JCTVC-G736
Luma/chroma interpolation precision

M. Coban, M. Karczewicz

16-bit interpolation process

- There is one intermediate stage in the HM4.0 interpolation process without non-normative offset where the data precision exceeds 16-bits
  - After the second stage filtering of 2D bipred filtering (17-bit)
- Right shift by 1 extra bit brings the precision to 16-bit
- Interpolation process becomes 16-bit without use of non-normative offset

2D bi-pred	HM4.0	Proposed
BitDepth=10 (HE)	Horizontal filtering >> 2 Vertical filtering >> 6	Horizontal filtering >> 2 Vertical filtering >> 7
BitDepth=8 (LC)	Horizontal filtering >> 0 Vertical filtering >> 6	Horizontal filtering >> 0 Vertical filtering >> 7

Results (16-bit interpolation)

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.1%	0.0%	0.0%	0.0%	0.3%	0.2%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.1%	0.0%	0.0%	-0.1%
Class E						
Overall	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Enc Time[%]		98%			98%	
Dec Time[%]		102%			101%	

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.0%	-0.2%	0.0%	0.1%	0.2%
Class C	0.0%	-0.1%	0.0%	0.0%	0.3%	0.0%
Class D	0.0%	0.2%	-0.1%	0.0%	0.0%	-0.2%
Class E	0.0%	0.2%	0.5%	0.0%	-0.1%	-0.2%
Overall	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Enc Time[%]		98%			98%	
Dec Time[%]		101%			100%	

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]		98%			98%	
Dec Time[%]		101%			102%	

QUALCOMM
CDMA Technologies

Higher Precision Interpolation

- The precision of the intermediate values after the horizontal filtering of 2D interpolation process can be increased by 1 bit while preserving the 16-bit interpolation with non-normative offset for HE case

  - After the first stage filtering of 2D filtering (unipred or bipred)
    - 10-bit BitDepth Luma: [-24552, 90024]   {-1,4,-11,40,40,-11,4,-1}
    - 10-bit BitDepth Chroma: [-9207, 74679]   {-4,27,46,-5}

  - Reducing the right shift by 1 of the filtered values after this stage still maintains 16-bit data range

  - Increase the amount of right shift after the second stage by 1

- Proposed change (HE case only, no change for LC)

  - 2D unipred: Horizontal filtering >> ~~2~~ 1,

    Vertical filtering >> ~~10~~ 11

  - 2D bipred: Horizontal filtering >> ~~2~~ 1,

    Vertical filtering >> ~~6~~ 7

QUALCOMM
CDMA Technologies

Results (Higher precision interpolation)

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.0%	-0.3%	-0.3%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	-0.1%	0.1%	0.0%	0.0%	0.0%
Class D	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class E						
Overall	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]		99%			100%	
Dec Time[%]		102%			103%	

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	-0.1%	0.2%	0.0%	0.0%	0.0%
Class D	0.0%	0.3%	0.2%	0.0%	0.0%	0.0%
Class E	0.1%	-0.1%	0.8%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%
Enc Time[%]		102%			102%	
Dec Time[%]		103%			103%	

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	-0.2%	0.3%	0.0%	0.0%	0.0%
Class C	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Class D	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%
Class E	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Enc Time[%]		100%			101%	
Dec Time[%]		101%			102%	