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JCTVC-M0140:
AHG9: Inter-layer RPS Prediction

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Agenda

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Introduction / Problem Statement

- Inter-layer RPS prediction has been proposed by JCTVC-L0231.
- However it contains the following problems:
  - Only in slice header
    - **In Version 1 RPS is transmitted both in SPS & slice header**
  - One flag for both Short-Term and Long-Term Ref Frames
    - **In Ref_idx Framework base layer images are marked as long term ref.**
  - used_by_curr_pic_flag should not be predicted
    - **Enhancement layer may have less numbers of DPBs although GOP structure is same as Base layer**
      - **since resolution of enhancement layer pictures may be 2 times or 1.5 times bigger than base layer.**
  - In AVC-baselayer case prediction is not possible

Proposal 1 [1/]

- The following changes in syntax are proposed to support inter layer RPS prediction in both SPS and slice header.

seq_parameter_set_rbsp ( ) {	Descriptor
…	
inter_layer_copy_flag	u (1)
if (!inter_layer_copy_flag) {	
num_short_term_ref_pic_sets	ue (v)
for (i = 0; i < num_short_term_ref_pic_sets; i++)	
short_term_ref_pic_set (i)	
long_term_ref_pics_present_flag	u (1)
if (long_term_ref_pics_present_flag) {	
num_long_term_ref_pics_sps	ue (v)
for (i = 0; i < num_long_term_ref_pics_sps; i++) {	
lt_ref_pic_poc_lsb_sps [i]	u (v)
used_by_curr_pic_lt_sps_flag [i]	u (1)
}	
}	
}	
…	

slice_header ( ) {	Descriptor
……	
pic_order_cnt_lsb	u (v)
inter_layer_copy_flag	u (1)
if (! inter_layer_copy_flag) {	
short_term_ref_pic_set_sps_flag	u (1)
if (!short_term_ref_pic_set_sps_flag)	
short_term_ref_pic_set (num_short_term_ref_pic_sets)	
else	
short_term_ref_pic_set_idx	u (v)
if (long_term_ref_pics_present_flag) {	
……	
}	
}	

Proposal 1 [2/]

- **Semantics**
  - **inter_layer_copy_flag** equals to 1 indicates that in current layer both short term and long term rps information are inherited directly from its referred layer. 0 indicates that both short term and long term rps information are transmitted exclusively for current layer. When not specified or the reference layer is the base layer and avc_base_layer_flag in vps_extension() is 1, its value shall be 0.

Proposal 2 [1/]

- The following syntax is proposed to support more flexible short-term RPS prediction between layers.
- Inside RPS, the **used_by_curr_pic_flag** will be transmitted exclusively to allow enhancement layer and referenced base layer to have same GOP structure while different DPB size.

seq_parameter_set_rbsp ( ) {	Descriptor
…	
inter_layer_prediction_flag	u (1)
num_short_term_ref_pic_sets	ue (v)
for (i = 0; i < num_short_term_ref_pic_sets; i++)	
short_term_ref_pic_set (i, inter_layer_prediction_flag)	
long_term_ref_pics_present_flag	u (1)
if (long_term_ref_pics_present_flag) {	
num_long_term_ref_pics_sps	ue (v)
for (i = 0; i < num_long_term_ref_pics_sps; i++) {	
lt_ref_pic_poc_lsb_sps [i]	u (v)
used_by_curr_pic_lt_sps_flag [i]	u (1)
}	
}	
…	

slice_header ( ) {	Descriptor
......	
pic_order_cnt_lsb	u (v)
inter_layer_prediction_flag	u (1)
short_term_ref_pic_set_sps_flag	u (1)
if (!short_term_ref_pic_set_sps_flag)	
short_term_ref_pic_set (num_short_term_ref_pic_sets, inter_layer_prediction_flag)	
else	
short_term_ref_pic_set_idx	u (v)
if (long_term_ref_pics_present_flag) {	
......	

	Descriptor
short_term_ref_pic_set (stRpsIdx, inter_layer_prediction) {	
if (stRpsIdx != 0)	
inter_ref_pic_set_prediction_flag	u (1)
if (inter_ref_pic_set_prediction_flag) {	
if (!inter_layer_rps_predition) {	
if (stRpsIdx = = num_short_term_ref_pic_sets)	
delta_idx_minus1	ue (v)
delta_rps_sign	u (1)
abs_delta_rps_minus1	ue (v)
}	
for (j = 0; j <= NumDcs [RefRpsIdx] ; j++) {	
used_by_curr_pic_flag [j]	u (1)
if (!used_by_curr_pic_flag [j])	
use_delta_flag [j]	u (1)
} else {	
num_negative_pics	ue (v)
num_positive_pics	ue (v)
for (i = 0; i < num_negative_pics; i++) {	
delta_poc_s0_minus1 [i]	ue (v)
used_by_curr_pic_s0_flag [i]	u (1)
}	
for (i = 0; i < num_positive_pics; i++) {	
delta_poc_s1_minus1 [i]	ue (v)
used_by_curr_pic_s1_flag [i]	u (1)
}	
}	
}	

Proposal 2 [2/]

- Semantics
  - **inter_layer_prediction_flag** equals to 1 indicates that when short term rps prediction is enabled in current layer , RPS parameters delta_rps_sign, delta_rps_sign and abs_delta_rps_minus1 are inherited directly from the reference layer. When not specified or the reference layer is the base layer and avc_base_layer_flag in vps_extension() is 1, its value shall be 0.

Proposal 3 [1/]

- The following syntax is proposed to enable same functionality as Proposal 2 but allow changing the flag by each of the reference picture.

short_term_ref_pic_set (stRpsIdx) {	Descriptor
if (stRpsIdx != 0)	
inter_ref_pic_set_prediction_flag	u (1)
if (inter_ref_pic_set_prediction_flag) {	
inter_layer_rps_predition_flag	u (1)
if (!inter_layer_rps_predition_flag) {	
if (stRpsIdx = = num_short_term_ref_pic_sets)	
delta_idx_minus1	ue (v)
delta_rps_sign	u (1)
abs_delta_rps_minus1	ue (v)
}	
for (j = 0; j <= NumDcs [RefRpsIdx] ; j++) {	
used_by_curr_pic_flag [j]	u (1)
if (!used_by_curr_pic_flag [j])	
use_delta_flag [j]	u (1)
} else {	
num_negative_pics	ue (v)
num_positive_pics	ue (v)
for (i = 0; i < num_negative_pics; i++) {	
delta_poc_s0_minus1 [i]	ue (v)
used_by_curr_pic_s0_flag [i]	u (1)
}	
for (i = 0; i < num_positive_pics; i++) {	
delta_poc_s1_minus1 [i]	ue (v)
used_by_curr_pic_s1_flag [i]	u (1)
}	
}	
}	

Proposal 3 [2/]

- Semantics
  - **inter_layer_prediction_flag** equals to 1 indicates that when short term rps prediction is enabled in current layer, parameters delta_rps_sign, delta_rps_sign and abs_delta_rps_minus1 inherited directly from its referred layer. When not specified or the reference layer is the base layer and avc_base_layer_flag in vps_extension() is 1, its value shall be 0.

Proposal 4.1 [1/]

- The following syntax are proposed to enable inter layer prediction for short-term and long-term RPS separately both in SPS and slice header.

seq_parameter_set_rbsp ( ) {	Descriptor
…	
inter_layer_short_copy_flag	u (1)
if (!inter_layer_short_copy_flag) {	
num_short_term_ref_pic_sets	ue (v)
for (i = 0; i < num_short_term_ref_pic_sets; i++)	
short_term_ref_pic_set (i)	
}	
long_term_ref_pics_present_flag	u (1)
inter_layer_long_copy_flag	u (1)
if (!inter_layer_long_copy_flag) {	
if (long_term_ref_pics_present_flag) {	
num_long_term_ref_pics_sps	ue (v)
for (i = 0; i < num_long_term_ref_pics_sps; i++) {	
lt_ref_pic_poc_lsb_sps [i]	u (v)
used_by_curr_pic_lt_sps_flag [i]	u (1)
}	
}	
}	
…	

slice_header ( ) {	Descriptor
……	
pic_order_cnt_lsb	u (v)
inter_layer_short_copy_flag	u (1)
if (!inter_layer_short_copy_flag) {	
short_term_ref_pic_set_sps_flag	u (1)
if (!short_term_ref_pic_set_sps_flag)	
short_term_ref_pic_set (num_short_term_ref_pic_sets)	
else	
short_term_ref_pic_set_idx	u (v)
}	
if (long_term_ref_pics_present_flag) {	
inter_layer_long_copy_flag	
if (!inter_layer_long_copy_flag) {	
……	
}	
}	

Proposal 4.1 [2/]

- Semantics
  - **inter_layer_short_copy_flag** equals to 1 indicates that in current layer short term RPS information are inherited directly from the reference layer. 0 indicates that in current layer short term RPS information are transmitted. When not specified or the reference layer is the base layer and avc_base_layer_flag in vps_extension() is 1, its value shall be 0.
  - **inter_layer_long_copy_flag** equals to 1 indicates that in current layer long term RPS information are inherited directly from the reference layer. 0 indicates that in current layer long term RPS information are transmitted. When not specified or the reference layer is the base layer and avc_base_layer_flag in vps_extension() is 1, its value should be 0. When current scalable framework is refIdex-based, the value shall be 0.

Proposal 4.2 [1/]

- The long term RPS prediction should be avoided when refIdx framework is applied.
- "rfpidx_scalaility" represents syntax element [to be defined somewhere like vps_extension] that indicates current framework is refidx-based.

seq_parameter_set_rbsp ( ) {	Descriptor
…	
inter_layer_copy_flag	u (1)
if (!inter_layer_copy_flag) {	
num_short_term_ref_pic_sets	ue (v)
for (I = 0; i < num_short_term_ref_pic_sets; i++)	
short_term_ref_pic_set (i)	
}	
if (!inter_layer_copy_flag ‖ rpfidx_scalability) {	
long_term_ref_pics_present_flag	u (1)
if (long_term_ref_pics_present_flag) {	
num_long_term_ref_pics_sps	ue (v)
for (i = 0; i < num_long_term_ref_pics_sps; i++) {	
lt_ref_pic_poc_lsb_sps [i]	u (v)
used_by_curr_pic_lt_sps_flag [i]	u (1)
}	
}	
}	
…	

slice_header ( ) {	Descriptor
......	
pic_order_cnt_lsb	u (v)
inter_layer_copy_flag	u (1)
if (! inter_layer_copy_flag) {	
short_term_ref_pic_set_sps_flag	u (1)
if (!short_term_ref_pic_set_sps_flag)	
short_term_ref_pic_set (num_short_term_ref_pic_sets)	
else	
short_term_ref_pic_set_idx	u (v)
}	
if (! inter_layer_copy_flag || rpfidx_scalability) {	
if (long_term_ref_pics_present_flag) {	
......	
}	
}	

Proposal 4.2 [2/]

- Semantics
  - **inter_layer_copy_flag** equals to 1 indicates that in current layer both short term and long term RPS information are inherited directly from the reference layer. 0 indicates that both short term and long term RPS information are transmitted explicitly for the current layer. When not specified or the reference layer is the base layer and avc_base_layer_flag in vps_extension() is 1, its value shall be 0.

Conclusion

- In this contribution it is claimed to fix the problem with inter-layer RPS prediction as proposed by JCTVC-L0231:
  - Only in slice header
    - **In Version 1 RPS is transmitted both in SPS & slice header**
  - One flag for both Short-Term and Long-Term Ref Frames
    - **In Ref_idx Framework base layer images are marked as long term ref.**
  - used_by_curr_pic_flag should not be predicted
    - **Enhancement layer may have less numbers of DPBs although GOP structure is same as Base layer**
      - **since resolution of enhancement layer pictures may be 2 times or 1.5 times bigger than base layer.**
  - In AVC-baselayer case prediction is not possible
- It is recommended that the proposed changes in syntax be adopted in SHVC WD.

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