Dynamic range restriction of temporal motion vector

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Introduction

❑ **Temporal motion vector predictor**

  ❖ In AMVP and PU merge

  ❖ Average 2.2% BD-rate saving for RA and LD test conditions

  ❖ Needs additional memory to store the temporal motion vector

❑ **Memory compression of temporal motion vector in HM 2.0**

  ❖ MVs of the first 4x4 PU in units of 16x16 size are stored with lower spatial resolution

  ❖ Both memory size and memory access bandwidth are reduced by 1/16.

MV 1	MV 2	MV 5	MV 6	MV 17	MV 18	MV 21	MV 22	...			
MV 3	MV 4	MV 7	MV 8	MV 19	MV 20	MV 23	MV 24				
MV 9	MV 10	MV 13	MV 14	MV 25	MV 26	MV 29	MV 30				
MV 11	MV 12	MV 15	MV 16	MV 27	MV 28	MV 31	MV 32				
...											
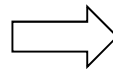
| MV 1	MV 17	...
...		

Motivation

	Width	Height	Bit width for X comp.	Bit width for Y comp.	Number of 4x4 blocks	MV per block	# of ref. lists	# of ref. pictures per ref. list	Required memory size (Mbits/frame)
Class A	2560	1600	15	14	256000	2	2	2	59.39
Class B	1920	1080	14	14	129600	2	2	2	29.03
Class C	832	480	13	12	24960	2	2	2	4.99
Class D	416	240	12	12	6240	2	2	2	1.20
Class E	1280	720	14	13	57600	2	2	2	12.44
Average									21.41

❑ **As picture sizes increases, dynamic range of MV becomes larger.**

❑ **Memory size needed to store the temporal motion vector is affected by**

  ❖ Spatial resolution of motion vector data,

  ❖ Bit width representing the value of each motion vector component.

Proposal

❑ **Clipping of the value of temporal motion vector component**

❖ Restricting the dynamic range of temporal motion vector component

❖ Bit width representing the dynamic range is signaled in SPS.

❖ Clipped motion vector is used as a temporal motion vector predictor.
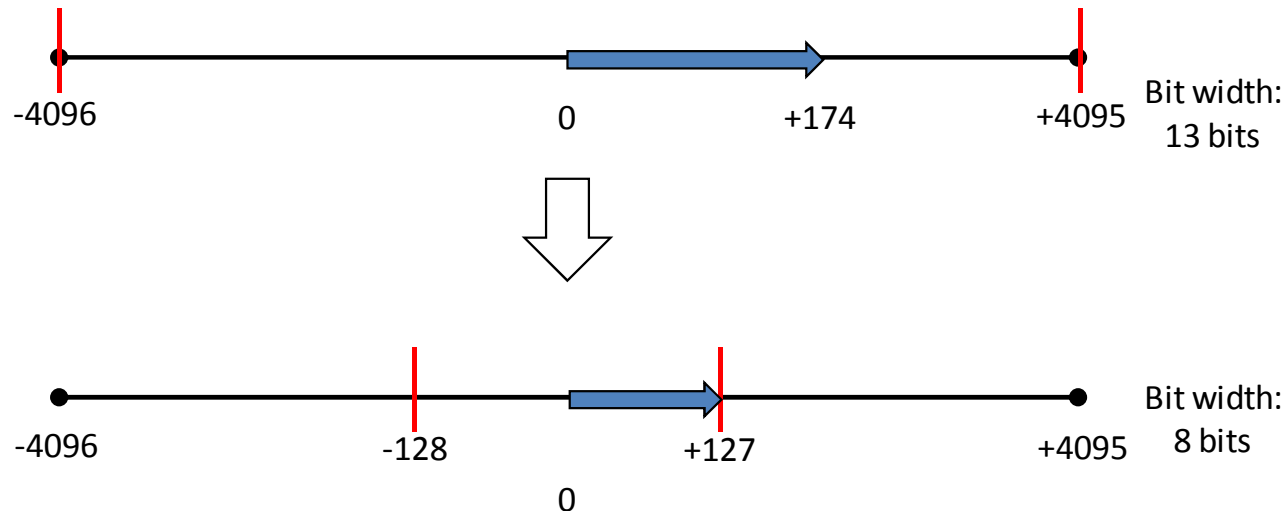
❑ **The required bit width to store temporal motion vector component is reduced.**

❑ **Memory size and memory access bandwidth are reduced.**

Test Conditions

❑ **Implemented on HM 2.0 software**

❑ **Platform**

  ❖ Intel Core i7 CPU X980 @ 3.33Ghz with 12GB RAM

❑ **Configurations**

  ❖ RA-HE, RA-LC, LD-HE, and LD-LC

❑ **Thanks to Sharp (E336) for cross-checking the proposed 8 bits version.**

Results

	6 bits	8 bits	10 bits
RA-HE	1.2%	0.3%	0.0%
RA-LC	1.5%	0.4%	0.0%
LD-HE	0.2%	0.0%	0.0%
LD-LC	0.4%	0.0%	0.0%
Average	**0.8%**	**0.2%**	**0.0%**
Average memory reduction (compared to HM 2.0)	**2.35x**	**1.76x**	**1.41x**

	6 bits	8 bits	10 bits
Total memory saving with memory compression method (D072) in HM 2.0 compared to HM 1.0	**37.61x**	**28.21x**	**22.57x**

Conclusions

❑ **We proposed**

  ❖ Dynamic range restriction of temporal motion vector to reduce the memory size and the memory access bandwidth.

❑ **Performance**

  ❖ Coding efficiency: Average 0.2% BD-Rate loss for 8 bits version
  ❖ Complexity: No impact
  ❖ Memory saving: Reduction by about half compared to HM 2.0

❑ **The proposed changes for syntax, semantics, and decoding process are provided in the document.**

❑ **We suggest the proposed method to be included into the next version of HM.**