



MEDIATEK

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CE6-related: Transform selection with intra prediction mode for implicit MTS

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Overall Summary

- Two variations are proposed to select transform for implicit MTS with the intra prediction mode
 - Variation 1: Intra prediction mode with an even number uses DST-VII
 - Variation 2: Intra prediction mode (specified in original ISP transform selection table) uses DST-VII

#	Config.	VTM-6.0 with MTS disabled and implicit MTS enabled			VTM-6.0		
		Y	U	V	Y	U	V
Variation 1	AI	-0.06%	-0.13%	-0.11%	0.03%	0.04%	0.07%
	RA	-0.05%	-0.14%	-0.03%	0.02%	0.10%	0.04%
Variation 2	AI	-0.04%	0.11%	0.13%	0.01%	0.04%	0.07%
	RA	0.00%	0.02%	0.06%	0.01%	0.02%	0.01%

Introduction to Implicit MTS for Intra Block

- Implicit MTS is used for ISP block or non-ISP intra block when LFNST is not applied and MIP is not selected
- A unified method in terms of block width and height is used to decide transform for ISP and non-ISP intra block
 - When block width is in $[4, 16]$, DST-VII is used for horizontal transform
 - When block height is in $[4, 16]$, DST-VII is used for vertical transform
- Since
 - Intra prediction mode is used to decide LFNST transform set
 - Using intra prediction mode at the transform stage has been agreed
- It is proposed to use intra prediction mode for implicit MTS

Variation 1

- If block width (or height) is smaller than or equal to 32 and the intra prediction mode is an even number, the horizontal (or vertical) transform is set to DST-VII
- MTS size constraint (equal to 32) is not changed

Performance of Variation 1

- More BD-rate saving when MTS is disabled and implicit MTS is enabled

	All Intra Main10				
	Over VTM-6.0 with MTS disabled and implicit MTS enabled				
	Y	U	V	EncT	DecT
Class A1	-0.13%	-0.41%	-0.47%	99%	104%
Class A2	0.00%	-0.14%	-0.15%	99%	98%
Class B	-0.12%	-0.16%	-0.10%	98%	100%
Class C	-0.06%	-0.02%	0.06%	100%	101%
Class E	0.07%	0.08%	0.03%	101%	98%
Overall	-0.06%	-0.13%	-0.11%	99%	100%
Class D	-0.07%	-0.06%	0.06%	99%	99%
Class F	0.03%	-0.01%	-0.01%	98%	100%

	Random access Main10				
	Over VTM-6.0 with MTS disabled and implicit MTS enabled				
	Y	U	V	EncT	DecT
Class A1	-0.10%	-0.43%	-0.27%	100%	103%
Class A2	-0.06%	-0.13%	-0.10%	100%	100%
Class B	-0.04%	-0.12%	0.07%	99%	100%
Class C	-0.01%	0.03%	0.10%	100%	100%
Class E					
Overall	-0.05%	-0.14%	-0.03%	100%	101%
Class D	0.05%	0.18%	-0.06%	100%	98%
Class F	-0.03%	-0.05%	-0.04%	99%	100%

Performance of Variation 1

- Minor BD-rate change on CTC

	All Intra Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.01%	0.05%	0.04%	100%	102%
Class A2	0.04%	0.08%	0.03%	99%	96%
Class B	0.03%	0.07%	0.06%	99%	98%
Class C	0.02%	-0.08%	0.08%	98%	98%
Class E	0.06%	0.11%	0.15%	99%	101%
Overall	0.03%	0.04%	0.07%	99%	99%
Class D	-0.01%	-0.08%	-0.06%	98%	102%
Class F	0.06%	0.10%	0.00%	98%	96%

	Random access Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.04%	0.16%	-0.03%	101%	110%
Class A2	0.03%	0.03%	0.07%	100%	105%
Class B	0.00%	0.05%	0.02%	100%	104%
Class C	0.01%	0.17%	0.10%	100%	105%
Class E					
Overall	0.02%	0.10%	0.04%	100%	106%
Class D	-0.01%	0.03%	-0.04%	100%	105%
Class F	0.02%	-0.09%	0.06%	100%	103%

Variation 2

- Intra prediction mode specified in original ISP transform selection table uses DST-VII
- MTS size constraint is 16

Intra prediction mode	Horizontal transform	Vertical transform
planar, 31, 32, 34, 36, 37	(width ≥ 4 && width ≤ 16) ? DST-VII : DCT-II	(height ≥ 4 && height ≤ 16) ? DST-VII : DCT-II
DC, 33, 35	DCT-II	DCT-II
..., 26, 28, 30, 39, 41, 43, ...,	(width ≥ 4 && width ≤ 16) ? DST-VII : DCT-II	DCT-II
..., 25, 27, 29, 38, 40, 42, ...	DCT-II	(height ≥ 4 && height ≤ 16) ? DST-VII : DCT-II

Performance of Variation 2

- More BD-rate saving when MTS is disabled and implicit MTS is enabled

	All Intra Main10				
	Over VTM-6.0 with MTS disabled and implicit MTS enabled				
	Y	U	V	EncT	DecT
Class A1	0.05%	0.13%	0.12%		
Class A2	0.01%	0.14%	0.16%		
Class B	-0.08%	0.18%	0.21%		
Class C	-0.11%	-0.04%	-0.03%		
Class E	-0.02%	0.14%	0.18%		
Overall	-0.04%	0.11%	0.13%		
Class D	-0.16%	-0.06%	0.11%		
Class F	-0.11%	0.06%	0.05%		

	Random access Main10				
	Over VTM-6.0 with MTS disabled and implicit MTS enabled				
	Y	U	V	EncT	DecT
Class A1	0.03%	-0.07%	0.10%		
Class A2	0.01%	-0.02%	-0.06%		
Class B	0.00%	0.11%	0.07%		
Class C	-0.01%	0.02%	0.12%		
Class E					
Overall	0.00%	0.02%	0.06%		
Class D	-0.06%	0.20%	-0.36%		
Class F	-0.03%	-0.09%	0.00%		

Performance of Variation 2

- Minor BD-rate change on CTC

	All Intra Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.01%	0.02%	0.01%	100%	100%
Class A2	0.02%	0.07%	0.03%	101%	100%
Class B	0.01%	0.07%	0.06%	100%	102%
Class C	0.00%	-0.09%	0.04%	100%	100%
Class E	0.02%	0.18%	0.19%	101%	101%
Overall	0.01%	0.04%	0.07%	100%	101%
Class D	-0.02%	0.09%	-0.03%	100%	102%
Class F	-0.02%	0.03%	-0.04%	99%	101%

	Random access Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1	0.02%	-0.07%	0.01%	100%	100%
Class A2	0.03%	-0.01%	-0.03%	101%	100%
Class B	0.00%	0.12%	0.07%	101%	100%
Class C	0.01%	-0.04%	-0.05%	101%	102%
Class E					
Overall	0.01%	0.02%	0.01%	101%	101%
Class D	-0.03%	-0.30%	0.04%	101%	101%
Class F	-0.04%	-0.11%	0.10%	100%	103%

Implicit MTS v.s. Explicit MTS

Anchor: VTM6 with DCT-II only

#	Config.	VTM-6.0 with both MTS and implicit MTS disabled				
		Y	U	V	EncT	DecT
Current implicit MTS	AI	-0.99%	-1.03%	-1.08%	104%	103%
	RA	-0.59%	-0.50%	-0.54%	101%	101%
Variation 1	AI	-1.04%	-1.16%	-1.20%	103%	103%
	RA	-0.64%	-0.65%	-0.57%	101%	102%
Variation 2	AI	-1.03%	-0.92%	-0.96%	103%	102%
	RA	-0.59%	-0.48%	-0.48%	101%	102%
Current explicit MTS	AI	-1.24%	-0.72%	-0.76%	119%	102%
	RA	-0.70%	-0.61%	-0.56%	108%	100%

Conclusions

- This contribution proposes to use intra prediction mode to select transform for implicit MTS
- With variation 1, MTS size constraint is kept as 32 and the transform selection method is used for ISP and non-ISP intra block
- With variation 2, MTS size is reduced to 16 and original ISP transform selection is used for ISP and non-ISP intra block
- It is suggested to consider the proposed variation into VVC and also use implicit MTS as CTC for RA
 - Compared to VTM6.0, implicit MTS: 0.11% RA Y with 6% encoding time reduction for RA
 - Compared to VTM6.0, variation 1: 0.06% RA Y with 6% encoding time reduction for RA

Backup

Implicit MTS v.s. VTM6

	All Intra Main10				
	Over VTM-6.0 with MTS disabled and implicit MTS enabled				
	Y	U	V	EncT	DecT
Class A1	0.30%	0.07%	0.11%	90%	102%
Class A2	0.25%	-0.14%	-0.20%	88%	98%
Class B	0.43%	-0.36%	-0.48%	88%	101%
Class C	0.14%	-0.52%	-0.46%	86%	98%
Class E	0.06%	-0.47%	-0.48%	88%	102%
Overall	0.25%	-0.31%	-0.33%	88%	100%
Class D	0.17%	-0.51%	-0.61%	84%	101%
Class F	0.13%	-0.27%	-0.36%	95%	96%

	Random access Main10				
	Over VTM-6.0 with MTS disabled and implicit MTS enabled				
	Y	U	V	EncT	DecT
Class A1	0.17%	0.50%	0.46%	96%	101%
Class A2	0.13%	0.13%	0.00%	94%	102%
Class B	0.11%	0.04%	-0.13%	94%	101%
Class C	0.03%	-0.08%	-0.13%	92%	101%
Class E					
Overall	0.11%	0.11%	0.01%	94%	101%
Class D	-0.01%	-0.35%	-0.01%	91%	101%
Class F	0.16%	-0.06%	-0.05%	94%	101%

	Low delay B Main10				
	Over VTM-6.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.10%	0.39%	0.18%	95%	101%
Class C	0.01%	-0.16%	-0.10%	97%	101%
Class E	0.28%	0.36%	0.37%	100%	101%
Overall	0.11%	0.20%	0.14%	97%	101%
Class D	-0.03%	-0.01%	0.37%	96%	101%
Class F	0.14%	0.21%	0.12%	97%	102%