

## JCTVC-G305: Bi-prediction for low delay coding

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# Summary

## 1. Background

- B slices are always utilized even if GBP pictures\*
  - Bi-prediction for GPB picture is the same as that for non-GPB pictures
- \*GPB picture; List 1 is identical to List 0 and no future reference is used

## 2. Proposal

- Bi-prediction for GPB pictures is proposed for improvement
- Proposed method
  - Bi-prediction using L1 PMV and L0 MV
    - ◆ L1 MVD is not signaled and it sets to (0, 0) at decoder
  - A flag to indentify whether the L1 MVD is parsed or not is signaled at slice layer
    - ◆ Flag is set to 1 when List 1 is identical to List 0 in this contribution

## 3. Results (BD rate saving)

- LDB-HE and LDB-LC; -0.9% (ENC/DEC time; 100%/100%)
- RA-HE and RA-LC; -0.2% (ENC/DEC time; 100%/100%)
- RA-HE and RA-LC (GOP size = 4; -g 4 -rg 4); -0.4% (ENC/DEC time; 100%/100%)

## 4. Recommendations

- Adopt the proposed method to WD5.0
  - Text is ready ; syntax change only. Any decoding process is not changed
  - Cross-verification by HHI (JCTVC-G603)

# Changes to the WD4 (1)

Changes to the WD is small and any decoding process is not changed

- Flag to identify if the list 1 motion vector difference is parsed at slice header
- Prediction unit is modified so that the L1 MVD can be set to (0, 0)

- **Slice header semantics**

- **mvd\_l1\_zero\_flag** equals to 1 indicates that difference between a list 1 vector component and its prediction, `mvd_l1[][][]`, is not parsed and it is set equal to 0. This flag equals to 1 indicates that `mvd_l1[][][]` is parsed.

slice_header( ) {	Descriptor
...	
if( nal_ref_idc != 0 )	
dec_ref_pic_marking( )	
}	
<b>if( slice_type == B )</b>	
<b>mvd_l1_zero_flag</b>	<b>u(1)</b>
if( entropy_coding_mode_flag && slice_type != I)	
<b>cabac_init_idc</b>	ue(v)
...	
}	

## Changes to the WD4 (2)

Changes to the WD is small

- Flag to identify if the list 1 motion vector difference is parsed at slice header
- Prediction unit is modified so that the L1 MVD can be set to (0, 0)

- Prediction unit syntax**

prediction_unit( x0, y0, log2CUSize ) {	Descriptor
...	
if( inter_pred_flag[ x0 ][ y0 ] == Pred_BI ) {	
if( num_ref_idx_l1_active_minus1 > 0 ) {	
...	
}	
<b>if( mvd_l1_zero_flag ) {</b>	
<b>mvd_l1[ x0 ][ y0 ][ 0 ] = 0</b>	
<b>mvd_l1[ x0 ][ y0 ][ 1 ] = 0</b>	
<b>} else {</b>	
if( entropy_coding_mode_flag ) {	
mvd_coding_cabac(mvd_l1[ x0 ][ y0 ][ 0 ], mvd_l1[ x0 ][ y0 ][ 1 ])	
} else {	
<b>mvd_l1[ x0 ][ y0 ][ 0 ]</b>	se(v)
<b>mvd_l1[ x0 ][ y0 ][ 1 ]</b>	se(v)
}	
<b>}</b>	
...	

# Modifications to encoder

Only two processes in ME are modified for GPB pictures (list 1 is identical to list 0)

- Select one of PMV candidates for L1 as the L1 MV for bi-prediction
- Discard the process to select the best PMV for L1 after motion search

**mvd\_l1\_zero\_flag** is set to 1 for GPB picture in this contribution

- Other implementation or criteria by the encoder is also possible using this flag

	ME steps	Modifications
1	Uni-prediction for L0	Same as HM4.0
2	Uni-prediction for L1	<ul style="list-style-type: none"> <li>• Motion search is the same as HM4.0</li> <li>• <b>PMV candidates for L1 which minimizes a prediction error is selected</b></li> <li>• <b>Store ref_idx[1] and mvp_idx[1]</b></li> </ul>
3	Select L1 MV for bi-prediction	<b>Best PMV is used as the L1 MV instead of L1 MV detected at step 2</b>
4	Motion search for the L0 MV for bi-prediction	Same as HM4.0
5	Choose best PMV of L0 for bi-prediction	Same as HM4.0
6	Choose best PMV of L1 for bi-prediction	<b>Discard this step</b>
7	Choose best prediction type (uni or bi-pred.)	Same as HM4.0

# Results

- Proposed method is integrated into HM4.0
  - it is utilized for GPB pictures (List 1 is identical to List 0) in this test
- 0.9% and 0.2% BD-rate saving for LD and RA conditions, respectively

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class B	-0.8%	-1.2%	-1.3%	-1.0%	-0.7%	-0.8%
Class C	-1.0%	-1.0%	-0.9%	-0.8%	-0.6%	-0.9%
Class D	-1.0%	-0.6%	-0.8%	-0.8%	-0.3%	-0.6%
Class E	-0.9%	-0.8%	0.0%	-1.0%	-0.8%	-0.4%
Overall	-0.9%	-0.9%	-0.9%	-0.9%	-0.6%	-0.7%
	-0.9%	-1.0%	-0.9%	-0.9%	-0.7%	-0.7%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.3%	-0.4%	-0.5%	-0.5%	0.1%	-0.1%
Class B	-0.3%	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%
Class C	-0.2%	-0.3%	-0.2%	-0.1%	-0.2%	-0.1%
Class D	-0.2%	-0.2%	-0.3%	-0.1%	-0.3%	-0.2%
<b>Overall</b>	-0.2%	-0.3%	-0.3%	-0.2%	-0.2%	-0.2%
	-0.2%	-0.3%	-0.3%	-0.2%	-0.2%	-0.2%
Enc Time[%]	100%			99%		
Dec Time[%]	100%			100%		

# Additional Results

- Proposed method is applied to key pictures only for RA
- When GOP size = 4 (-g 4 -rg 4), the gain becomes double

Table 1. GOP size =4 (common condition with -g 4 and -rg 4)

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.4%	-0.3%	-0.6%	-0.7%	-0.1%	-0.4%
Class B	-0.4%	-0.5%	-0.5%	-0.5%	-0.4%	-0.6%
Class C	-0.4%	-0.3%	-0.3%	-0.3%	-0.2%	-0.3%
Class D	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.4%
<b>Overall</b>	-0.4%	-0.4%	-0.5%	-0.4%	-0.3%	-0.4%
	-0.4%	-0.4%	-0.5%	-0.4%	-0.2%	-0.4%
Enc Time[%]	100%			99%		
Dec Time[%]	100%			101%		

Table 2. GOP size =8 (common condition)

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.3%	-0.4%	-0.5%	-0.5%	0.1%	-0.1%
Class B	-0.3%	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%
Class C	-0.2%	-0.3%	-0.2%	-0.1%	-0.2%	-0.1%
Class D	-0.2%	-0.2%	-0.3%	-0.1%	-0.3%	-0.2%
<b>Overall</b>	-0.2%	-0.3%	-0.3%	-0.2%	-0.2%	-0.2%
	-0.2%	-0.3%	-0.3%	-0.2%	-0.2%	-0.2%
Enc Time[%]	100%			99%		
Dec Time[%]	100%			100%		

# Conclusion

- Bi-prediction for GPB pictures is proposed
  - L1 MVD is not signaled and it sets to (0, 0)
  - Flag to identify whether L1 MVD is parsed or not is signaled at slice header
- Proposal achieves 0.9% and 0.2% BD-rate improvement without any additional ENC/DEC time for LD and RA, respectively
- Additionally confirmed that proposal achieves 0.4% BD-rate improvement is achieved for RA when GOP size is 4
- It is recommended that the proposal is adapted into the WD5.
  
- Thank you, HHI, for cross-checking experiments we proposed



## Supplementary slides

# Encoder only change, LD

- Test method; G305 + (L1 MVD=0 is signaled) and mvd\_l1\_zero\_flag is not signaled
- ME part of encoder is not changed
- Encoder achieves 0.3% BD-rate improvement
- Syntax change achieves 0.6% additional BD-rate improvement for LD conditions

Table 1. G305 (encoder only change)

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class B	-0.3%	-0.4%	-0.7%	-0.4%	-0.2%	-0.1%
Class C	-0.3%	-0.3%	-0.1%	-0.3%	-0.1%	-0.3%
Class D	-0.1%	0.1%	0.1%	-0.1%	0.1%	-0.1%
Class E	-0.3%	-0.5%	0.0%	-0.5%	-0.2%	-0.3%
Overall	-0.3%	-0.2%	-0.2%	-0.3%	-0.1%	-0.2%
	-0.3%	-0.3%	-0.3%	-0.3%	-0.2%	-0.2%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

Table 2. G305 (encoder and decoder change; proposal)

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class B	-0.8%	-1.2%	-1.3%	-1.0%	-0.7%	-0.8%
Class C	-1.0%	-1.0%	-0.9%	-0.8%	-0.6%	-0.9%
Class D	-1.0%	-0.6%	-0.8%	-0.8%	-0.3%	-0.6%
Class E	-0.9%	-0.8%	0.0%	-1.0%	-0.8%	-0.4%
Overall	-0.9%	-0.9%	-0.9%	-0.9%	-0.6%	-0.7%
	-0.9%	-1.0%	-0.9%	-0.9%	-0.7%	-0.7%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

# Encoder only change, RA

- Test method; G305 + (L1 MVD=0 is signaled) and mvd\_l1\_zero\_flag is not signaled
- ME part of encoder is not changed
- Encoder achieves 0.1% BD-rate improvement
- Syntax change achieves 0.1% additional BD-rate improvement for RA conditions

Table 1. G305 (encoder only change)

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.2%	-0.2%	-0.5%	-0.4%	0.3%	0.1%
Class B	-0.1%	-0.1%	-0.2%	-0.2%	-0.2%	-0.2%
Class C	0.0%	0.0%	0.1%	0.0%	-0.1%	0.0%
Class D	0.0%	0.0%	-0.1%	0.0%	-0.1%	0.0%
<b>Overall</b>	-0.1%	-0.1%	-0.2%	-0.1%	0.0%	0.0%
	-0.1%	-0.1%	-0.2%	-0.1%	0.0%	0.0%
Enc Time[%]	100%			99%		
Dec Time[%]	100%			100%		

Table 2. G305 (encoder and decoder change; proposal)

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.3%	-0.4%	-0.5%	-0.5%	0.1%	-0.1%
Class B	-0.3%	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%
Class C	-0.2%	-0.3%	-0.2%	-0.1%	-0.2%	-0.1%
Class D	-0.2%	-0.2%	-0.3%	-0.1%	-0.3%	-0.2%
<b>Overall</b>	-0.2%	-0.3%	-0.3%	-0.2%	-0.2%	-0.2%
	-0.2%	-0.3%	-0.3%	-0.2%	-0.2%	-0.2%
Enc Time[%]	100%			99%		
Dec Time[%]	100%			100%		