JCTVC-G239

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Non-CE11: Modified method for coding the positions of last significant coefficients in the CABAC mode

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Overall Summary

- Method for coding last_significant_coeff_x and last_significant_coeff_y with a new binarization scheme to further reduce the number of coded bins for improved complexity and efficiency performance
- Y BD-rate gains 0.1%, 0.0%, 0.0% and 0.1% for HE-AI, HE-RA, HE-LDB, and HE-LDP, respectively
- Reduce the max number of total coded bins to 9 (from 20) for each coordinate
- Reduce the max number of CABAC bins to 5 (from 16)
- Related contributions G520 and G704

Proposed Method

- Representation by most significant bit (MSB) index and refinement bits
- Binarization
  - A concatenation of a prefix bin string and a suffix bin string
  - The prefix string represents the MSB index plus one, or **msb_plus_one,** of symbol *x* with

    msb_plus_one = Floor (Log2(*x*)) + 1, if *x* > 0 , or 0 otherwise.

  - Prefix part representing msb_plus_one in a truncated unary code
  - Suffix part representing refinement bins in a fixed-length binary code
- Entropy Coding
  - The prefix bins for msb_plus_one & the leading refinement (suffix) bin coded by CABAC
    - 23 contexts used for each coordinate for Luma
  - The remaining refinement bits bypass coded
  - Context selection derived from transform size & MSB index

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Binarization for 16x16 & 32x32 Blocks

	Proposed Method		WD 4 of HEVC	
last_significant_coeff_x / last_significant_coeff_y	msb_plus_one	refinement bins	Truncated unary	Fixed binary
0	0	-	1	-
1	10	-	01	-
2	110	0	001	-
3	110	1	0001	-
4	1110	00	00001	-
5	1110	01	000001	-
6	1110	10	0000001	-
7	1110	11	00000001	-
8	1111	000	00000000	000
9	1111	001	00000000	001
10	1111	010	00000000	010
11	1111	011	00000000	011
12	1111	100	00000000	100
13	1111	101	00000000	101
14	1111	110	00000000	110
15	1111	111	00000000	111

	Bin String for 16 ~ 31 for TU32x32	
	Prefix bins	Suffix
WD 4 of HEV	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	x x x x
Proposed	1 1 1 1 1	x x x x

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Context Selection

Context Selection in WD 4

i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
lastCtx	0	1	2	3	3	4	4	5	5	5	5	6	6	6	6	7
i	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
lastCtx	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10	

ctxIdxInc = lastCtx[(1 << (log2TrafoSize – 1)) + binIdx]

Context Selection for Prefix in the Proposed Method

i	0	1	2	3
lastCtxOffset	0	3	8	15

ctxIdxInc = lastCtxOffset[log2TrafoSize.-2] + binIdx

Experimental Results

- Reference results generated by HM 4.0
- Verification (G947)
  - Thank Orange for cross checking
  - A small difference found for LDP. Cross checker's results are confirmed after re-running simulation.

	All Intra HE			Random Access HE			Low delay B HE		
	Y	U	V	Y	U	V	Y	U	V
Class A	-0.1%	-0.1%	0.0%	-0.1%	0.0%	-0.3%			
Class B	-0.1%	0.0%	0.0%	-0.1%	0.0%	-0.1%	0.0%	0.2%	-0.1%
Class C	0.0%	0.0%	0.0%	0.0%	-0.1%	0.1%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.2%	0.0%	0.4%	-0.4%
Class E	-0.1%	-0.2%	-0.1%				-0.1%	-0.4%	-0.5%
Overall	-0.1%	0.0%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.1%	-0.2%

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Conclusions

- Overall BD rate gains 0 – 0.1% for Luma and -0.1 – 0.3 % for Chroma
- Significantly reduce the maximal number of CABAC bins (from 16 to 5 bins for each coordinate)
- Simplified binarization and context selection
- Recommend to adopt the proposal into WD

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Thank you