

JVET-R0219

Alternative block size conditions for BDPCM

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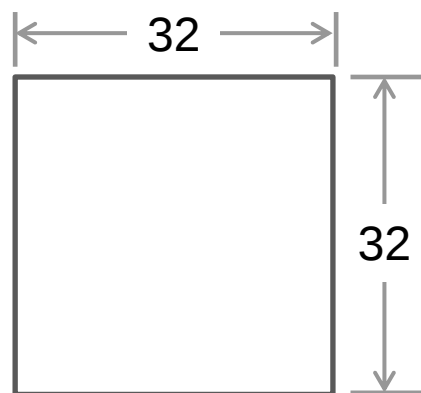
■ Problem statement

- **In the current design, BDPCM is restricted as follows by the block size condition.**
 - Luma and 4:4:4 Chroma : allowed only CU==TU case
 - 4:2:0 and 4:2:2 Chroma : allowed CU==TU case and CU!=TU case partially
- **BDPCM for 4:2:0 and 4:2:2 Chroma are adopted at the last meeting.**
- **If newly-introduced BDPCM with CU!=TU case is a problem from a design point of view, it should be prohibited.**
- **Otherwise, if it is not a problem, the block size condition should be fixed.**
 - Because the current block size threshold is meaningless in the case of max TU size $\leq$ MaxTsSize.

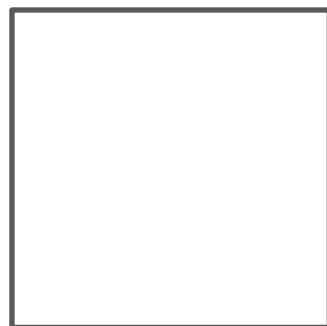
■ Proposal

- **Method 1**
 - The block size condition is changed to prohibit BDPCM in CU!=TU case for 4:2:0 and 4:2:2 Chroma
- **Method 2**
 - The block size condition is relaxed for Luma and Chroma.
 - If the max TU size is less than or equal to MaxTsSize, BDPCM is allowed all CU sizes.

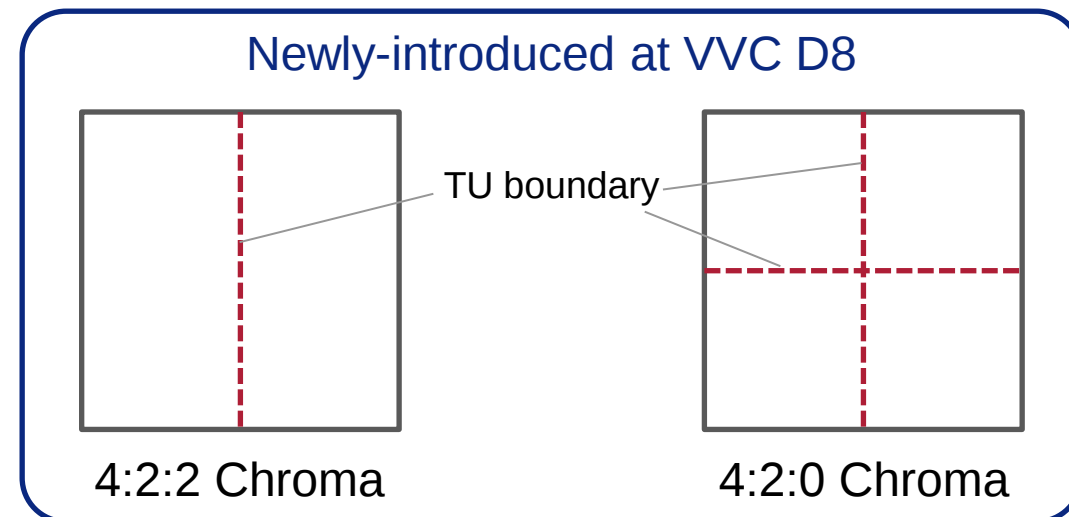
- BDPCM applied CU size shall be less than or equal to MaxTsSize.
 - BDPCM applied CU shall be applied transform skip.
 - The max value of MaxTsSize is 32.
- ex) 32x32 CUs with MaxTbSizeY = 32 (the min value of itself)
 - For 4:2:2 and 4:2:0 Chroma, 32x32 CU is split into multiple TUs, and actual max TS size < 32x32.



Luma



4:4:4 Chroma



- If BDPCM with CU!=TU case is a problem, it should be prohibited.
- Otherwise, if it is not a problem, the block size condition should be fixed.
 - If the max TU size <= MaxTsSize, BDPCM can be allowed all CU sizes. Because transform skip can be applied all CU sizes.

- The block size condition for chroma is changed to restrict BDPCM only CU==TU case.
- For luma
 - Same as the current spec.
- For chroma

if(cbWidth / SubWidthC <= MaxTsSize MaxBdpcmWidthC && cbHeight / SubHeightC <= MaxTsSize MaxBdpcmHeightC && sps_bdpcm_enabled_flag) {	
intra_bdpcm_chroma_flag	ae(v)

MaxBdpcmWidthC = Min(MaxTbSizeY / SubWidthC, MaxTsSize) (xx)

MaxBdpcmHeightC = Min(MaxTbSizeY / SubHeightC, MaxTsSize) (xx)

- The BDPCM block size condition is relaxed under restriction that BDPCM applied CU shall be applied transform skip.
 - The block size condition is changed to allow BDPCM for all CU sizes when the max TU size is less than or equal to MaxTsSize.

■ For luma

if(sps_bdpcm_enabled_flag && cbWidth <= MaxTsSize MaxBdpcmSizeY && cbHeight <= MaxTsSize MaxBdpcmSizeY)	
intra_bdpcm_luma_flag	ae(v)

MaxBdpcmSizeY = MaxTbSizeY > MaxTsSize ? MaxTsSize : CtbSizeY (xx)

■ For chroma

if(cbWidth / SubWidthC <= MaxTsSize MaxBdpcmWidthC && cbHeight / SubHeightC <= MaxTsSize MaxBdpcmHeightC && sps_bdpcm_enabled_flag) {	
intra_bdpcm_chroma_flag	ae(v)

MaxBdpcmWidthC = MaxTbSizeY / SubWidthC > MaxTsSize ? MaxTsSize : CtbSizeY / SubWidthC (xx)

MaxBdpcmHeightC = MaxTbSizeY / SubHeightC > MaxTsSize ? MaxTsSize : CtbSizeY / SubHeightC (xx)

Comparison between the current design and proposal

■ In the case of 4:2:0, MaxTbSizeY = 32, MaxTsSize = 32

No.	CU size Y	TU size Y	CU size C	TU size C	VVC D8 BDPCM Y / BDPCM C	Method 1 BDPCM Y / BDPCM C	Method 2 BDPCM Y / BDPCM C
1	128x128	32x32	64x64	16x16	Prohibited / Prohibited	Prohibited / Prohibited	Allowed / Allowed
2	128x64	32x32	64x32	16x16	Prohibited / Prohibited	Prohibited / Prohibited	Allowed / Allowed
3	64x128	32x32	32x64	16x16	Prohibited / Prohibited	Prohibited / Prohibited	Allowed / Allowed
4	64x64	32x32	32x32	16x16	Prohibited / Allowed	Prohibited / Prohibited	Allowed / Allowed
5	64x32	32x32	32x16	16x16	Prohibited / Allowed	Prohibited / Prohibited	Allowed / Allowed
6	32x64	32x32	16x32	16x16	Prohibited / Allowed	Prohibited / Prohibited	Allowed / Allowed
7	32x32	32x32	16x16	16x16	Allowed / Allowed	Allowed / Allowed	Allowed / Allowed
8	32x16	32x16	16x8	16x8	Allowed / Allowed	Allowed / Allowed	Allowed / Allowed
9	16x32	16x32	8x16	8x16	Allowed / Allowed	Allowed / Allowed	Allowed / Allowed
10	16x16	16x16	8x8	8x8	Allowed / Allowed	Allowed / Allowed	Allowed / Allowed

■ CTC QP

	All Intra Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	-0.01%	-0.04%	0.01%	100%	100%
Class TGM	-0.01%	-0.01%	-0.02%	102%	99%

	Random access Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	0.02%	0.01%	-0.08%	100%	100%
Class TGM	-0.02%	-0.04%	0.01%	100%	100%

	Low delay B Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	0.04%	0.11%	0.50%	100%	101%
Class TGM	-0.09%	-0.07%	-0.07%	100%	101%

■ Low QP

	All Intra Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	0.00%	0.02%	0.04%	100%	101%
Class TGM	-0.02%	0.00%	0.00%	100%	98%

	Random access Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	0.01%	0.22%	0.18%	100%	100%
Class TGM	-0.02%	-0.11%	-0.11%	100%	100%

	Low delay B Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	-0.01%	0.00%	-0.08%	100%	100%
Class TGM	-0.01%	-0.03%	-0.09%	100%	101%

■ CTC QP

	All Intra Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	-0.09%	-0.12%	-0.09%	100%	99%
Class TGM	0.01%	-0.03%	-0.01%	100%	100%

	Random access Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	-0.06%	-0.14%	0.04%	100%	100%
Class TGM	-0.02%	-0.07%	-0.06%	100%	100%

	Low delay B Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	0.13%	0.53%	0.15%	100%	100%
Class TGM	0.03%	0.02%	0.13%	100%	100%

■ Low QP

	All Intra Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	-0.02%	0.00%	-0.01%	100%	99%
Class TGM	-0.02%	0.00%	-0.01%	100%	100%

	Random access Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	0.04%	-0.04%	-0.01%	100%	100%
Class TGM	0.02%	-0.10%	-0.06%	100%	100%

	Low delay B Main10				
	Over VTM-8.0 Log2MaxTbSize=5				
	Y	U	V	EncT	DecT
Class F	-0.04%	0.00%	-0.08%	100%	100%
Class TGM	-0.09%	-0.10%	-0.16%	100%	101%

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■ Method 1 or Method 2 is recommended to adopt to VVC D9 and VTM-9.

- **Proponents recommend Method 1 to adopt because it has less impact than Method 2.**