JVET-O0205
CE8-related: Improvements on BDPCM

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Summary

- Proposal
  - To derive the intra prediction mode for the BDPCM based on the actual prediction mode, which is either the horizontal or vertical mode
  - To use line-shaped CG for the BDPCM block

- Simulation results (Based on VTM-5.0)
  - Method 1

	AI					RA					LDB				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class F	-0.12%	0.04%	-0.08%	99%	98%	-0.09%	0.08%	0.10%	100%	98%	0.02%	-0.21%	-0.44%	100%	100%
TGM	-0.18%	-0.06%	-0.07%	100%	99%	-0.18%	-0.02%	-0.13%	99%	98%	-0.04%	0.01%	0.04%	100%	102%

  - Method 1 + Method 2

	AI					RA					LDB				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class F	-0.18%	-0.11%	-0.08%	101%	103%	-0.12%	0.07%	0.10%	101%	105%	-0.24%	-0.30%	-0.31%	99%	98%
TGM	-0.28%	-0.14%	-0.15%	102%	102%	0.00%	0.09%	0.03%	100%	102%	-0.23%	-0.17%	-0.16%	99%	100%

- Thank Tencent (JVET-O0705) and MediaTek (JVET-O0969) for crosschecking ☺

Proposed method 1

- Intra mode derivation for BDPCM
  - To derive the intra prediction mode for the BDPCM based on bdpcm_dir_flag
    - If the BDPCM mode is set to 1, the syntax elements for the intra prediction modes remain not parsed
    - Intra mode is set using bdpcm_dir_flag
      - 0 : Horizontal
      - 1 : Vertical

Proposed method 1

- Proposed spec

8.4.1. General decoding process for coding units coded in intra prediction mode

(…)

– If pcm_flag[xCb][yCb] is equal to 1, the reconstructed picture is modified as follows:

$$S_L[xCb + i][yCb + j] = pcm_sample_luma[(cbHeight * j) + i] << (BitDepth_Y - PcmBitDepth_Y), \quad (8\text{-}6)$$

with i = 0..cbWidth − 1, j = 0..cbHeight − 1

– Otherwise, the following applies:

1. The variable MipSizeId[x][y] for x = xCb..xCb + cbWidth − 1 and y = yCb..yCb + cbHeight − 1 is derived as follows:
   – If both cbWidth and cbHeight are equal to 4, MipSizeId[x][y] is set equal to 0.
   – Otherwise, if both cbWidth and cbHeight are less than or equal to 8, MipSizeId[x][y] is set equal to 1.
   – Otherwise, MipSizeId[x][y] is set equal to 2.
2. The luma intra prediction mode is derived as follows:
   – If intra_mip_flag[xCb][yCb] is equal to 1, the derivation process for matrix-based intra prediction mode as specified in clause 8.4.2 is invoked with the luma location (xCb, yCb), the width of the current coding block in luma samples cbWidth and the height of the current coding block in luma samples cbHeight as input.
   – Otherwise, the derivation process for the luma intra prediction mode as specified in clause 8.4.3 is invoked with the luma location (xCb, yCb), the width of the current coding block in luma samples cbWidth and the height of the current coding block in luma samples cbHeight as input.

~~3. The variable predModeIntra is derived as follows:~~

~~– If BdpcmFlag[xCb][yCb] is equal to 1, predModeIntra is derived as follows:~~

~~predModeIntra = BdpcmDir[xCb][yCb] ? 50 : 18 (8-7)~~

~~–~~3. ~~Otherwise, predModeIntra is~~ set equal to IntraPredModeY[xCb][yCb].

4. The general decoding process for intra blocks as specified in clause 8.4.5.1 is invoked with the sample location (xTb0, yTb0) set equal to the luma location (xCb, yCb), the variable nTbW set equal to cbWidth, the variable nTbH set equal to cbHeight, predModeIntra, and the variable cIdx set equal to 0 as inputs, and the output is a modified reconstructed picture before in-loop filtering.

Proposed method 1

- Proposed spec

8.4.3 Derivation process for luma intra prediction mode

Input to this process are:

– a luma location (xCb , yCb) specifying the top-left sample of the current luma coding block relative to the top-left luma sample of the current picture,

– a variable cbWidth specifying the width of the current coding block in luma samples,

– a variable cbHeight specifying the height of the current coding block in luma samples.

In this process, the luma intra prediction mode IntraPredModeY[xCb][yCb] is derived.

Table 8-3 specifies the value for the intra prediction mode IntraPredModeY[xCb][yCb] and the associated names.

Table 8-3 – Specification of intra prediction mode and associated names

Intra prediction mode	Associated name
0	INTRA_PLANAR
1	INTRA_DC
2..66	INTRA_ANGULAR2..INTRA_ANGULAR66
81..83	INTRA_LT_CCLM, INTRA_L_CCLM, INTRA_T_CCLM

NOTE – : The intra prediction modes INTRA_LT_CCLM, INTRA_L_CCLM and INTRA_T_CCLM are only applicable to chroma components.

IntraPredModeY[xCb][yCb] is derived as follows:

– If BdpcmFlag[xCb][yCb] is equal to 1, IntraPredModeY[xCb][yCb] is derived as follows :

IntraPredModeY[xCb][yCb] = BdpcmDir[xCb][yCb] ? INTRA_ANGULAR50 : INTRA_ANGULAR18

– Otherwise, if ~~or~~ BdpcmFlag[xCb][yCb] is equal to 0 and intra_luma_not_planar_flag[xCb][yCb] is equal to 0, IntraPredModeY[xCb][yCb] is set equal to INTRA_PLANAR .

– Otherwise (BdpcmFlag[xCb][yCb] is equal to 0 and intra_luma_not_planar_flag[xCb][yCb] is equal to 1), the following ordered steps apply:

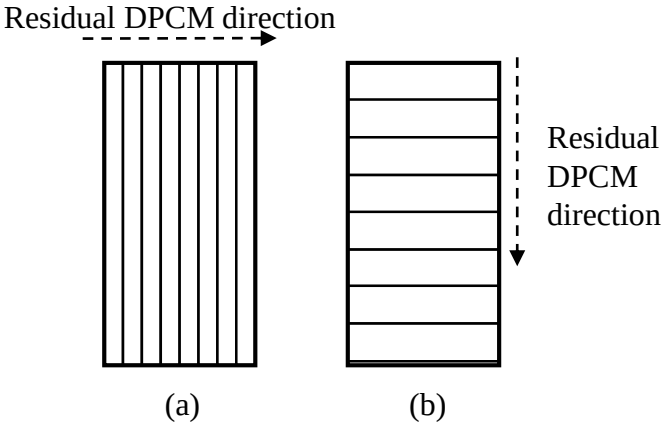
(…)

Proposed method 2

- Line-shaped CG
  - CG can be square (only for 4x4, conventional), rectangular or line
  - The number of residuals in a CG is kept 16
  - CG size is decided adaptively according to the direction of the BDPCM and the block size
  - If the CG is not a line, then the scanning order remains in the diagonal direction

CG size for BDPCM direction and block size

	Block Size	Coefficient group Size
Horizontal BDPCM	$\boldsymbol{M \times N, N \geq 16}$	1×16
	$\boldsymbol{M \times N, N = 8}$	2×8
	$\boldsymbol{M \times N, N = 4}$	4×4
Vertical BDPCM	$\boldsymbol{M \times N, M \geq 16}$	16×1
	$\boldsymbol{M \times N, M = 8}$	8×2
	$\boldsymbol{M \times N, M = 4}$	4×4



Example. 8x16 BDPCM block CG partition
(a) Horizontal BDPCM, CG size 1x16
(b) Vertical BDPCM, CG size 8x2

Test result

- Simulation result under CTC
  - BDPCM is only enabled for Class F and TGM

- Method 1

		Over VTM-5.0				
		Y	U	V	EncT	DecT
AI	**Class F**	**-0.12%**	**0.04%**	**-0.08%**	**99%**	**98%**
	TGM	**-0.18%**	**-0.06%**	**-0.07%**	**100%**	**99%**
RA	**Class F**	**-0.09%**	**0.08%**	**0.10%**	**100%**	**98%**
	TGM	**-0.18%**	**-0.02%**	**-0.13%**	**99%**	**98%**
LB	**Class F**	**0.02%**	**-0.21%**	**-0.44%**	**100%**	**100%**
	TGM	**-0.04%**	**0.01%**	**0.04%**	**100%**	**102%**

- Combination of method 1 and method 2

		Over VTM-5.0				
		Y	U	V	EncT	DecT
AI	**Class F**	**-0.18%**	**-0.11%**	**-0.08%**	**101%**	**103%**
	TGM	**-0.28%**	**-0.14%**	**-0.15%**	**102%**	**102%**
RA	**Class F**	**-0.12%**	**0.07%**	**0.10%**	**101%**	**105%**
	TGM	**0.00%**	**0.09%**	**0.03%**	**100%**	**102%**
LB	**Class F**	**-0.24%**	**-0.30%**	**-0.31%**	**99%**	**98%**
	TGM	**-0.23%**	**-0.17%**	**-0.16%**	**99%**	**100%**

Thank you