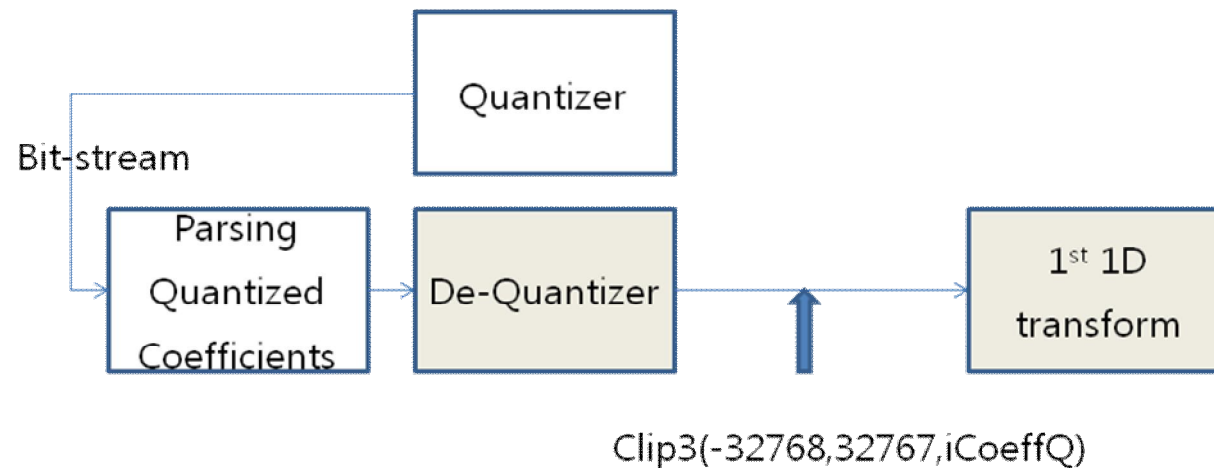# JCTVC-F257: About clip operation removal from de-quantization part of HM

Elena Alshina, Alexander Alshin
Samsung Electronics Ltd
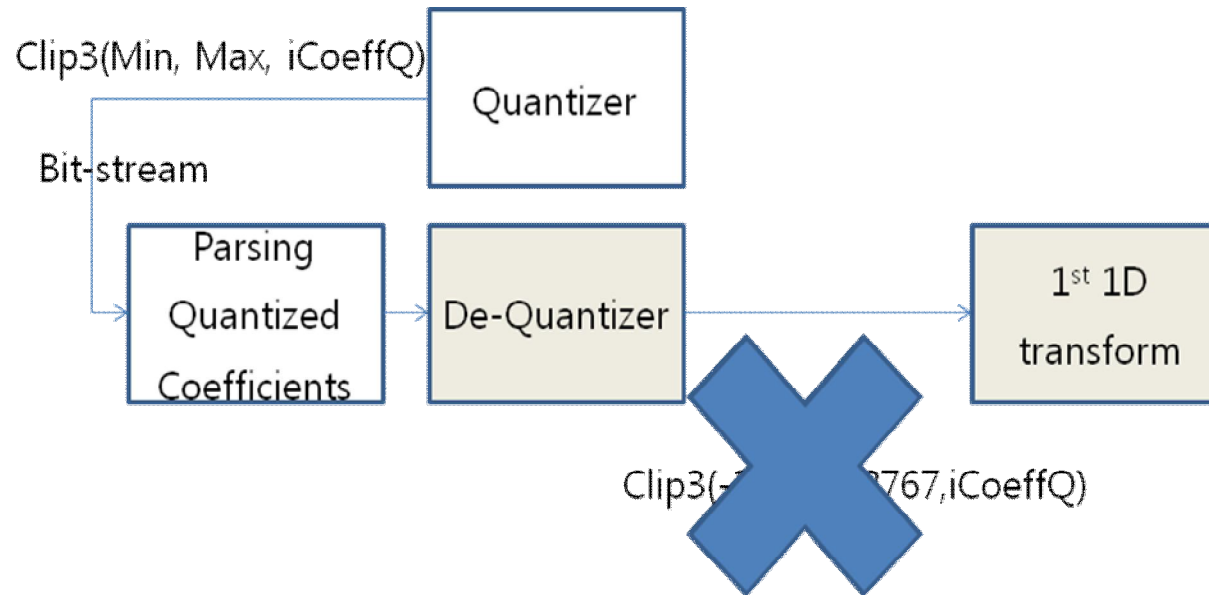
Motivation

Observation:

– iCoeffQ values out of 16 bits never happen in tests (normal, low, high QP)

- But theoretically iCoeffQ values out of 16 bits are possible

Even if such big value of quantized coefficients is written to bit-stream then it will be clipped on decoder side → <u>no need to spend buts for information which will be never used</u>

Proposed change

$\text{Max} = -\text{Min}$

$= 32767 * 2^{(\log_2 S - 1 - QP/6)} / g\_auiIQ[QP\%6];$

S is transform size; $0 \le QP \le 51$;

g_auiIQ = {40,45,51,57,64,72};

▶ JCTVC-F257: About clip operation removal from de-quantization part of HM

Derivation

$$\text{iCoeffQ} = ((\text{piQCoef}[n]*(\text{Int})\ \text{g\_auiIQ}\ [QP\%6] << \text{m\_cQP.m\_iPer})+\text{iAdd})>>\text{iShift}$$

$\text{iShift} = p - 9 + \log_2 S; \text{iAdd} = 1 << (\text{iShift}-1);$

$\text{m\_cQP.m\_iPer} = QP/6+p-8;$

$\text{uiQ} = \text{g\_auiIQ}[QP\%6]; \text{g\_auiIQ} = \{40,45,51,57,64,72\};$

p – source bit-depth

$$|\text{iCoeffQ}\ | \leq 32767$$

$$|\text{iCoeffQ} * \text{g\_auiIQ}\ [QP\%6]| \leq ((32767 << \text{iShift}) >> \text{m\_cQP.m\_iPer})$$

$$|\text{iCoeffQ}| \leq 32767*2^{(\log_2 S-1\ -\ QP/6)} / \text{g\_auiIQ}\ [QP\%6];$$

Test results (Normal ==Low ==High QP)

	Intra			Intra LoCo		
	Y	U	V	Y	U	V
Class A	0.000	0.000	0.000	0.000	0.000	0.000
Class B	0.000	0.000	0.000	0.000	0.000	0.000
Class C	0.000	0.000	0.000	0.000	0.000	0.000
Class D	0.000	0.000	0.000	0.000	0.000	0.000
Class E	0.000	0.000	0.000	0.000	0.000	0.000
All	0.000	0.000	0.000	0.000	0.000	0.000
Enc Time[%]	100%			100%		
Dec Time[%]	98%			97%		

	Random access			Random access LoCo		
	Y	U	V	Y	U	V
Class A	0.000	0.000	0.000	0.000	0.000	0.000
Class B	0.000	0.000	0.000	0.000	0.000	0.000
Class C	0.000	0.000	0.000	0.000	0.000	0.000
Class D	0.000	0.000	0.000	0.000	0.000	0.000
Class E						
All	0.000	0.000	0.000	0.000	0.000	0.000
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

	Low delay			Low delay LoCo		
	Y	U	V	Y	U	V
Class A						
Class B	0.000	0.000	0.000	0.000	0.000	0.000
Class C	0.000	0.000	0.000	0.000	0.000	0.000
Class D	0.000	0.000	0.000	0.000	0.000	0.000
Class E	0.000	0.000	0.000	0.000	0.000	0.000
All	0.000	0.000	0.000	0.000	0.000	0.000
Enc Time[%]	100%			100%		
Dec Time[%]	100%			99%		

Thanks a lot to Cisco for verification for this test!

Conclusion

We propose to remove clip operation from de-quantization part of HM and use clip operation

$$iQCoeff = Clip3(-Max, Max, iQCoeff)$$

with parameters

$$Max = 32767 * 2^{(\log_2 S - 1 - QP/6)} / g\_auiIQ[QP\%6]; \quad (***)$$

$$S \text{ is transform size; } 0 \le QP \le 51;$$

$$g\_auiIQ = \{40,45,51,57,64,72\};$$

instead.

Encoder shall not generate quantized coefficients with magnitude over predetermined limit (***). This guideline for Encoder should be included into HEVC specification.

▶ JCTVC-F257: About clip operation removal from de-quantization part of HM