

*JCTVC-H0155*



## ***CE10.3: Simplification of First Delta Calculation in Deblocking by SKT/SKKU***

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# Summary

- This contribution addresses simplification of the deblocking filter in two ways
  - *Use a simple luma weak filter.*

$$(HM5.0) \quad \Delta = \text{Clip}(-t_c, t_c, \{9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8\} \gg 4)$$

$$(\text{proposed}) \quad \Delta = \text{Clip}(-t_c, t_c, \{(q_0 - p_0) \ll 2 - (q_1 - p_1) + 4\} \gg 3)$$
  - *Unification of the luma and chroma filters*  
use the proposed filter above for both luma & chroma
- BD-rate (Y) results are similar to the HM5.0 anchor, and, subjective quality is also similar to the HM5.0 in our viewing test.
  - Overall encoding/decoding complexity: 100% / 99%
  - 0.0% (AI\_HE), 0.0% (AI\_LC)
  - 0.0% (RA\_HE), 0.1% (RA\_LC)
  - 0.2% (LDB\_HE), 0.1% (LDB\_LC)
  - 0.1% (LDP\_HE), 0.1% (LDP\_LC)

Thank **Qualcomm** for their verification in JCTVC-H0459

# HM5.0: Weak Filter

- The first delta calculation for the first pixel

- Luma

$$\Delta = \text{Clip}(-t_c, t_c, ((9 \times (q0 - p0) - 3 \times (q1 - p1) + 8) \gg 4))$$

$$p0' = p0 + \Delta$$

$$q0' = q0 - \Delta$$

- Chroma

$$\Delta = \text{Clip}(-t_c, t_c, (((q0 - p0) \ll 2) - (q1 - p1) + 4) \gg 3))$$

$$p0' = p0 + \Delta$$

$$q0' = q0 - \Delta$$

- For the first delta calculation for luma in HM5.0

- 2 multiplications are required
- Different from chroma filter

# Proposed Method: *Weak Filter*

- The first delta calculation for the first pixel

- Luma

$$\Delta = \text{Clip}(-t_c, t_c, (((q0 - p0) \ll 2) - (q1 - p1) + 4) \gg 3))$$

$$p0' = p0 + \Delta$$

$$q0' = q0 - \Delta$$

- Chroma

$$\Delta = \text{Clip}(-t_c, t_c, (((q0 - p0) \ll 2) - (q1 - p1) + 4) \gg 3))$$

$$p0' = p0 + \Delta$$

$$q0' = q0 - \Delta$$

- Two benefits of the proposed first delta calculation for luma
  - No multiplications are required.
  - The hardware logics for luma and chroma filter can be shared

# Simulation Results (1)

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	99%			98%		

# Simulation Results (2)

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.1%	0.0%	-0.1%	0.2%	0.1%	0.0%
Class B	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Class C	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%
Class D	0.0%	-0.2%	-0.1%	0.0%	0.0%	-0.1%
Class E						
Overall	0.0%	-0.1%	0.0%	0.1%	0.0%	0.0%
	0.0%	-0.1%	0.0%	0.1%	0.0%	0.0%
Class F	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	98%			100%		

# Simulation Results (3)

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
<b>Class A</b>						
<b>Class B</b>	0.1%	-0.1%	0.0%	0.1%	-0.1%	-0.1%
<b>Class C</b>	0.1%	-0.1%	0.1%	0.1%	0.1%	-0.1%
<b>Class D</b>	0.0%	0.1%	0.6%	0.0%	0.3%	0.3%
<b>Class E</b>	0.6%	0.2%	0.0%	0.3%	0.0%	0.1%
<b>Overall</b>	0.2%	0.0%	0.2%	0.1%	0.1%	0.0%
	0.2%	0.0%	0.1%	0.1%	0.0%	0.1%
<b>Class F</b>	-0.1%	-0.2%	-0.3%	0.0%	-0.2%	-0.3%
<b>Enc Time[%]</b>	100%			100%		
<b>Dec Time[%]</b>	99%			97%		

# Simulation Results (4)

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.1%	0.2%	0.1%	0.0%	0.1%	-0.3%
Class C	0.1%	-0.1%	-0.1%	0.0%	0.1%	0.1%
Class D	0.0%	0.3%	-0.1%	-0.1%	-0.1%	0.7%
Class E	0.4%	-0.4%	0.2%	0.4%	-0.6%	-0.8%
Overall	0.1%	0.1%	0.1%	0.1%	-0.3%	0.0%
	0.1%	0.1%	0.0%	0.1%	-0.2%	0.0%
Class F	-0.1%	0.2%	0.3%	0.1%	-1.0%	0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	99%			100%		



# Conclusion Remarks

- This contribution addresses simplification of the deblocking filter in two ways
  - The first way is to use a simple luma weak filter which is identical to chroma filter with no multiplication
  - The second way is to unify the simple luma weak filter and chroma filter
- Simulation results
  - BD-rate (Y) results are similar to the HM5.0 anchor. (0.0% (AI\_HE), 0.0% (AI\_LC), 0.0% (RA\_HE), 0.1% (RA\_LC), 0.2% (LDB\_HE), 0.1% (LDB\_LC), 0.1% (LDP\_HE), and 0.1% (LDP\_LC))
  - Encoding/Decoding times are also similar or smaller than the HM5.0
  - In our viewing test, subjective quality is also similar to the HM5.0
- Only 1 line of modification (in source code and working draft) is required
- Recommended to employ this simple mechanism in coming HM design
- We thank Qualcomm for crosschecking the proposal (JCTVC-H0459)