

JCTVC-W0038

HEVC Encoder Optimization

Yuwen He

Yan Ye

Louis Kerofsky



Overview

- **Encoder Optimization**
 - Deblocking filter parameter selection
 - Chroma quantization parameter adjustment
- **Simulation results**
- **Conclusions**

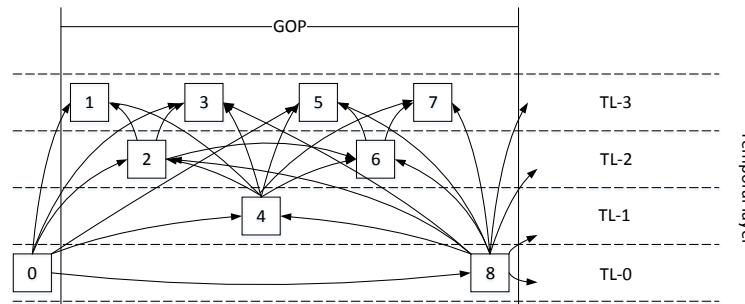
Deblocking filter parameter selection

- The deblocking filter parameters, beta offset “slice_beta_offset_div2” and tc offset “slice_tc_offset_div2”, are signaled in the slice header
- The beta offset and tc offset are selected to minimize the distortion between deblocked picture and original picture:

$$(BO, TO)_{\text{Opt}} = \arg_{(BO, TO)} \min \text{Distortion}(DB(rec, BO, TO), org_{YCbCr})$$

where BO is beta offset and TO is tc offset

- Instead of applying parameter search in a brute force manner for each possible (BO, TO) pair, early termination is applied to accelerate the parameter searching process
- The hierarchical coding structure is considered to avoid quality flickering
 - For those pictures at the same temporal level coded with same QP, their deblocking parameters are kept similar



Chroma quantization parameter adjustment

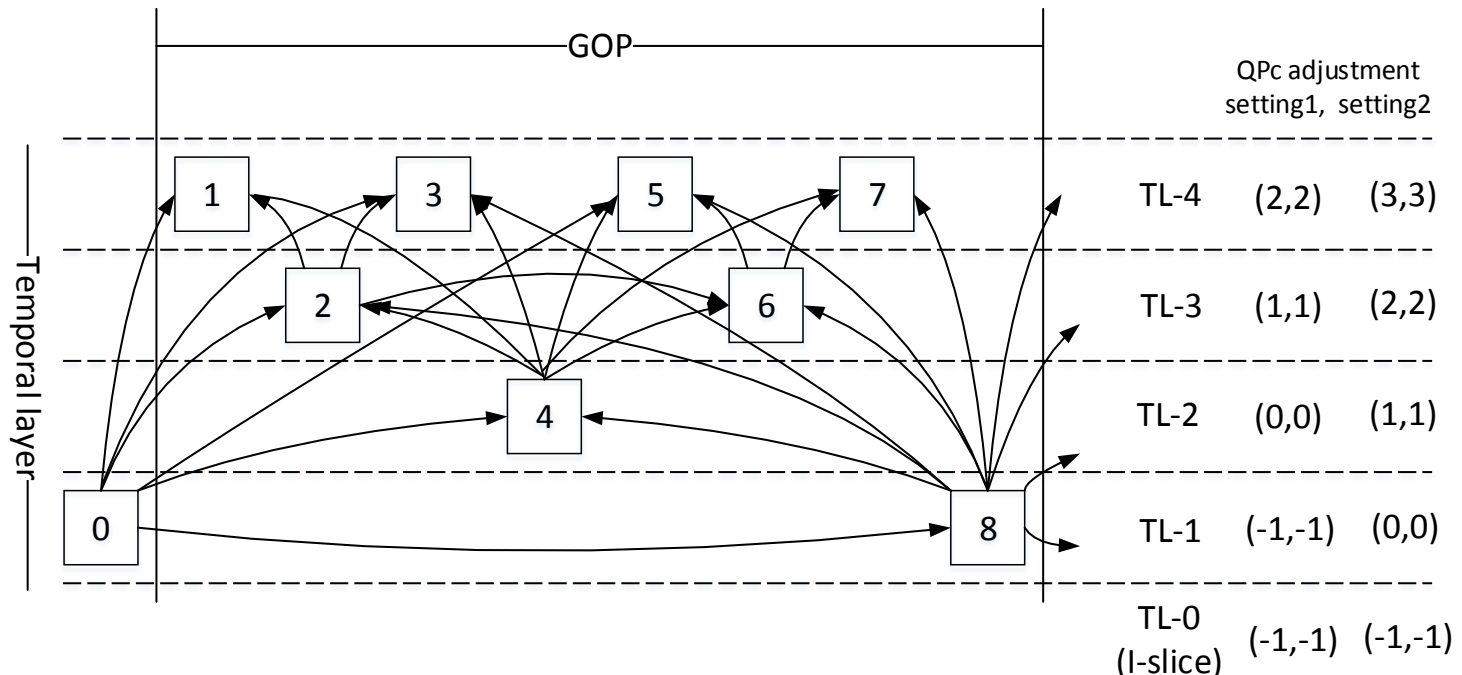
- The chroma QP adjustment allocates more bits to pictures at lower temporal level than to those pictures at higher temporal level

$$QPc_offset = QPc_adj(TL_Idx)$$

TL_Idx is temporal level index. The chroma QP QPc is calculated as:

$$QPc = QP + \text{Clip}(-12, 12, QPc_offset)$$

- The chroma QP adjustment is signaled in slice header
- In simulation, the chroma QP adjustments (Cb, Cr) are set as:



Simulation results

- Test1: Deblocking parameter selection
- Test2: Chroma QP adjustment
 - Setting1: (-1, -1, 0, 1, 2)
 - Setting2: (-1, 0, 1, 2, 3)
- Test3:
 - Deblocking parameter selection + Chroma QP adjustment setting1
 - Deblocking parameter selection + Chroma QP adjustment setting2

Simulation results (HEVC CTC test sequences)

Test1 vs. HM-16.7

	All Intra Main			Random Access Main			Low delay B Main			Low delay P Main		
	Y	U	V	Y	U	V	Y	U	V	Y	U	V
Class A	-0.3%	-0.1%	-0.1%	-0.5%	-0.3%	-0.2%						
Class B	-0.2%	-0.3%	-0.2%	-0.4%	-0.5%	-0.5%	-0.4%	0.0%	-0.3%	-0.8%	-0.3%	-0.3%
Class C	-0.1%	-0.2%	-0.2%	-0.4%	-0.5%	-0.5%	-0.2%	0.0%	-0.3%	-0.5%	-0.1%	-0.2%
Class D	-0.1%	-0.2%	-0.1%	-0.2%	-0.4%	-0.3%	-0.3%	0.5%	-0.1%	-0.3%	-0.3%	0.2%
Class E	0.0%	0.0%	0.0%				-0.2%	-0.2%	0.0%	-0.4%	-0.6%	-0.1%
Overall	-0.2%	-0.2%	-0.1%	-0.4%	-0.4%	-0.4%	-0.3%	0.1%	-0.2%	-0.5%	-0.3%	-0.1%
	-0.2%	-0.2%	-0.1%	-0.4%	-0.4%	-0.4%	-0.3%	0.0%	-0.2%	-0.5%	-0.2%	-0.1%
Class F	-0.1%	-0.3%	-0.4%	-0.2%	-0.5%	-0.5%	0.0%	-0.1%	-0.3%	-0.2%	-0.4%	-0.5%
Enc												
Time[%]	106%			102%			102%			102%		
Dec												
Time[%]	105%			103%			101%			101%		

Simulation results (HEVC CTC test sequences)

Test2 setting1 vs. HM-16.7

	Random Access Main			Low delay B Main			Low delay P Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.8%	-14.4%	-14.9%						
Class B	1.0%	-13.1%	-13.0%	1.1%	-16.1%	-16.0%	1.1%	-16.1%	-16.2%
Class C	0.7%	-9.1%	-8.4%	1.0%	-11.2%	-10.7%	0.9%	-11.6%	-10.9%
Class D	0.7%	-10.1%	-9.1%	0.8%	-12.9%	-12.3%	0.9%	-12.9%	-12.2%
Class E				0.7%	-16.2%	-15.7%	0.5%	-17.4%	-17.0%
Overall	0.8%	-11.8%	-11.4%	0.9%	-14.1%	-13.7%	0.9%	-14.4%	-14.0%
	0.8%	-11.4%	-11.0%	0.9%	-13.9%	-13.4%	0.9%	-14.2%	-13.7%
Class F	0.9%	-6.6%	-5.8%	1.1%	-9.0%	-8.6%	1.2%	-8.5%	-8.4%
Enc Time[%]	101%			101%			101%		
Dec Time[%]	102%			99%			101%		

Simulation results (HEVC CTC test sequences)

Test2 setting2 vs. HM-16.7

	Random Access Main			Low delay B Main			Low delay P Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.1%	-3.4%	-4.3%						
Class B	0.1%	-4.4%	-5.2%	0.0%	-1.7%	-2.3%	-0.1%	-1.3%	-2.2%
Class C	-0.3%	-1.5%	-1.0%	-0.3%	0.1%	0.7%	-0.3%	0.3%	0.9%
Class D	-0.1%	-2.8%	-1.9%	-0.2%	-0.7%	-0.3%	-0.2%	-0.2%	0.7%
Class E				0.1%	-8.5%	-7.5%	0.1%	-9.0%	-8.6%
Overall	-0.1%	-3.1%	-3.2%	-0.1%	-2.3%	-2.0%	-0.1%	-2.1%	-1.9%
	-0.1%	-2.8%	-2.7%	-0.1%	-2.0%	-1.7%	-0.1%	-1.8%	-1.6%
Class F	0.2%	-3.5%	-2.6%	0.2%	-1.9%	-1.9%	0.0%	-2.2%	-1.3%
Enc Time[%]		101%			100%			100%	
Dec Time[%]		101%			98%			100%	

Simulation results (HEVC CTC test sequences)

Test3 setting1 vs. HM-16.7

	Random Access Main			Low delay B Main			Low delay P Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.3%	-14.5%	-15.2%						
Class B	0.6%	-13.6%	-13.5%	0.7%	-16.1%	-16.0%	0.2%	-16.3%	-16.5%
Class C	0.3%	-9.7%	-8.8%	0.8%	-11.6%	-10.9%	0.4%	-12.0%	-11.2%
Class D	0.5%	-10.6%	-9.5%	0.6%	-12.7%	-12.3%	0.5%	-13.1%	-12.6%
Class E				0.5%	-16.3%	-15.6%	0.2%	-17.3%	-17.0%
Overall	0.4%	-12.2%	-11.9%	0.7%	-14.2%	-13.7%	0.4%	-14.6%	-14.3%
	0.4%	-11.9%	-11.5%	0.7%	-13.9%	-13.5%	0.4%	-14.4%	-14.0%
Class F	0.7%	-7.3%	-6.6%	1.1%	-9.1%	-8.7%	1.0%	-9.1%	-8.7%
Enc Time[%]	100%			100%			100%		
Dec Time[%]	100%			100%			100%		

Simulation results (HEVC CTC test sequences)

Test3 setting2 vs. HM-16.7

	Random Access Main			Low delay B Main			Low delay P Main		
	Y	U	V	Y	U	V	Y	U	V
Class A	-0.5%	-3.5%	-4.5%						
Class B	-0.3%	-5.0%	-5.8%	-0.4%	-1.7%	-2.4%	-0.9%	-1.5%	-2.2%
Class C	-0.6%	-2.2%	-1.5%	-0.5%	0.1%	0.5%	-0.7%	0.0%	0.6%
Class D	-0.4%	-3.3%	-2.4%	-0.4%	-0.5%	0.0%	-0.5%	-0.7%	0.9%
Class E				-0.1%	-8.3%	-6.9%	-0.4%	-8.8%	-7.9%
Overall	-0.4%	-3.6%	-3.7%	-0.4%	-2.2%	-1.9%	-0.7%	-2.3%	-1.8%
	-0.4%	-3.2%	-3.2%	-0.4%	-1.9%	-1.6%	-0.7%	-2.1%	-1.5%
Class F	0.0%	-4.1%	-3.3%	0.1%	-2.2%	-2.1%	0.0%	-2.1%	-1.2%
Enc Time[%]	100%			100%			100%		
Dec Time[%]	101%			98%			100%		

Conclusions

- This contribution proposes two encoder optimization methods
- Deblocking filter parameter selection achieves luma BD rate saving:
 - AI: 0.2%, RA: 0.4%, LDB: 0.3%, LDP:0.5%
 - Reduced blocking artifacts at low bitrate
- Chroma QP adjustment based on temporal level provides flexibility to allocate bits for chroma coding efficiently:
 - Setting2
 - Chroma: RA: 3.2%, LDB: 2.2%, LDP: 2.0%
 - Luma : RA: 0.1%, LDB: 0.1%, LDP: 0.1%
 - Other settings can achieve different trade-off between chroma and luma
- The proposed technologies can be beneficial to general video content. Suggest to integrate into next HM version