Modifications to Intra- frame coding

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Summary

- **Modifications to intra frame coding**
  - M1: modified down-sampling filter for LM mode
    - 4-tap vertical filter for left neighbor reconstructed luma samples
  - M2: Removal of MPM remapping tables
  - M3: Harmonization of Intra mode coding
    - Removal of escape bit in HE
    - FLC replaces VLC for intra mode coding in LC
  - BD-rate Performance

	AI-LC			AI-HE		
	Y	U	V	Y	U	V
M1	0.0%	-0.2%	-0.2%	0.0%	-0.2%	-0.2%
M2	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
M3	-0.1%	0.0%	0.0%	0.1%	0.1%	0.1%

* Thanks to NEC for the cross-check

M1: Modification to LM mode

- Modified down-sampling filter for left neighbor reconstructed luma samples
  - Using vertical 4-tap filter [1,3,3,1], instead of [1,1]
  - Two additional samples are involved (left-above and left-below reconstructed luma samples)
- About 0.2% gain for chroma while maintaining one line buffer

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	0.0%	-0.5%	-0.6%	0.0%	-0.5%	-0.6%
Class B	0.0%	-0.1%	-0.1%	0.0%	-0.1%	-0.1%
Class C	0.0%	-0.1%	-0.1%	0.0%	-0.1%	-0.1%
Class D	0.0%	-0.1%	-0.1%	0.0%	0.0%	-0.1%
Class E	0.0%	-0.1%	-0.2%	0.0%	-0.1%	-0.2%
Overall	0.0%	-0.2%	-0.2%	0.0%	-0.2%	-0.2%
	0.0%	-0.2%	-0.2%	0.0%	-0.2%	-0.2%
Enc Time[%]		100%			100%	
Dec Time[%]		100%			101%	

M2: modified MPM remapping

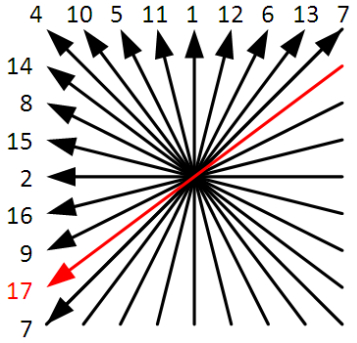
- **Modified MPM remapping from neighbor block**
  - Removal of 3 MPM remapping tables
  - Simplified availability checking of neighbor blocks

Neighbor block	Remapped mode in HM4	Remapped mode in proposal
Neighbor block is unavailable	DC or Planar *(depend on the availability combination of two neighbor blocks)*	Planar
Neighbor block is not an Intra-coded block	DC	Planar
Intra mode number of neighbor block is greater than the maximum mode number of current block	table-based remapping	Planar

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%
Class B	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
Class C	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%
Class D	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Class E	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%
Overall	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Enc Time[%]		100%			100%	
Dec Time[%]		100%			100%	

M3: Harmonization of Intra mode coding (1/3)

Block size	Total number of Intra modes (HM4.0 / proposal)	Total number of remaining Intra modes (HM4.0 / proposal)
2x2	4 / 4	2 / 2
4x4	18 / 18	16 / 16
8x8	35 / 34	33 / 32
16x16	35 / 34	33 / 32
32x32	35 / 34	33 / 32
64x64	4 / 4	2 / 2



- **Intra mode number reduction by introducing a bi-prediction mode which merges two existing diagonal modes (HOR+8 and VER+8)**
  - Total number of Intra modes for 8x8/16x16/32x32 blocks is reduced from 35 to 34
    - Escape bit for remaining Intra mode coding in HE configuration is not required,
  - For 4x4 block size, additional mode(HOR+6) is added
    - better symmetrically distribution of Intra modes for 4x4 block
- **FLC replaces VLC for Intra mode coding in LC configuration**
  - Total number of the remaining modes can be expressed as power of 2

M3: Harmonization of Intra mode coding (2/3)

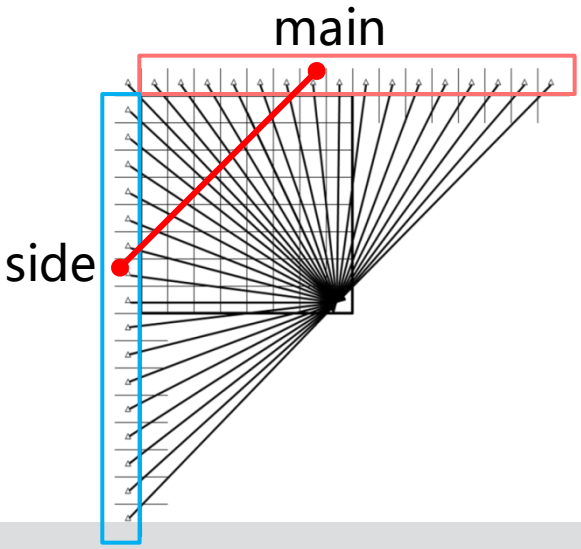
- **Advantages**
  - Unified binarization of intra mode coding for HE and LC configurations
  - Simpler parsing, increased parsing throughput
  - No mode ranking, no VLC tables
  - Coherent Intra mode design for block 4x4
- **Negligible BD performance impact**

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	-0.1%	0.0%	0.1%	0.1%	0.2%	0.2%
Class B	-0.1%	0.0%	0.1%	0.2%	0.1%	0.2%
Class C	-0.1%	-0.1%	-0.1%	0.1%	0.0%	0.1%
Class D	-0.1%	0.0%	0.0%	0.0%	-0.1%	-0.1%
Class E	-0.1%	0.0%	0.1%	0.2%	0.3%	0.4%
Overall	-0.1%	0.0%	0.0%	0.1%	0.1%	0.1%
	-0.1%	0.0%	0.0%	0.1%	0.1%	0.1%
Enc Time[%]		100%			100%	
Dec Time[%]		100%			100%	

M3: Harmonization of Intra mode coding (3/3)

- **Implementation of Bi-prediction mode**
  - Its prediction value is the average of two reference samples from main and side arrays
  - Only one change is added
    - The averaging operation is performed to modify main array before angular Intra prediction

main = (main + side)>>1



THANK YOU!