

On Deblocking process simplification for slice and tile boundaries

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Motivation

- ✓ In current HEVC CD, loop filters are allowed to use on Tile/Slice boundaries. When Tile is used for high-level parallel processing, additional processing and storage is required.

	requirement (worst case)	Details for 4 Tiles per HD
QP	$(136 + 240) \times 2 \times 6$ bit	6 bits(QP) per 8x8, (Luma / Chroma) → 4512 bits
Bs	$(272 + 480) \times 2$ bit	2 bits (Bs) per 4x4 → 1504 bits
SAO	$(68 + 120) \times 3 \times (3 + 5 + 16)$ bit	3 (type_idx)+ 5 (band_position)+16(offset) bits per LCU (16x16) → 13536 bits

Even if 4 Tiles on HD resolution, 2.4Kbyte is required for filtering.
(340 tile per HD is allowed in Main Profile...)

Approach

- ✓ Only Simplified Deblocking filter on Tile/Silce boundaries.
- ✓ Post filter on Tile/Slice boundaries.

Simplified In-loop filter (Deblocking only) # for enabling across filter flag

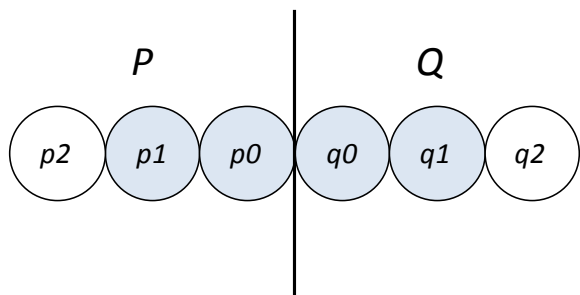
1. Use slice QPs instead of CU QPs for a variable tC derivation
2. Fix filtered samples to p1, p0, q0, q1 for luma and p0, q0 for chroma.
(this is same as current Deblocking filter specification)

Method A: Always Filtering on Tile/Silce boundaries

Method B: New decision for Filter ON/OFF

→ Filer only on uneven boundaries.

Most of decision is same as
current de-blocking filter
except for using slice QPs


$$\begin{aligned} \text{aveQ} &= (2 * q_0 + q_1 + q_2 + 2) \gg 2 \\ \text{aveP} &= (2 * p_0 + p_1 + p_2 + 2) \gg 2 \\ d &= | \text{aveQ} - \text{aveP} | \\ dq0 &= | q_0 - q_1 |, \quad dq1 = | q_1 - q_2 | \\ dp0 &= | p_0 - p_1 |, \quad dp1 = | p_1 - p_2 | \\ \text{if}(d == 0 \parallel d < dq0 \parallel d < dq1 \parallel d < dp0 \parallel d < dp1) \\ &\quad \text{filter off} \\ \text{Otherwise:} \\ &\quad \text{filter on} \end{aligned}$$

→ Only slice QPs are used for the filtering

Post filtering # for disabling across filter flag

The post filtering SEI for the tile/slice boundary filters

→ Encoder can transmit which filter is better on tile/slice boundaries.

boundary_post_filter(payloadSize) {	Descriptor
boundary_post_filter_flag	u(1)
if(boundary_post_filter_flag) {	
across_filter_type	u(2)
pf_beta_offset_div2	se(v)
pf_tc_offset_div2	se(v)
}	
}	

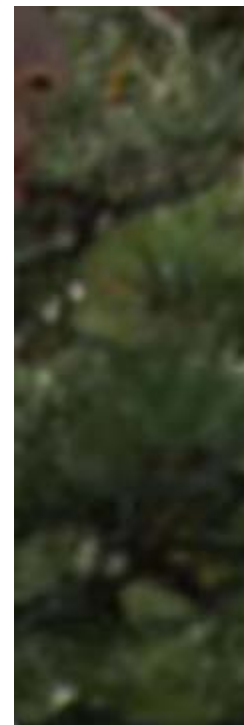
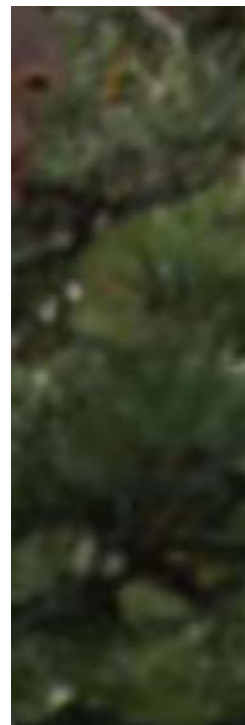
boundary_post_filter_flag equal to 1 indicates the boundary post filter is enable. **boundary_post_filter_flag** equal to 0 indicates the decoder shall ignore this SEI messages.

across_filter_type specifies which processing boundaries should be filtered as shown in Table 3.

pf_beta_offset_div2 and **pf_tc_offset_div2** indicates deblocking filter control parameters which is specified in HEVC specification, for post filtering.

Value	Description
0	across tile disable / across slice disable
1	across tile enable / across slice disable
2	across tile disable / across slice enable
3	across tile enable / across slice enable

Subjective Results



HM6.1(filter ON)

HM6.1 (filter OFF)

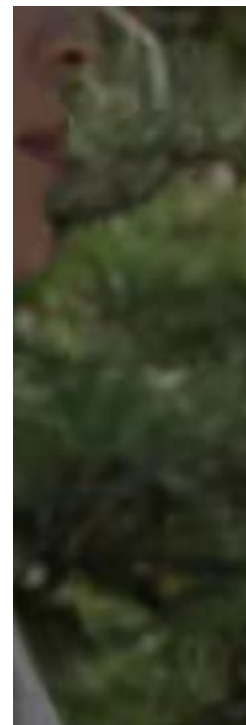
Method A

Method B

post filter

***kimono, RA-Main, QP=32, Frame Num=1
4 Tiles (crossing on center of the picture)***

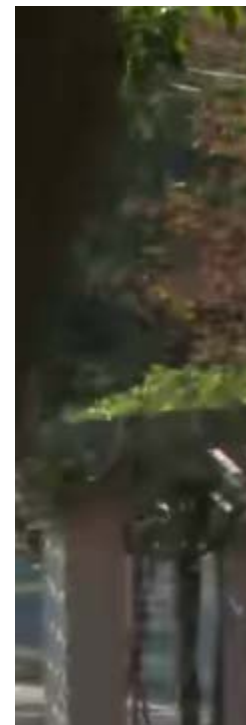
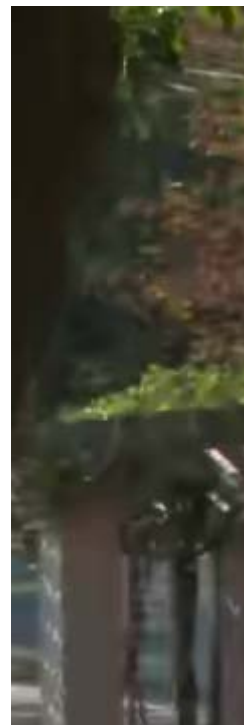
Subjective Results



HM6.1(filter ON) HM6.1 (filter OFF) Method A Method B post filter

***kimono, RA-Main, QP=32, Frame Num=5
4 Tiles (crossing on center of the picture)***

Subjective Results



HM6.1(filter ON) HM6.1 (filter OFF) Method A Method B post filter

***Park Scene, RA-Main, QP=37, Frame Num=5
4 Tiles (crossing on center of the picture)***

Results (Objective)

4 Tiles (2x2) (Class A and Class B only / Overall)		Vs 4 Tiles (2x2) with 3 in-loop filters					
		Main			HE10		
		AI	RA	LB	AI	RA	LB
In – loop Filter	Method A (all)	0.0 / 0.0	0.1 / 0.2	0.1 / 0.5	0.0 / 0.0	0.1 / 0.3	0.1 / 0.5
	Method B (adaptive)	0.0 / 0.0	0.0 / 0.1	0.0 / 0.1	0.0 / 0.0	0.1 / 0.1	0.0 / 0.1
Post Filter	Before Filtering	0.0 / 0.0	0.1 / 0.1	0.0 / 0.0	0.0 / 0.1	0.1 / 0.1	0.0 / 0.0
	After Filtering	0.0 / 0.0	0.1 / 0.1	0.0 / 0.0	0.0 / 0.1	0.1 / 0.1	0.0 / 0.0

Conclusion

✓ Objective performance loss is limited.

Recommendation

- ✓ Recommendation to adopt only simplified deblocking filter on tile/slice boundaries in the DIS of HEVC.
- ✓ Consider to use Post filter on tile boundaries to provide significant complexity reduction in case of high-level parallel processing.