CE4-related: MV rounding unification

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Overall Summary

- In VTM4.0 MV rounding, both rounding to zero and rounding away from zero are used
- Proposed to unify the MV rounding to rounding to zero

	RA			LB		
	Y	U	V	Y	U	V
Rounding to zero	-0.01%	-0.02%	-0.06%	-0.06%	-0.03%	-0.38%
Rounding away from zero	0.01%	0.01%	0.01%	-0.01%	0.03%	0.02%

Problem Definition

- In last meeting, the MV rounding method for pair-wise average candidate, triangular merge candidate, affine MVP candidate, and affine sub-block MV derivation are unified
- However, in VTM-4.0 MV rounding, two kinds of MV rounding are still used
  - The rounding to zero is used in the spatial/temporal MV scaling in inter mode MVP derivation, regular merging candidate list generation, triangular merging candidate list generation
  - The rounding away from zero is used in inherited affine merging candidate derivation, affine subblock MV derivation, pair-wise merging candidate derivation, and MV precision rounding in AMVR.

Different Rounding Methods

- MV_rounded = MV >= 0 ? ((MV + offset) >> shift) : -((((-MV) + offset) >> M)
- Rounding to zero:
  - offset = (1 << (shift – 1)) – 1
- Rounding away from zero:
  - offset = (1 << (shift – 1))

	RA			LB		
	Y	U	V	Y	U	V
Rounding to zero	-0.01%	-0.02%	-0.06%	-0.06%	-0.03%	-0.38%
Rounding away from zero	0.01%	0.01%	0.01%	-0.01%	0.03%	0.02%

Proposed Method

- Propose to unify the MV rounding in VVC to use rounding to zero
  - Better coding efficiency
- The formula can be rewritten for less instructions
  - MV_rounded = MV >= 0 ?
    ((MV + offset) >> shift) : -(((-MV) + offset) >> M)
  - offset = (1 << (shift – 1)) – 1

  - MV_rounded = (MV + offset - (MV >= 0 ? 1: 0)) >> shift
  - offset = (1 << (shift – 1))

Detail Simulation Results

- Anchor: VTM4.0

Rounding to zero

	Random Access Main 10 Over VTM-4.0				
	Y	U	V	EncT	DecT
Class A1	-0.02%	-0.05%	-0.04%	99%	101%
Class A2	-0.02%	0.02%	-0.03%	100%	100%
Class B	-0.03%	-0.01%	0.01%	99%	100%
Class C	0.01%	-0.03%	-0.19%	101%	102%
Class E					
Overall	-0.01%	-0.02%	-0.06%	100%	101%
Class D	-0.03%	-0.02%	-0.04%	101%	96%
Class F	-0.02%	0.02%	-0.12%	100%	94%

	Low delay B Main10 Over VTM-4.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.04%	-0.04%	-0.15%	101%	100%
Class C	-0.10%	-0.07%	-0.53%	101%	99%
Class E	-0.06%	0.02%	-0.55%	101%	96%
Overall	-0.06%	-0.03%	-0.38%	101%	99%
Class D	-0.14%	-0.75%	-0.99%	101%	101%
Class F	-0.23%	-0.27%	-0.04%	101%	100%

Rounding away from zero

	Random Access Main 10 Over VTM-4.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.06%	0.02%	100%	101%
Class A2	0.00%	0.06%	0.02%	99%	100%
Class B	0.01%	-0.02%	-0.01%	98%	100%
Class C	0.02%	-0.02%	0.02%	100%	99%
Class E					
Overall	0.01%	0.01%	0.01%	99%	100%
Class D	0.04%	0.10%	0.07%	101%	98%
Class F	0.01%	0.01%	0.02%	99%	94%

	Low delay B Main10 Over VTM-4.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.01%	-0.06%	-0.07%	100%	102%
Class C	-0.03%	0.19%	0.17%	100%	100%
Class E	-0.02%	-0.05%	-0.03%	99%	96%
Overall	-0.01%	0.03%	0.02%	100%	100%
Class D	0.00%	0.01%	-0.55%	100%	101%
Class F	-0.04%	-0.28%	-0.11%	100%	105%

Thank Kwai for cross-checking

Conclusions

- In VTM4.0 MV rounding, both rounding to zero and rounding away from zero are used
- Proposed to unify the MV rounding to rounding to zero
- The formula can be rewritten for less instructions
  – MV_rounded = (MV + offset - (MV >= 0 ? 1: 0)) >> shift
  – offset = (1 << (shift – 1))

	RA			LB		
	Y	U	V	Y	U	V
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Rounding away from zero	0.01%	0.01%	0.01%	-0.01%	0.03%	0.02%

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