354. Using any of these networks, computer system 300 can communicate with other entities. Such communication can be uni-directional, receive only (for example, broadcast TV), uni-directional send-only (for example CANbus to certain CANbus devices), or bi-directional, for example to other computer systems using local or wide area digital networks. Certain protocols and protocol stacks can be used on each of those networks and network interfaces (354) as described above.

[0090] Aforementioned human interface devices, human-accessible storage devices, and network interfaces can be attached to a core 340 of the computer system 300.

[0091] The core 340 can include one or more Central Processing Units (CPU) 341, Graphics Processing Units (GPU) 342, specialized programmable processing units in the form of

Field Programmable Gate Areas (FPGA) 343, hardware accelerators 344 for certain tasks, and so forth. These devices, along with Read-only memory (ROM) 345, Random-access memory (RAM) 346, internal mass storage such as internal non-user accessible hard drives, solid-state drives (SSDs), and the like 347, may be connected through a system bus 348. In some computer systems, the system bus 348 can be accessible in the form of one or more physical plugs to enable extensions by additional CPUs, GPU, and the like. The peripheral devices can be attached either directly to the core's system bus 348, or through a peripheral bus 349. Architectures for a peripheral bus include peripheral component interconnect (PCI), USB, and the like.

[0092] CPUs 341, GPUs 342, FPGAs 343, and accelerators 344 can execute certain instructions that, in combination, can make up the aforementioned computer code. That computer code can be stored in ROM 345 or RAM 346. Transitional data can be also be stored in RAM 346, whereas permanent data can be stored for example, in the internal mass storage 347. Fast storage and retrieve to any of the memory devices can be enabled through the use of cache memory, that can be closely associated with one or more CPU 341, GPU 342, mass storage 347, ROM 345, RAM 346, and the like.

[0093] The computer readable media can have computer code thereon for performing various computer-implemented operations. The media and computer code can be those specially designed and constructed for the purposes of the present disclosure, or they can be of the kind well known and available to those having skill in the computer software arts.

[0094] As an example and not by way of limitation, the computer system having architecture 300, and specifically the core 340 can provide functionality as a result of processor(s) (including CPUs, GPUs, FPGA, accelerators, and the like) executing software

embodied in one or more tangible, computer-readable media. Such computer-readable media can be media associated with user-accessible mass storage as introduced above, as well as certain storage of the core 340 that are of non-transitory nature, such as core-internal mass storage 347 or ROM 345. The software implementing various embodiments of the present disclosure can be stored in such devices and executed by core 340. A computer-readable medium can include one or more memory devices or chips, according to particular needs. The software can cause the core 340 and specifically the processors therein (including CPU, GPU, FPGA, and the like) to execute particular processes or particular parts of particular processes described herein, including defining data structures stored in RAM 346 and modifying such data structures according to the processes defined by the software. In addition or as an alternative, the computer system can provide functionality as a result of logic hardwired or otherwise embodied in a circuit (for example: accelerator 344), which can operate in place of or together with software to execute particular processes or particular parts of particular processes described herein. Reference to software can encompass logic, and vice versa, where appropriate. Reference to a computer-readable media can encompass a circuit (such as an integrated circuit (IC)) storing software for execution, a circuit embodying logic for execution, or both, where appropriate. The present disclosure encompasses any suitable combination of hardware and software.

[0095] While this disclosure has described several exemplary embodiments, there are alterations, permutations, and various substitute equivalents, which fall within the scope of the disclosure. It will thus be appreciated that those skilled in the art will be able to devise numerous systems and methods which, although not explicitly shown or described herein, embody the principles of the disclosure and are thus within the spirit and scope thereof.

[0096] Non-Patent Literature:

[1] IDF_10092019_high level syntax control for video coding_v2

[0097] List of Acronyms:

HLS: High level syntax
HEVC: High Efficiency Video Coding
VVC: Versatile Video Coding
CTU: Coding Tree Unit
SPS: Sequence Parameter Set
PPS: Picture Parameter Set
APS: Adaptive Parameter Set
PH: Picture Header
SH: Slice Header
SAO: Sample Adaptive Offset2
AU: Access Unit
NAL: Network Abstraction Layer
RBSP: Raw Byte Sequence Payload

WHAT IS CLAIMED IS:

1. A method of encoding or decoding video data, the method being performed by at least one processor and comprising:
 - indicating, with a syntax element, types of slices for all slices of a coded picture, the syntax element being coded using an unsigned integer, and
 - encoding or decoding the video data based on the types of slices indicated via the syntax element.
2. The method of claim 1, wherein for the coded picture, only related syntax elements are coded.
3. The method of claim 2, wherein when all slices of the coded picture are indicated as including intra-prediction, no inter-prediction syntax elements are coded.
4. The method of claim 1, wherein picture header related syntax elements are included in a slice layer raw byte sequence payload network abstraction layer unit, and a flag is used to indicate the presence of the picture header related syntax elements in the slice layer raw byte sequence payload network abstraction layer unit.
5. The method of claim 1, wherein the types of the slices may be inferred from a decoded access unit delimiter value.

6. The method of claim 1, wherein the types of the slices may be inferred when signaled in high level syntax.

7. The method of claim 1, wherein the types of the slices may be inferred based on a number of rectangular slices in the coded picture.

8. The method of claim 1, wherein the syntax element is a 0-th order Exp-Golomb-coded syntax element.

9. The method of claim 1, wherein the syntax element is a 2 bit syntax element configurable with three statuses.

10. The method of claim 1, wherein the syntax element is a 2 bit syntax element configurable with four statuses.

11. An apparatus for coding or encoding video data, the apparatus comprising:
at least one memory configured to store computer program code; and
at least one processor configured to access the at least one memory and operate according to the computer program code, the computer program code comprising:
indicating code configured to cause the at least one processor to indicate, via a syntax element, types of slices for all slices of a coded picture, the syntax element being coded using an unsigned integer, and

encoding or decoding code configured to encode or decode the video data based on the types of slices indicated via the syntax element.

12. The apparatus of claim 11, wherein the indicating code is configured to indicate the types of slices such that, for the coded picture, only related syntax elements are coded.

13. The apparatus of claim 12, wherein the indicating code is configured to indicate the types of slices such that when all slices of the coded picture are indicated as including intra-prediction, no inter-prediction syntax elements are coded.

14. The apparatus of claim 11, wherein the indicating code is configured to indicate the types of slices such that picture header related syntax elements are included in a slice layer raw byte sequence payload network abstraction layer unit, and a flag is used to indicate the presence of the picture header related syntax elements in the slice layer raw byte sequence payload network abstraction layer unit.

15. The apparatus of claim 11, wherein the indicating code is configured to indicate the types of slices such that the types of the slices may be inferred from a decoded access unit delimiter value.

16. The apparatus of claim 11, wherein the indicating code is configured to indicate the types of slices such that the types of the slices may be inferred when signaled in high level syntax.

17. The apparatus of claim 11, wherein the indicating code is configured to indicate the types of slices such that the types of the slices may be inferred based on a number of rectangular slices in the coded picture.

18. The apparatus of claim 11, wherein the indicating code is configured such that the syntax element is a 0-th order Exp-Golomb-coded syntax element.

19. The apparatus of claim 11, wherein the indicating code is configured such that the syntax element is a 2 bit syntax element configurable with three statuses.

20. A non-transitory computer-readable storage medium storing instructions that cause at least one processor to:

indicate, with a syntax element, types of slices for all slices of a coded picture, the syntax element being coded using an unsigned integer, and

encode or decode the video data based on the types of slices indicated via the syntax element.

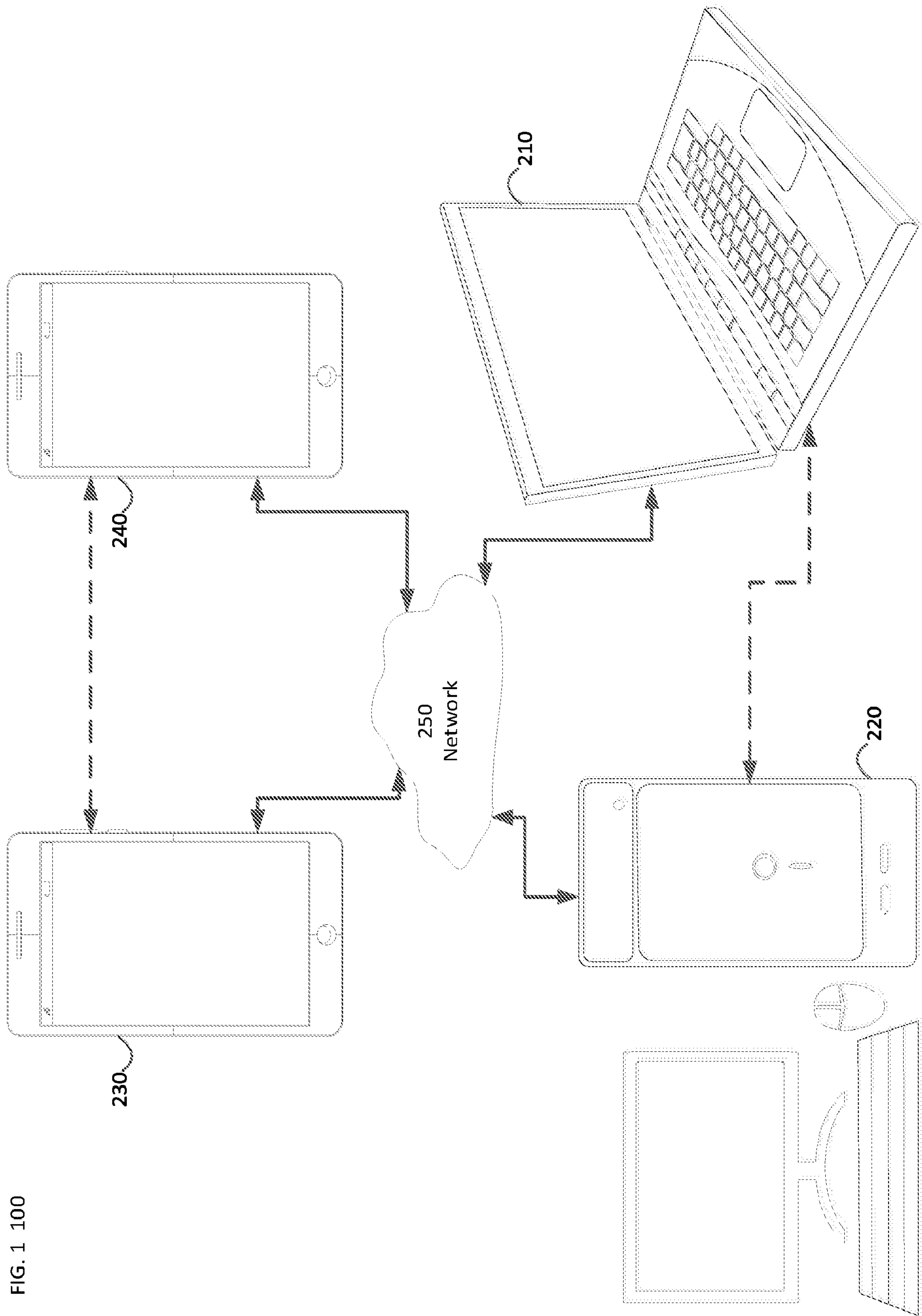
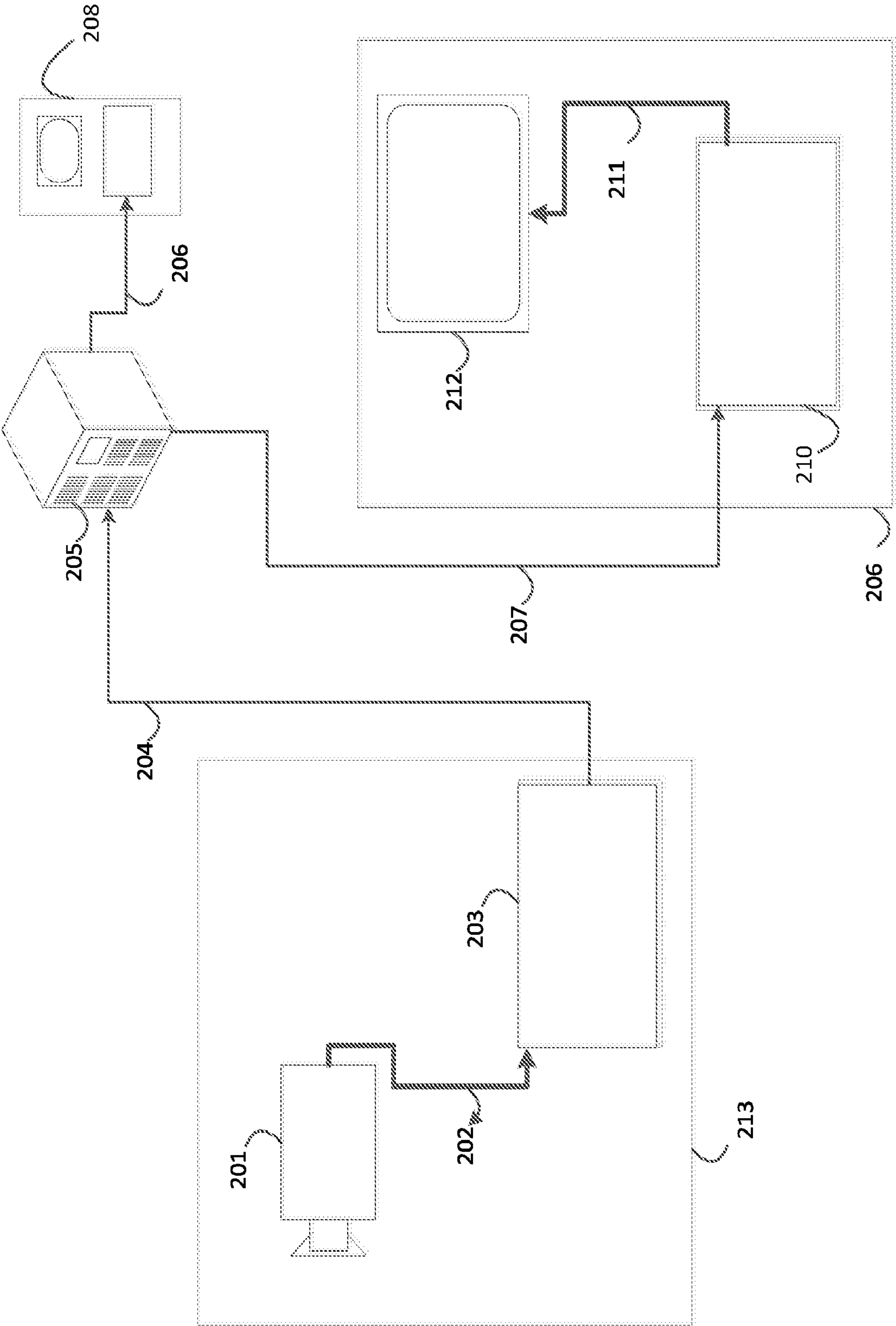
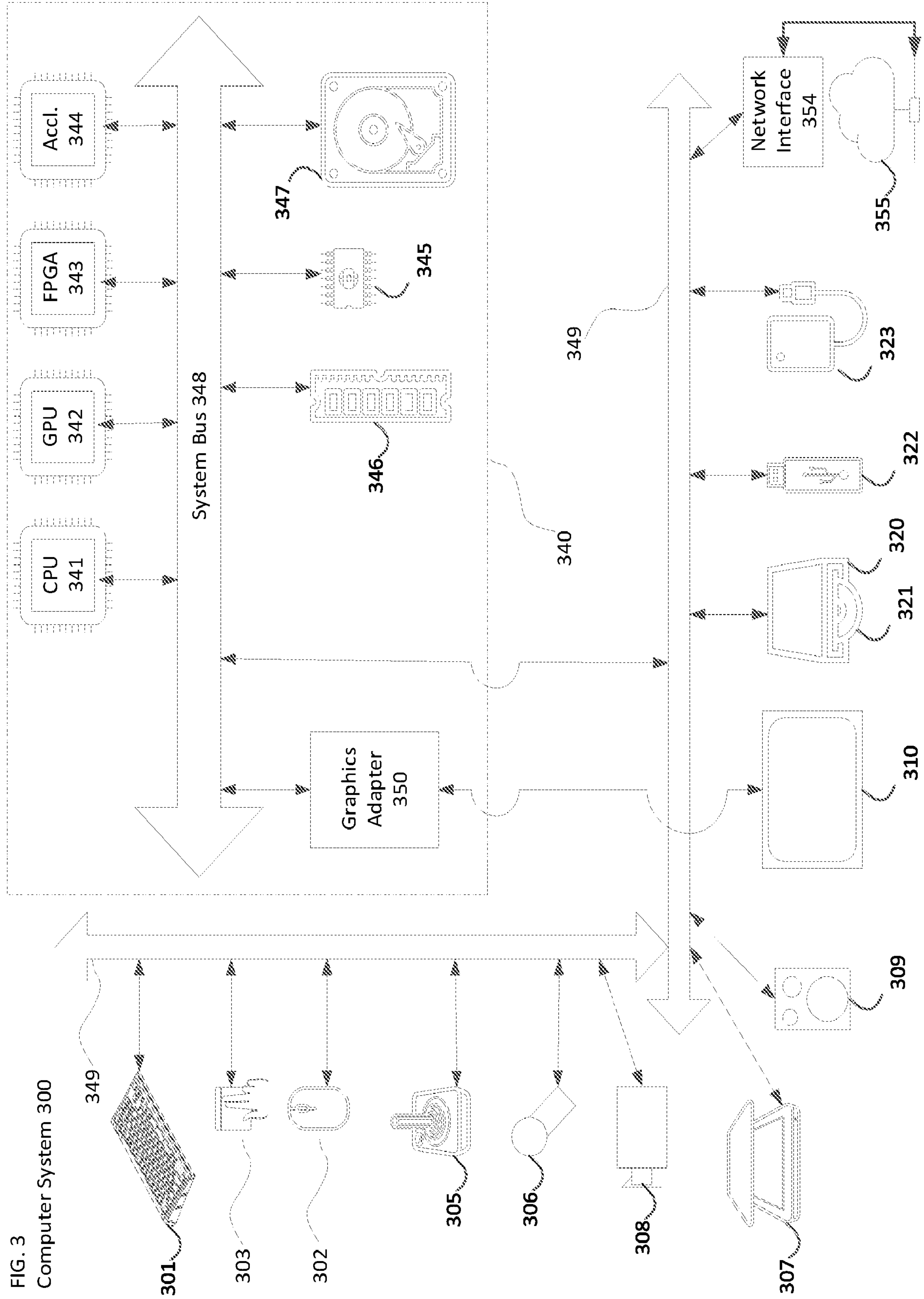


FIG. 1 100

FIG. 2





INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 20/65899

A. CLASSIFICATION OF SUBJECT MATTER

IPC - H04N 13/00 (2021.01)

CPC - H04N 19/597, H04N 19/70, H04N 19/58, H04N 13/161, H04N 13/111, H04N 19/573

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 2014/0198181 A1 (QUALCOMM Incorporated) 07 July 2014 (17.07.2014) entire document (especially para [0071]-[0073], [0152], [0171], [0181], [0215]-[0217], [0251]-[0252]).	1-4, 6-8, 11-14, 16-18, 20 5, 9-10, 15, 19
Y	US 2014/0036999 A1 (VID SCALE INC.) 06 February 2014 (06.02.2014) entire document (especially para [0141]-[0143], Table 9)	5, 15
Y	US 2012/0189053 A1 (Chen et al.) 26 July 2012 (26.07.2012) entire document (especially para [0021]-[0023], para [0038]-[0044])	9, 10, 19

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

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Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Lee Young

Telephone No. PCT Helpdesk: 571-272-4300