

# HEVC v1 scalability hook: long-term pictures with layer\_id values

**JCTVC-L0170**

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# Proposal Overview

- Design goals
  1. Long-term reference picture with `nuh_layer_id` A may be used as reference for pictures with `nuh_layer_id` B, where  $B \geq A$
  2. 0 to N pictures (with different values of `nuh_layer_id`) from the same access unit can be marked as “used for long-term reference”
- Proposed consequences
  - `nuh_layer_id` value indicated for long-term reference pictures in RPS
    - Enables to keep long-term reference pictures from a different layers (than that of the current picture) marked as “used for long-term reference” – otherwise, they would be marked as “unused for reference”.
  - Applies also to RPS applied for the base layer, as the RPS of a base-layer picture has to include those long-term pictures (originating from any layer) that are kept marked as “used for long-term reference”.

# Proposal: Sequence Parameter Set

seq_parameter_set_rbsp( ) {	<b>Descriptor</b>
...	
<b>long_term_ref_pics_present_flag</b>	u(1)
if( long_term_ref_pics_present_flag ) {	
<b>nonbase_layer_long_term_ref_pics_present_flag</b>	u(1)
<b>num_long_term_ref_pics_sps</b>	ue(v)
for( i = 0; i < num_long_term_ref_pics_sps; i++ ) {	
<b>lt_ref_pic_poc_lsb_sps[ i ]</b>	u(v)
<b>used_by_curr_pic_lt_sps_flag[ i ]</b>	u(1)
<b>if( nonbase_layer_long_term_ref_pics_present_flag )</b>	
<b>lt_ref_reserved_zero_6bits_sps[ i ]</b>	u(6)
}	
}	
<b>sps_temporal_mvp_enable_flag</b>	u(1)

# Proposal: Slice Segment Header

slice_segment_header( ) {	Descriptor
...	
<b>num_long_term_pics</b>	ue(v)
for( i = 0; i < num_long_term_sps + num_long_term_pics; i++ ) {	
if( i < num_long_term_sps )	
<b>lt_idx_sps[ i ]</b>	u(v)
else {	
<b>poc_lsb_lt[ i ]</b>	u(v)
<b>used_by_curr_pic_lt_flag[ i ]</b>	u(1)
if( nonbase_layer_long_term_ref_pics_present_flag )	
<b>reserved_zero_6bits_lt[ i ]</b>	u(6)
}	
<b>delta_poc_msb_present_flag[ i ]</b>	u(1)
if( delta_poc_msb_present_flag[ i ] )	
<b>delta_poc_msb_cycle_lt[ i ]</b>	ue(v)
}	
...	

# Overview of changes in RPS decoding

- Two lists of `nuh_reserved_6bits` values are additionally constructed to derive the reference picture set; `LayerIdLtCurr` and `LayerIdLtFoll` with `NumPocLtCurr` and `NumPocLtFoll` number of elements, respectively.
- When `nonbase_layer_long_term_ref_pics_present_flag` is equal to 1, long-term reference pictures are additionally identified by their `nuh_reserved_zero_6bits` values.
  - It is allowed to have two pictures with the same POC values in RPS as long as they have different `nuh_reserved_zero_6bits` values
- Detailed text in the contribution

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# Appendix: Simulation Results

- If the encoder were mandated to maintain long-term pictures for all layers of an access unit, fewer short-term reference frames can be kept in the DPB and the impact on RD performance can be drastic.
- Example 1: EL short-term reference pictures is reduced by 2 in the TE software and using the common RA test conditions

	RA HEVC 2x			RA HEVC 1.5x			RA HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	10.7%	9.9%	10.1%				10.4%	10.8%	11.1%
Class B	16.6%	12.5%	12.2%	12.4%	8.2%	8.2%	17.5%	15.0%	14.7%
<b>Overall (EL+BL)</b>	14.9%	11.8%	11.6%	12.4%	8.2%	8.2%	15.5%	13.8%	13.7%
<b>Overall (EL)</b>	25.0%	20.3%	19.9%	28.0%	19.0%	18.7%	28.4%	24.3%	23.7%

- Example 2: the number of EL short-term reference pictures is reduced from two to one in the low-delay common conditions

	LD-P HEVC 2x			LD-P HEVC 1.5x			LD-P HEVC SNR		
	Y	U	V	Y	U	V	Y	U	V
Class A	5,7%	7,0%	7,7%				5,5%	6,6%	7,2%
Class B	9,8%	13,6%	16,2%	8,9%	12,0%	14,7%	7,7%	13,0%	15,0%
<b>Overall (EL+BL)</b>	8,6%	11,7%	13,8%	8,9%	12,0%	14,7%	7,1%	11,2%	12,8%
<b>Overall (EL)</b>	12,9%	17,3%	20,3%	16,9%	22,5%	27,1%	11,0%	16,8%	19,1%