

# **JCT3V-E0144 – Simplification and Improvement of ARP**

---

**Min Woo Park**

Multimedia Platform Lab.  
DMC R&D Center  
**Samsung Electronics**

# List of Proposed Methods

- ❖ Method 1: Applying ARP only to merge mode
- ❖ Method 2: Not using ARP when enabling IC
- ❖ Method 3: Not using half weight for chroma
- ❖ Method 4: Allowing non-zero weight value for inter-view prediction block

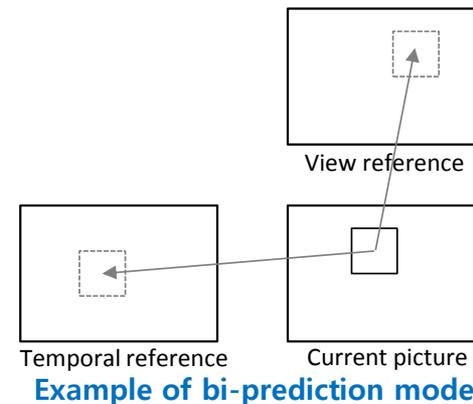
# Applying ARP Only to Merge Mode

- ❖ The current ARP is applied to 2Nx2N merge & INTER
- ❖ We propose to apply ARP only to 2Nx2N merge
  - The number of mode decision for ARP can be reduce from "6" to "3" in 2Nx2N partition size.
  - "DV derivation process" can be only performed in merge mode.
- ❖ Experiment results (CTC, based on HTM 7.0r1)
  - No coding loss w/ 97% encoding time

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	synth PSNR / total bitrate	enc time	dec time	ren time
Balloons	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	97.1%	93.2%	98.8%
Kendo	0.0%	0.1%	-0.1%	0.0%	0.0%	0.0%	97.4%	95.6%	100.3%
Newspaper_CC	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	98.2%	95.9%	102.0%
GT_Fly	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	97.6%	100.1%	102.3%
Poznan_Hall2	0.0%	-0.3%	0.0%	-0.1%	-0.1%	0.0%	97.0%	96.9%	100.0%
Poznan_Street	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	96.8%	104.4%	99.2%
Undo_Dancer	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	96.9%	101.8%	100.1%
1024x768	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.6%	94.9%	100.4%
1920x1088	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.1%	100.8%	100.4%
<b>average</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>97.3%</b>	<b>98.3%</b>	<b>100.4%</b>

# Not Using ARP When Enabling IC (1)

- ❖ ARP weight is signalled even if the current block is an inter-view prediction mode.
- ❖ If  $ic\_flag == 1$ , the current block is most likely to be an inter-view prediction mode.
- ❖ If bi-prediction mode from both temporal & view direction, the number of mode decision to be performed is "6".
  - $ARP\ weight(0, 0.5, 1) * IC\ flag(0, 1)$



- ❖ Therefore, we propose not to use ARP when IC is enabled.
- ❖ With proposed method,
  - Unnecessary ARP weight signalling can be removed.
  - The mode decision complexity can be reduced.

# Not Using ARP When Enabling IC (2)

## ❖ Experimental results

- CTC, based on HTM 7.0r1
- Method 1 + Method2
- 0.1% bit-saving for synthesized views w/ 95% encoding time

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	synth PSNR / total bitrate	enc time	dec time	ren time
Balloons	0.0%	-0.3%	-0.1%	-0.1%	0.0%	-0.1%	94.2%	88.4%	99.2%
Kendo	0.0%	-0.3%	-0.4%	-0.1%	-0.1%	-0.1%	94.9%	100.8%	99.8%
Newspaper_CC	0.0%	-0.2%	-0.2%	0.0%	0.0%	-0.3%	94.8%	94.9%	101.2%
GT_Fly	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	97.7%	101.5%	101.7%
Poznan_Hall2	0.0%	0.0%	0.2%	0.0%	0.0%	0.1%	94.7%	100.3%	101.2%
Poznan_Street	0.0%	-0.3%	-0.1%	0.0%	0.0%	0.0%	93.4%	100.0%	100.6%
Undo_Dancer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	95.9%	101.3%	100.4%
1024x768	0.0%	-0.2%	-0.2%	-0.1%	0.0%	-0.2%	94.6%	94.7%	100.1%
1920x1088	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	95.4%	100.8%	101.0%
<b>average</b>	<b>0.0%</b>	<b>-0.1%</b>	<b>-0.1%</b>	<b>0.0%</b>	<b>0.0%</b>	<b>-0.1%</b>	<b>95.1%</b>	<b>98.2%</b>	<b>100.6%</b>

# Not Using Half Weight for Chroma

- ❖ We observed that the chroma residual can be as it is w/o applying a weight.
- ❖ Therefore, We propose not to use 0.5 weight for chroma components.
- ❖ Experimental results
  - CTC, based on HTM 7.0r1
  - Method 1 + Method 2 + Method 3
  - 0.1% bit-saving for texture & synthesized views w/ 95% encoding time

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	synth PSNR / total bitrate	enc time	dec time	ren time
Balloons	0.0%	-0.5%	-0.3%	-0.1%	-0.1%	-0.1%	94.7%	98.7%	99.8%
Kendo	0.0%	-0.3%	-0.5%	-0.1%	-0.1%	-0.2%	94.7%	97.1%	100.1%
Newspaper_CC	0.0%	-0.1%	-0.2%	0.0%	0.0%	-0.3%	94.6%	99.8%	100.5%
GT_Fly	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	97.7%	100.0%	100.5%
Poznan_Hall2	0.0%	-0.2%	-0.1%	-0.1%	-0.1%	-0.1%	94.2%	95.8%	99.5%
Poznan_Street	0.0%	-0.3%	0.0%	0.0%	0.0%	0.0%	93.9%	100.3%	100.4%
Undo_Dancer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	95.2%	103.0%	99.6%
1024x768	0.0%	-0.3%	-0.3%	-0.1%	-0.1%	-0.2%	94.7%	98.5%	100.1%
1920x1088	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	95.2%	99.8%	100.0%
<b>average</b>	<b>0.0%</b>	<b>-0.2%</b>	<b>-0.2%</b>	<b>-0.1%</b>	<b>0.0%</b>	<b>-0.1%</b>	<b>95.0%</b>	<b>99.2%</b>	<b>100.1%</b>

# Allowing Non-Zero Weight Value (1)

- ❖ Even if the current block is an inter-view prediction mode, ARP weight is signalled and is always set to '0'.
- ❖ To perform ARP, 2 conditions should be satisfied at decoding time
  - Condition 1: ARP weight has non-zero value
  - Condition 2: Prediction direction is not inter-view prediction
- ❖ So, ARP weight can be set to the value which can result in the best coding performance
- ❖ Therefore, we propose to allow non-zero value for the ARP weight when the current block mode is an inter-view prediction mode

# Allowing Non-Zero Weight Value (2)

## ❖ Experimental results

- CTC, based on HTM 7.0r1
- Method 1 + Method 2 + Method 3 + Method 4
- 0.1% bit-saving for coded & synthesized views w/ 94.7% encoding time

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	synth PSNR / total bitrate	enc time	dec time	ren time
Balloons	0.0%	-0.5%	-0.6%	-0.2%	-0.2%	-0.2%	93.5%	91.0%	97.9%
Kendo	0.0%	-0.5%	-0.5%	-0.2%	-0.1%	-0.2%	94.8%	99.7%	100.4%
Newspaper_CC	0.0%	-0.4%	-0.3%	-0.1%	-0.1%	-0.4%	94.3%	96.1%	99.6%
GT_Fly	0.0%	-0.1%	-0.4%	0.0%	0.0%	-0.1%	97.6%	95.6%	100.8%
Poznan_Hall2	0.0%	-0.4%	0.1%	-0.1%	-0.1%	0.0%	94.1%	99.1%	100.4%
Poznan_Street	0.0%	-0.5%	-0.3%	-0.1%	-0.1%	-0.1%	93.3%	103.7%	100.6%
Undo_Dancer	0.0%	0.0%	-0.1%	0.0%	0.0%	0.0%	95.6%	103.6%	100.7%
1024x768	0.0%	-0.4%	-0.5%	-0.1%	-0.1%	-0.2%	94.2%	95.6%	99.3%
1920x1088	0.0%	-0.3%	-0.2%	0.0%	0.0%	0.0%	95.1%	100.5%	100.7%
<b>average</b>	<b>0.0%</b>	<b>-0.3%</b>	<b>-0.3%</b>	<b>-0.1%</b>	<b>-0.1%</b>	<b>-0.1%</b>	<b>94.7%</b>	<b>98.4%</b>	<b>100.1%</b>

# Conclusions

- ❖ We propose 4 methods for ARP
  - 0.1% bit-saving for coded and synthesized views
  - With 94.7% encoding time

	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	synth PSNR / total bitrate	Enc time	Dec. time
Method 1 (Applying ARP only to merge mode)	0.0%	0.0%	0.0%	0.0%	0.0%	97.3%	98.3%
Method 1 and 2 (+ Not using ARP in case of enabling IC)	-0.1%	-0.1%	0.0%	0.0%	-0.1%	95.1%	98.2%
Method 1, 2, and 3 (+ Not using half weight for chroma)	-0.2%	-0.2%	-0.1%	0.0%	-0.1%	95.0%	99.2%
Method 1, 2, 3, and 4 (+ Allowing non-zero value for inter-view prediction block)	-0.3%	-0.3%	-0.1%	-0.1%	-0.1%	94.7%	98.4%

- ❖ We recommend to adopt the proposed methods into next 3D-HEVC TM.

Thanks to **MediaTek** for the cross checking (JCT3V-E0274).

