AHG6: Report on unified QP derivation process in deblocking of I_PCM regions (JCTVC-I0035)

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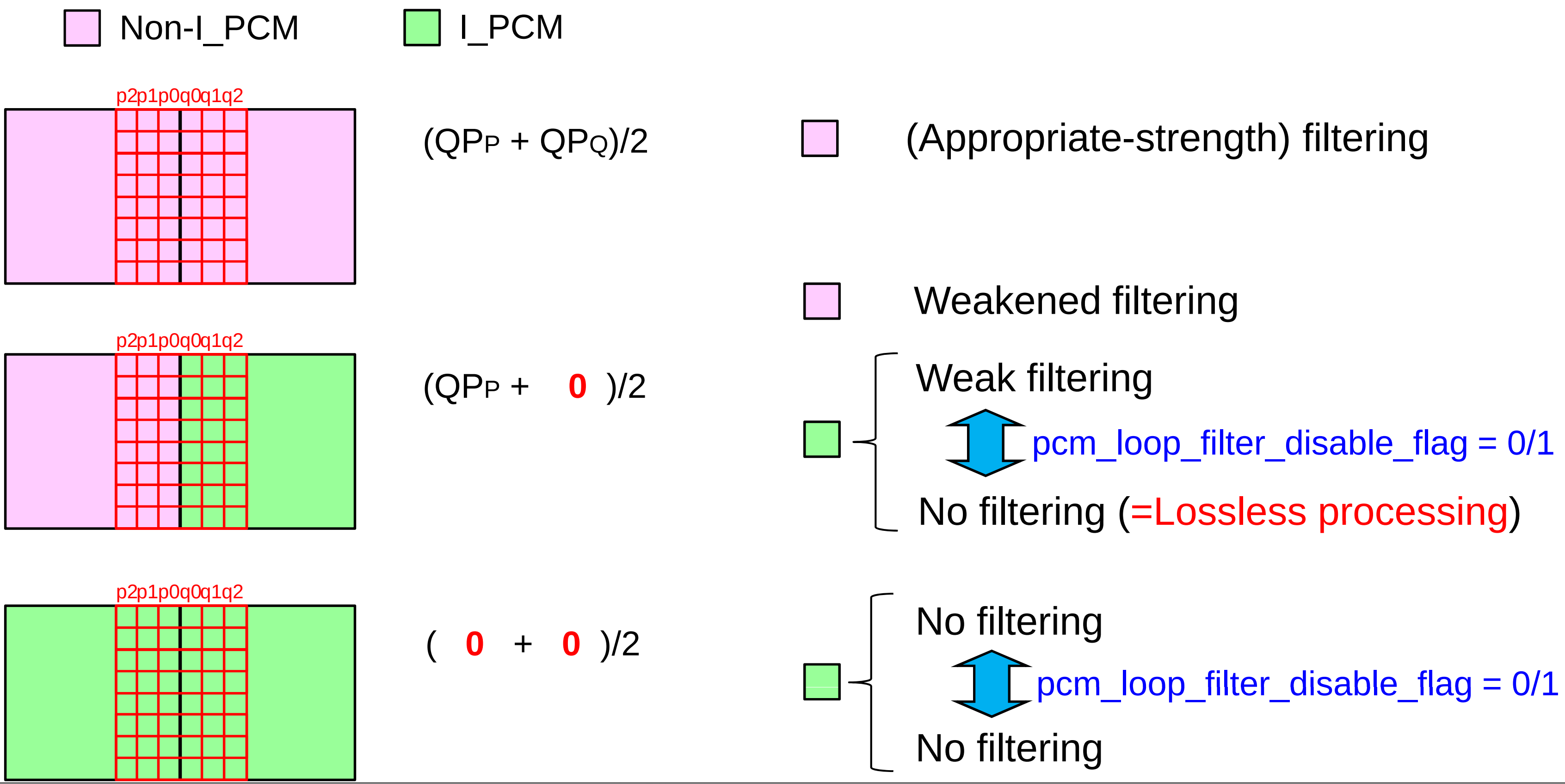
Summary

- Review of I_PCM deblocking
- Unified QP derivation in I_PCM deblocking
  - Scheme1: Use QP_Y regardless of I_PCM
  - Scheme2: Signal QP_Y on top of Scheme1
- Simulation results
  - Scheme1 degrades the picture fidelity of lossless coded regions.
  - pcm_loop_filter_disable_flag=1 avoids the picture fidelity degradation without additional side information increases.
  - Scheme2 avoids the picture fidelity degradation with additional side information of 20kbps (in CIF video coding).

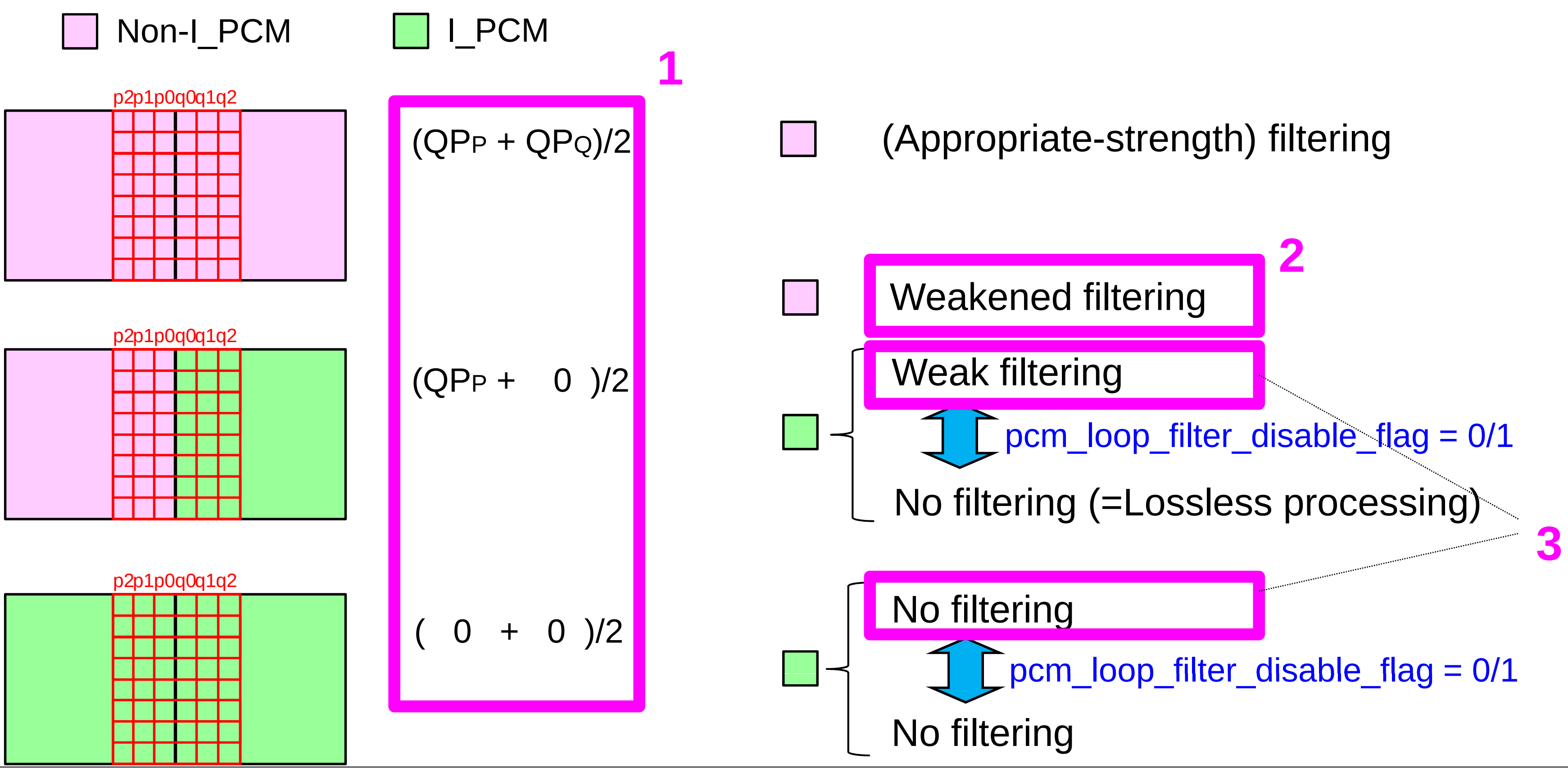
I_PCM Deblocking

- QP of I_PCM region is set equal to 0 in order to skip filtering on block boundaries across two I_PCM regions
- pcm_loop_filter_disable_flag is used to ensure lossless processing on I_PCM regions when they contain lossless samples; its functionality is similar to qpprime_y_zero_transquant_bypass_flag.



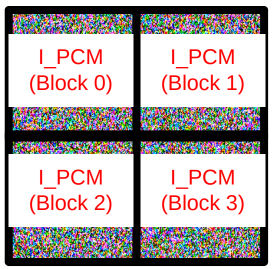
Issues of I_PCM Deblocking

1. Different QP derivation for deblocking process
2. Weakened filtering on non-I_PCM regions next to I_PCM regions
3. Weak/no filtering on I_PCM regions even when they contain lossy samples.

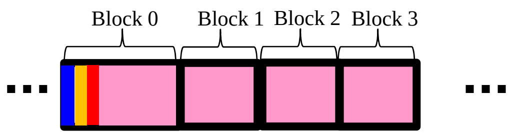


Unified QP derivation in I_PCM deblocking

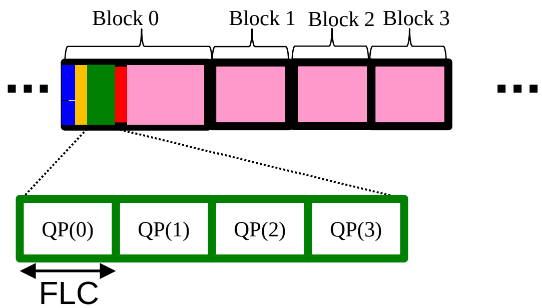
- Scheme1: Use QP_Y regardless of I_PCM
- Scheme2: Signal QP_Y on top of Scheme1
  - ➢ If I_PCM block size is larger than or equal to MinCUDQPSize, its QP value is coded by using FLC with the minimum number of bits needed for the QP range.



(a)



(b) HM-6.0 / Scheme1 / Scheme2 (I_PCM < MinCUQG)



(c) Scheme2 (I_PCM >= MinCUQG)

pred_type, pcm_flag, etc.

pcm_alignment_zero_bit

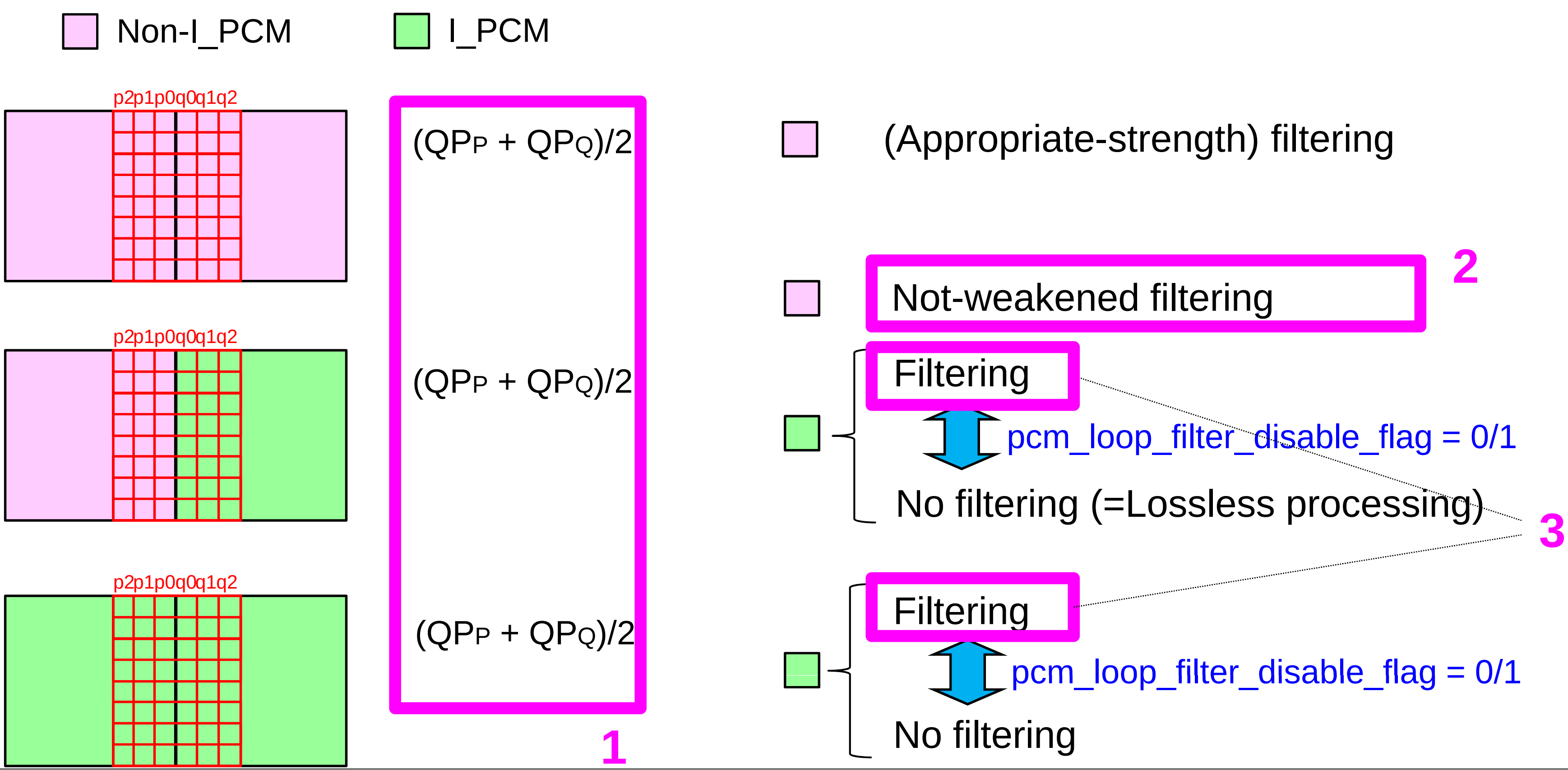
num_subsequent_pcm

cu_qp_plus_offset

PCM sample data (luma/chroma)

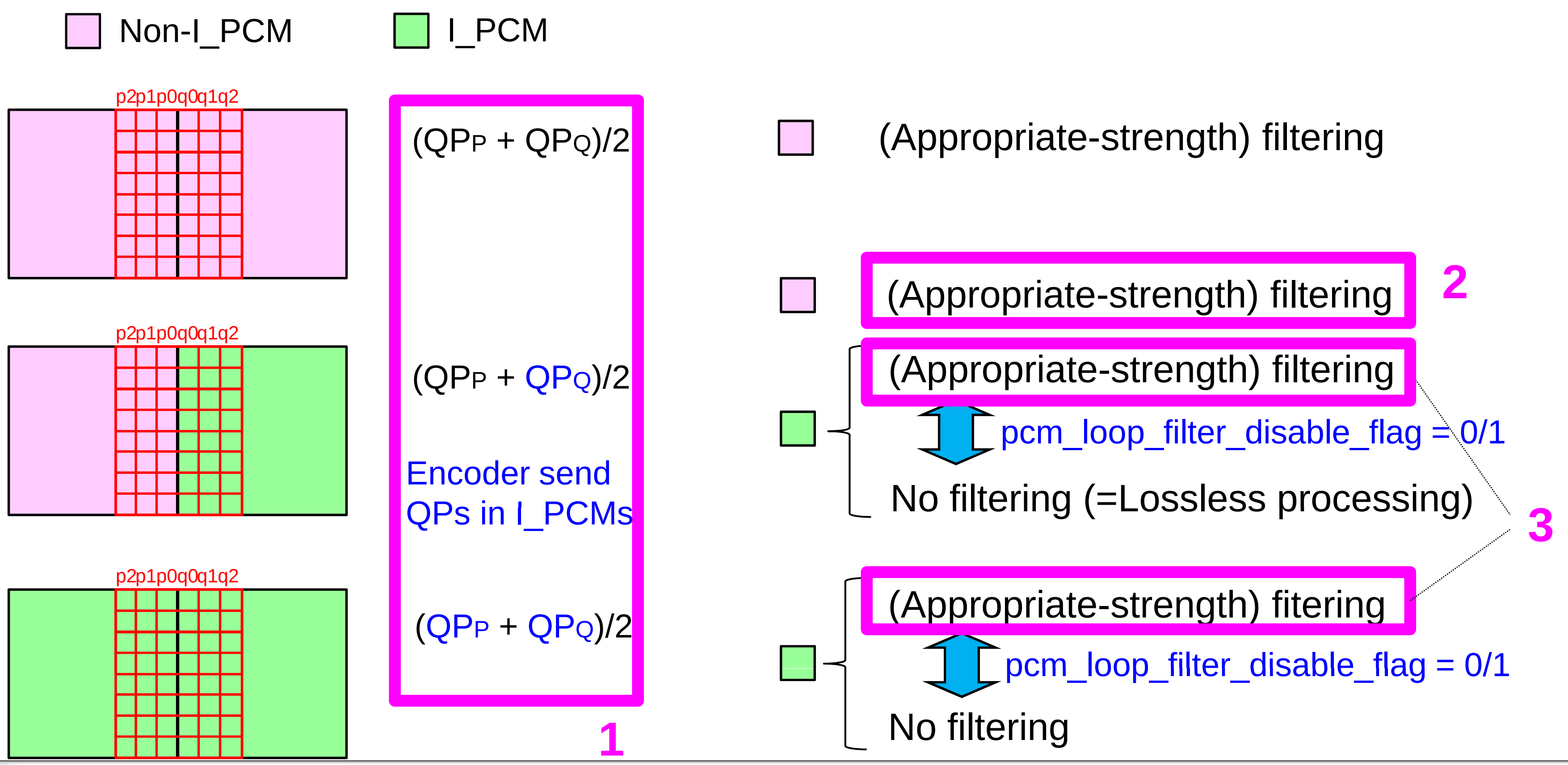
Analysis of Scheme1

1. Unified QP derivation for deblocking process
2. Appropriate-strength filtering on non-I_PCM regions next to I_PCM regions
3. Filtering on I_PCM regions even when they contain lossy samples.



Analysis of Scheme2

1. Unified QP derivation for deblocking process
2. Appropriate-strength filtering on non-I_PCM regions next to I_PCM regions
3. Appropriate-strength filtering on I_PCM regions even when they contain lossy samples.



Summary of HM/Scheme1/Scheme2

	HM	Scheme1	Scheme2
Functionality changes	NA	- Unification of QP derivation in deblocking. - Appropriate filtering on non-I_PCM regions next to I_PCM regions. - Filtering on I_PCM regions even when they contain lossy samples.	- Unification of QP derivation in deblocking. - Appropriate filtering on non-I_PCM regions next to I_PCM regions. - Filtering on I_PCM regions even when they contain lossy samples. - QP controlabilty where IPCM >= minCUQG.
Impact on text	NA	- Removal of two paragraphs in deblocking	- Removal of two paragraphs in deblocking - Addition of new syntax element in PU
Impact on software	NA	- Removal of 12 lines in deblocking	- Removal of 12 lines in deblocking - Addition of 19KB patch to entropy coding, etc.

Simulation

- Two tests

  - Common test sequences with JCTVC-H1200 using I_PCM (PCMEnabledFlag=1, PCMLog2MaxSize=5, and PCMLog2MinSize=3)

  - Synthesized test sequence with low QPs (2, 6, 10, and 14)

Synthesized sequence, *Sandstorms* (CIF 30Hz)

Common Test Sequence Results (Scheme1)

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class B	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class C	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Class D	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Class E	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Overall	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Class F	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Enc Time[%]		100%			100%	
Dec Time[%]		100%			99%	

	Random Access Main			Random Access H[illegible]		
	Y	U	V	Y	U	[illegible]
Class A	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Class B	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Class C	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Class D	0.00%	0.00%	0.00%	0.00%	0.00%	[illegible]
Class E						
Overall	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class F	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Enc Time[%]		100%			99%	
Dec Time[%]		99%			100%	

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class C	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class D	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class E	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Overall	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class F	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Enc Time[%]		100%			100%	
Dec Time[%]		99%			99%	

- No changes in BD-rates since I_PCM is not selected.

- Negligible changes in enc/dec times because of minor software modifications.

Common Test Sequence Results (Scheme2)

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class B	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class C	0.00%	0.00%	0.00%	0.00%	0.00%	
Class D	0.00%	0.00%	0.00%	0.00%	0.00%	
Class E	0.00%	0.00%	0.00%	0.00%	0.00%	
Overall	0.00%	0.00%	0.00%	0.00%	0.00%	
	0.00%	0.00%	0.00%	0.00%	0.00%	
Class F	0.00%	0.00%	0.00%	0.00%	0.00%	
Enc Time[%]		101%			101%	
Dec Time[%]		100%			99%	

	Random Access Main			Random Access H		
	Y	U	V	Y	U	
Class A	0.00%	0.00%	0.00%	0.00%	0.00%	
Class B	0.00%	0.00%	0.00%	0.00%	0.00%	
Class C	0.00%	0.00%	0.00%	0.00%	0.00%	
Class D	0.00%	0.00%	0.00%	0.00%	0.00%	
Class E						
Overall	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class F	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Enc Time[%]		100%			99%	
Dec Time[%]		100%			100%	

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class C	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class D	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class E	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Overall	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Class F	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Enc Time[%]		99%			100%	
Dec Time[%]		99%			99%	

- No changes in BD-rates since I_PCM is not selected.

- Negligible changes in enc/dec times because of minor software modifications.

Synthesized Test Sequence Results

	Random access main (QP=2, 6, 10, 14)					
	Delta Rate kbps	Delta Y dB	Delta U dB	Delta V dB	Enc Time %	Dec Time %
Scheme 1 with pcm_loop_filter_disable=0	-0.05	0.00	-4.10	-4.10	99	102
Scheme 2 with QP=QPslice signaling	14.70	0.00	-4.10	-4.10	99	99
Scheme 1 with pcm_loop_filter_disable=1	0.00	0.00	0.00	0.00	100	101
Scheme 2 with QP=0 signaling	19.47	0.00	0.00	0.00	99	99

- Scheme1 and Scheme2 degrades the picture fidelity of the lossless coded regions at high bit rates. (The current AVC-style specification is well designed for high picture fidelity applications!)

- Scheme2 with QP=0 in I_PCM avoids the degradation with additional overheads.

- pcm_loop_filter_disable_flag enables encoders to keep the picture fidelity of the lossless coded regions without additional overheads.

Conclusions

- I_PCM Deblocking

- Unified QP derivation in I_PCM deblocking
  - Scheme1: Use QP_Y regardless of I_PCM
  - Scheme2: Signal QP_Y on top of Scheme1

- Simulation results
  - X-checked by Ericsson. Than you!

- Recommendation
  - If the unification of QP derivation in the deblocking is considered, keep pcm_loop_filter_disable_flag and include Scheme1 in the DIS text.

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