

# JCTVC-U0103

## On CHROMA DERIVATION OF INTRA BLOCK COPY FOR NON-444 VIDEO

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# Introduction

- In HEVC SCC draft 3, intra block copy (IBC) mode is signaled as normal inter mode
- For 444 sequences, block vectors (BVs) are always integers.
- For non-444 sequences, one BV may point to a reference **chroma sample** at **fractional** position
  - All fractional chroma BVs are **clipped to integer** precision

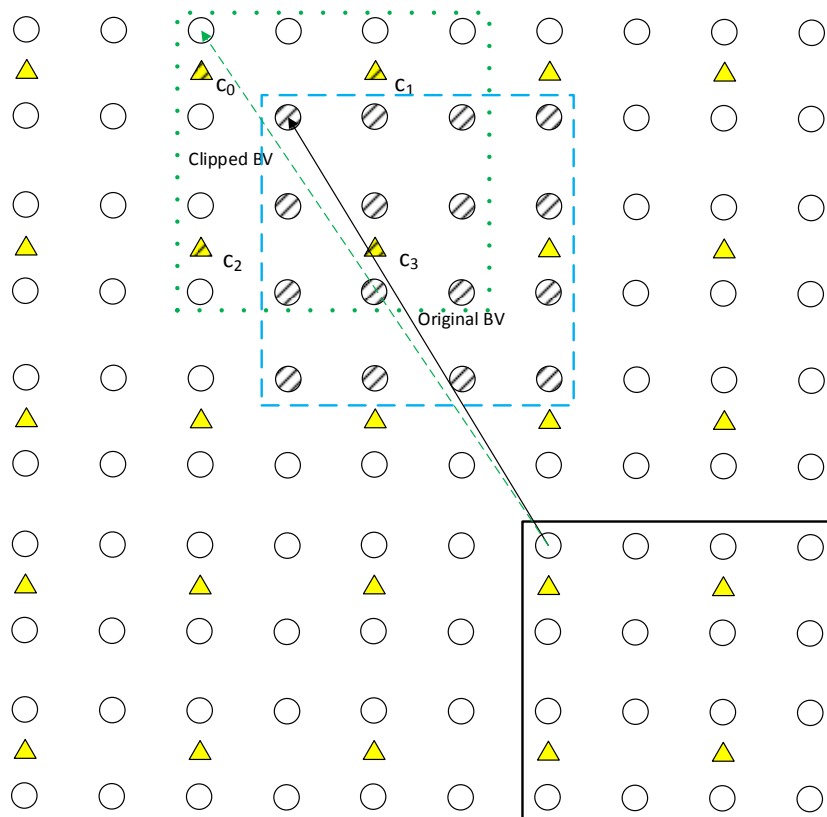
$$\text{mvCLX}[0] = ((\text{mvLX}[0] \gg (1 + \text{SubWidthC})) * 8) \quad (8-201)$$

$$\text{mvCLX}[1] = ((\text{mvLX}[1] \gg (1 + \text{SubHeightC})) * 8) \quad (8-202)$$

- This contribution proposes two options to improve the chroma derivation process for IBC CUs for non-444 sequences

# The Existing Chroma BV Clipping

- The existing BV clipping
  - All fractional chroma BVs are clipped **towards negative infinity**
  - The nearest integer samples,  $C_0$ ,  $C_1$ ,  $C_2$  and  $C_3$ , with equal or smaller horizontal and vertical coordinates are used



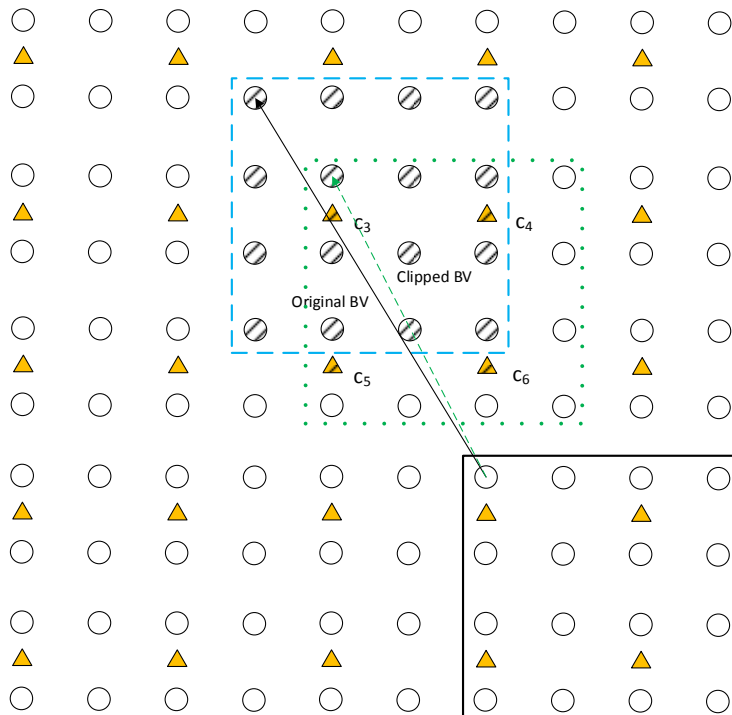
- Shadowed circles are luma reference samples
- Shadowed triangles are chroma reference samples
- Only chroma sample  $C_3$  is overlapped with the luma reference block

# Option #1: improved BV clipping method

- The proposed BV clipping method
  - All fractional BVs are clipped **towards zero**

$$\text{mvCLX}[0] = \text{sign}(\text{mvLX}[0]) * (\text{abs}(\text{mvLX}[0]) >> (1 + \text{SubWidthC})) * 8 \quad (8-201)$$

$$\text{mvCLX}[1] = \text{sign}(\text{mvLX}[1]) * (\text{abs}(\text{mvLX}[1]) >> (1 + \text{SubHeightC})) * 8 \quad (8-202)$$



- The proposed set of chroma reference samples
  - $C_3$ ,  $C_4$ ,  $C_5$  and  $C_6$  are used as used as chroma reference samples
  - Two chroma samples  $C_3$ ,  $C_4$  are overlapped with the luma reference block
  - Being closer to the current CU

## Option #2: chroma sample interpolation

- It is proposed to **enable interpolation filtering** to derive fractional chroma samples for IBC CUs
  - Unified design of IBC and inter modes on chroma derivation

~~—If the picture with index refIdx from reference picture list LX of the slice is not the current picture,~~

$$mvCLX[0] = mvLX[0] * 2 / SubWidthC \quad (8-199)$$

$$mvCLX[1] = mvLX[1] * 2 / SubHeightC \quad (8-200)$$

~~—Otherwise~~

$$mvCLX[0] = ((mvLX[0] \gg (1 + SubWidthC)) * 8) \quad (8-201)$$

$$mvCLX[1] = ((mvLX[1] \gg (1 + SubHeightC)) * 8) \quad (8-202)$$

- **Bit-stream conformance constraint** are applied to ensure the availability of chroma reference samples when interpolation filtering is used

# Coding performance of improved BV clipping (Option #1)

- Average lossy BD-rate savings for YUV text & graphics with motion 1080p & 720p
  - AI: {0.3%, 0.6%, 0.7%}
  - RA: {0.1%, 0.3%, 0.5%}
  - LB: {0.0%, 0.2%, 0.6%}

All Intra			Random Access			Low delay B		
G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
-0.3%	-0.6%	-0.7%	-0.1%	-0.3%	-0.5%	0.0%	-0.2%	-0.6%
-0.2%	-0.4%	-0.4%	0.0%	-0.4%	-0.5%	0.1%	-0.3%	-0.1%
0.0%	0.0%	-0.1%	0.0%	0.3%	0.0%	0.0%	-0.2%	0.0%
97%			99%			98%		
100%			96%			99%		

# Coding performance of improved BV clipping (Option #1)

- Average lossless bit-rate savings of 0.1%, 0.1% and 0.1% for AI, RA and LB for YUV text & graphics with motion 1080p & 720p

All Intra				Random Access				Low Delay B			
Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)
-0.1%	-0.1%	-0.2%	0.0%	-0.1%	-0.1%	-0.2%	0.0%	-0.1%	-0.1%	-0.3%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
97%				98%				99%			
97%				103%				99%			

## Coding performance of chroma interpolation (Option #2)

- Average lossy BD-rate savings for YUV text & graphics with motion 1080p & 720p
  - AI: {2.5%, 3.1% , 3.0%}
  - RA: {1.5%, 1.9%, 2.0%}
  - LB: {0.8%, 1.4%, 1.6%}

All Intra			Random Access			Low delay B		
G/Y	B/U	R/V	G/Y	B/U	R/V	G/Y	B/U	R/V
-2.5%	-3.1%	-3.0%	-1.5%	-1.9%	-2.0%	-0.8%	-1.4%	-1.6%
-0.6%	-1.3%	-1.4%	-0.4%	-0.6%	-0.8%	-0.2%	-1.1%	-0.2%
-0.1%	-0.6%	-0.2%	-0.1%	-0.3%	-0.2%	0.0%	-0.5%	-0.2%
105%			100%			100%		
97%			96%			100%		



## Coding performance of chroma interpolation (Option #2)

- Average lossless bit-rate savings of 0.6%, 0.9% and 1.0% for AI, RA and LB for YUV text & graphics with motion 1080p & 720p

All Intra				Random Access				Low Delay B			
Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)	Bit-rate change (Total)	Bit-rate change (Average)	Bit-rate change (Min)	Bit-rate change (Max)
-0.6%	-0.6%	-2.0%	0.4%	-0.9%	-0.5%	-1.9%	0.0%	-1.0%	-0.4%	-1.9%	0.0%
-0.2%	-0.2%	-0.2%	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	-0.1%	-0.1%	-0.1%	0.0%
0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
107%				101%				102%			
101%				101%				99%			

Thanks to Qualcomm for the cross-check!

# Closing remarks

- Propose two options to improve the chroma derivation process in the current IBC unification framework
  - Option #1: improved BV clipping method
  - Option #2: chroma interpolation filtering
- Coding performance
  - Option #1: average BD-rate savings of 0.3%, 0.1% and 0.1% for AI, RA and LB in lossy coding
  - Option #2 average BD-rate savings of 2.5%, 1.5% and 0.8% for AI, RA and LB in lossy coding
- Suggest to adopt one of two options into SCC