Reduction of context bins and bypass bins grouping for cu_qp_delta

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Motivation

- ✓ **Reduction of context coded bins for higher throughput**
- ✓ **Concatenation of bypass coded bins for parallel processing**

Draft7 : context coded bins is used for most of bins for cu_qp_delta

cu_qp_delta coding in Draft7

	Semantic	Binarization Type	Bin Type
significant_flag	Abs(cu_qp_delta) > 0 ? 1 : 0	FL (cMax = 1)	Context bin
sign_flag	cu_qp_delta < 0 ? 1 : 0	FL (cMax = 1)	Bypass bin
absVminus1	Abs(cu_qp_delta) - 1	TU (cMax=24+(QpBdOffsetY>>1)+sign_flag)	Context bin

Approach

- ✓ **Use bypass coded bins instead of context coded bins**
- ✓ **Change bin coding order for concatenation of bypass coded bins**

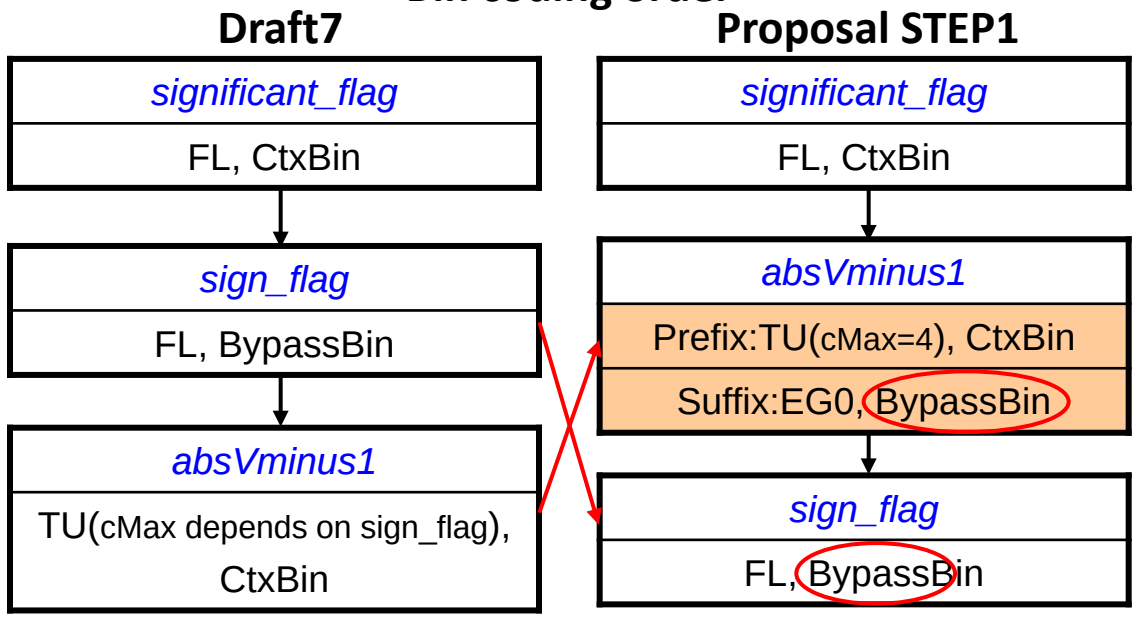
- ✓ **Swap of sign_flag and absVminus1**
  - ✓ **Removal of dependency between sign_flag and absVminus1(cMax of TU)**
  - ✓ **Bin coding order for sign_flag and absVminus1 is swapped**

absVminus1 binarization

Value	Draft7 (TU)		Proposal (TU+EG0)		
	TU	length	TU	EG0	length
0	0	1	0		1
1	10	2	10		2
2	110	3	110		3
3	1110	4	1110		4
4	11110	5	1111	0	5
5	111110	6	1111	100	7
6	1111110	7	1111	101	7
7	11111110	8	1111	11000	9
8	111111110	9	1111	11001	9
9	1111111110	10	1111	11010	9
. . .					
25	“1”*25	25	1111	111100110	13

context bin | context bin | bypass bin

Bin coding order



Bypass coded bins grouping

Reduction of context coded bins and total bins in worst case

✓ Bypass coding for absVminus1

✓ Prefix part of absVminus1 is coded using bypass coded bins instead of context coded bins

ctxIdxInc

		binIdx=0	binIdx=1	binIdx=2	binIdx=3	binIdx>=4	Worst CtxBin Num
absVminus1	Draft7	1	2	2	2	2	25
	STEP1	1	2	2	2	Bypass	4
	STEP2a	1	2	Bypass	Bypass	Bypass	2
	STEP2b	1	Bypass	Bypass	Bypass	Bypass	1
	STEP2c	Bypass	Bypass	Bypass	Bypass	Bypass	0
	J0089	1	1	1	1	Bypass	4

Prefix (TU)

Suffix (EG0)

STEP2c : Context coded bin is only significant_flag
All other bins are bypass coded bins (concatenation)

Coding efficiency [%]

	Main			HE10		
	AI	RA	LB	AI	RA	LB
STEP1	0.02	0.03	0.01	0.02	0.01	0.01
STEP2a	0.04	0.06	0.03	0.05	0.02	0.04
STEP2b	0.06	0.05	0.03	0.06	0.04	0.05
STEP2c	0.09	0.08	0.06	0.09	0.09	0.05

isolated bypass bins number ratio [%]

	Main			HE10		
	AI	RA	LB	AI	RA	LB
STEP1	-4.4	-3.6	-3.3	-4.4	-3.8	-3.5
STEP2a	-11.5	-9.7	-9.2	-11.7	-10.1	-9.5
STEP2b	-19.3	-15.9	-15.0	-19.5	-16.4	-15.5
STEP2c	-35.2	-26.8	-24.3	-35.4	-27.4	-24.8

ctx bins number ratio [%]

	Main						HE10					
	AI		RA		LB		AI		RA		LB	
	dQP	Total	dQP	Total	dQP	Total	dQP	Total	dQP	Total	dQP	Total
STEP1	-7.9	-0.3	-8.1	-0.1	-8.2	-0.2	-8.0	-0.3	-8.3	-0.3	-8.4	-0.3
STEP2a	-21.5	-0.9	-23.2	-0.7	-24.1	-0.7	-21.6	-0.9	-23.5	-0.7	-24.4	-0.7
STEP2b	-35.9	-1.5	-38.8	-1.2	-40.3	-1.2	-36.0	-1.4	-39.0	-1.2	-40.7	-1.3
STEP2c	-62.6	-2.5	-65.2	-1.9	-66.6	-2.0	-62.7	-2.4	-65.4	-2.0	-66.9	-2.1

This contribution recommends “STEP2c”

anchor HM7.0
setting
MaxCuDQPDepth=3
AdaptiveQP=1
MaxQPAdaptationRange=12

Conclusion

It was confirmed that proposed modification can reduce context coded bins and isolated bypass coded bins without significant impact on coding efficiency (in range of 0.1%).

Recommendation

It is suggested to consider the inclusion of this proposal in the DIS of HEVC.