



MEDIATEK

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CE2-related: Reduction of bits for ALF coefficient fractional part

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Overall Summary

- Reduce the precision of adaptive loop filter (ALF) coefficient fractional part from 9 bits to 7 bits
 - Combining with CE2.2.2 reduces the multiplier inputs from 15 bits to 8 bits

		Over VTM-2.0.1		
		Y BD-rate	Enc. Time	Dec. Time
7-bit fractional part	AI	-0.01%	100%	101%
	RA	-0.03%	100%	101%
	LB	-0.09%	100%	101%
7-bit fractional part + CE2.2.2 (coefficient range constraints)	AI	-0.01%	100%	101%
	RA	-0.04%	100%	98%
	LB	-0.11%	100%	101%

Precision and Range of ALF Coefficients

- ALF in VTM2.0.1
 - The precision in the fractional part is 9-bits
 - The allowed integer representation range of non-center ALF coefficients is $[-614, 614]$.
 - The allowed integer representation range of non-center ALF coefficients is $[-14224, 15248]$, since the filter gain is kept to 512
 - The number of required bits to represent a non-center coefficient and a center coefficient is 11 and 15, respectively.
- Proposed to reduce the precision of the fractional part from 9 bits to 7 bits

Summary of Required Bits in Each Test

- Using 8bits to represent one filter coefficient

	# of bits for fractional part	# of bits for a non-center coefficient	#of bits for a center coefficient	Others
VTM2.0.1	9	11	15	
Proposed	7	9	13	
CE2.2.2	9	10	10	Reduced range
Proposed + CE2.2.2	7	8	8	Reduced range

Results of Reducing Fractional Bits

	All Intra Main10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1	-0.01%	-0.02%	-0.10%	100%	101%
Class A2	0.02%	-0.01%	-0.01%	100%	101%
Class B	0.01%	-0.04%	-0.03%	100%	101%
Class C	-0.03%	-0.05%	-0.04%	100%	101%
Class E	-0.02%	-0.07%	-0.08%	100%	100%
Overall	-0.01%	-0.04%	-0.05%	100%	101%
Class D	-0.06%	-0.07%	-0.08%	100%	102%
Class F (optional)					
	Random Access Main 10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1	-0.10%	0.07%	-0.11%	100%	100%
Class A2	0.00%	-0.02%	-0.07%	100%	102%
Class B	-0.01%	-0.09%	-0.07%	100%	101%
Class C	-0.04%	-0.09%	-0.10%	100%	102%
Class E					
Overall	-0.03%	-0.05%	-0.09%	100%	101%
Class D	-0.10%	-0.22%	-0.40%	100%	101%
Class F (optional)					
	Low delay B Main10				
	Over VTM-2.0.1				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.03%	-0.14%	-0.53%	100%	101%
Class C	-0.05%	0.07%	0.03%	100%	101%
Class E	-0.25%	0.50%	-0.07%	100%	100%
Overall	-0.09%	0.09%	-0.23%	100%	101%
Class D	0.00%	0.34%	-0.58%	100%	100%
Class F (optional)					

Results of Reducing Fractional Bits + CE2.2.2

All Intra Main10					
Over VTM-2.0.1					
	Y	U	V	EncT	DecT
Class A1	-0.01%	-0.01%	-0.10%	100%	102%
Class A2	0.02%	-0.01%	-0.01%	100%	102%
Class B	0.01%	-0.04%	-0.03%	100%	101%
Class C	-0.03%	-0.05%	-0.04%	100%	100%
Class E	-0.02%	-0.07%	-0.08%	100%	100%
Overall	-0.01%	-0.04%	-0.05%	100%	101%
Class D	-0.06%	-0.07%	-0.08%	100%	101%
Class F (optional)					
Random Access Main 10					
Over VTM-2.0.1					
	Y	U	V	EncT	DecT
Class A1	-0.10%	0.03%	-0.13%	100%	98%
Class A2	0.00%	0.00%	-0.06%	101%	100%
Class B	-0.01%	-0.09%	-0.07%	100%	95%
Class C	-0.04%	-0.09%	-0.10%	100%	102%
Class E					
Overall	-0.04%	-0.05%	-0.09%	100%	98%
Class D	-0.10%	-0.21%	-0.40%	100%	101%
Class F (optional)					
Low delay B Main10					
Over VTM-2.0.1					
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-0.05%	-0.17%	-0.47%	100%	102%
Class C	-0.04%	0.15%	0.02%	100%	101%
Class E	-0.32%	0.57%	-0.11%	100%	99%
Overall	-0.11%	0.12%	-0.22%	100%	101%
Class D	-0.01%	0.40%	-0.48%	100%	99%
Class F (optional)					

Conclusions

- Proposed reduction of bits for adaptive loop filter (ALF) coefficient fractional part.

		Over VTM-2.0.1		
		Y BD-rate	Enc. Time	Dec. Time
7-bit fractional part based on CE2.2.2	AI	-0.01%	100%	101%
	RA	-0.04%	100%	98%
	LB	-0.11%	100%	101%

- Combined with CE2.2.2.
 - # of required bits to representing a non-center coefficient: 11 bit to 8it.
 - # of required bits to representing a center coefficient: 15 bit to 8 bit.
 - The input of multipliers are reduced to 8 bits from 11bits or 15bits
- Thank Orange for cross-checking the results.

