

JCTVC-G441

Redundancy Removal of Explicit Weighted Prediction Syntax

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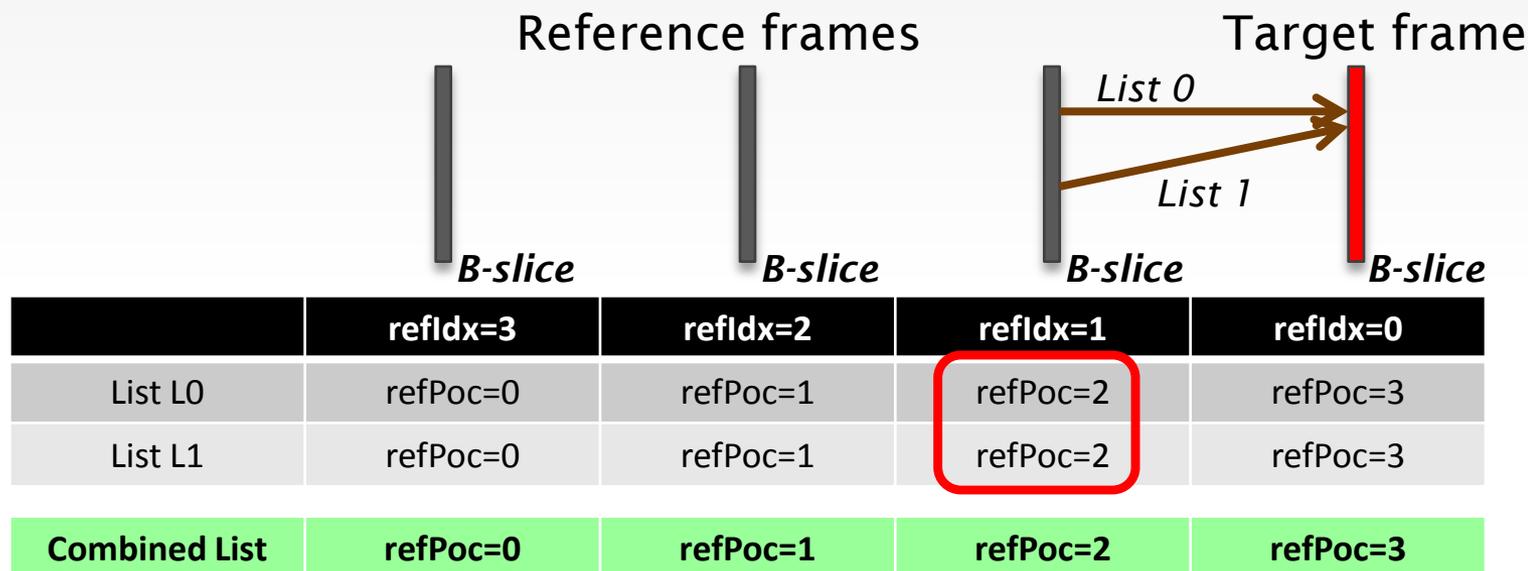
Overall Summary

- **Weighted Prediction in HEVC**
 - AVC based WP (AVCWP) was adopted in HM4/WD4
 - AVCWP has redundant representation of syntax in B-slice
- **Proposal:**
 - Redundancy removal of explicit weighted prediction syntax
 - Proposal 1:
 - Unifying pred_weight_table syntax to combined list management (JCTVC-D421)
 - Proposal 2:
 - Introducing simple prediction to pred_weight_table syntax elements
- **Results:**
 - Report experimental results on black-fade and white-fade sequences
 - Cross-checking results are reported in JCTVC-G525 by Technicolor

Proposal 1

Background of Weighted Prediction (WP)

- pred_weight_table syntax is signaled at each reference frame
- Ex) In forward B-slice, same pred_weight_table syntax could be signaled to the decoder



- Proposal 1:
 - Introducing combined_pred_weight_table syntax based on combined list management (JCTVC-D421)
 - The above redundant representation is removed

Syntax modification

• Slice header and Combined pred weight table syntax

	Descriptor
slice_header() {	
...	
if((weighted_pred_flag && slice_type == P) (weighted_bipred_idc == 1 && slice_type == B)){	
if(ref_pic_list_combination_flag && slice_type == B)	
combined_pred_weight_table()	
else	
pred_weight_table()	
}	
...	
}	

If ref_pic_list_combination_flag is false, then conventional pred_weight_table syntax is used.

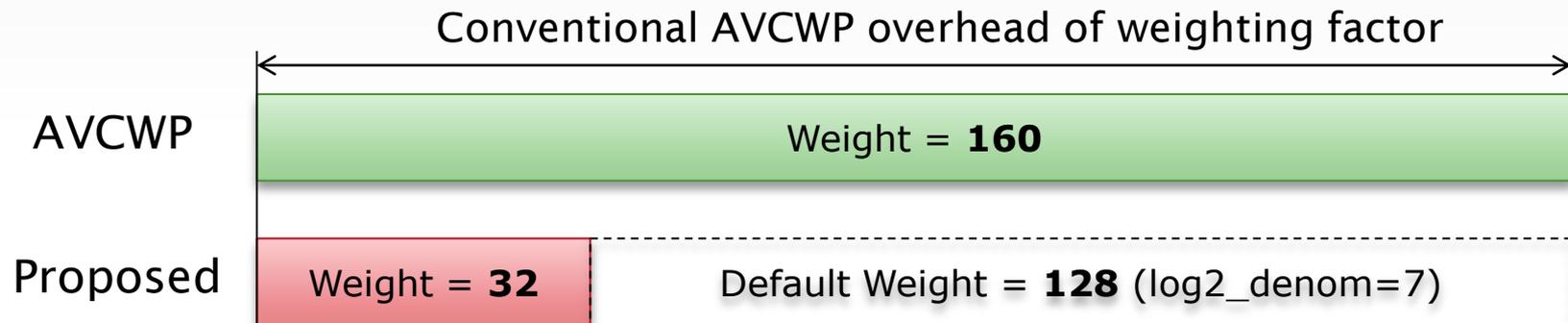
	Descriptor
combined_pred_weight_table() {	
luma_log2_weight_denom	ue(v)
if(chroma_format_idc != MONO_IDX)	
chroma_log2_weight_denom	ue(v)
for(i = 0; i <= num_ref_com_le_active_minus1; i++) {	
luma_weight_common_flag	u(1)
if(luma_weight_common_flag) {	
luma_weight_common[i]	
luma_offset_common[i]	se(v)
}	
if(chroma_format_idc != MONO_IDX) {	
chroma_weight_common_flag	u(1)
if(chroma_weight_common_flag)	
for(j = 0; j < 2; j++) {	
chroma_weight_common[i][j]	se(v)
chroma_offset_common[i][j]	se(v)
}	
}	
}	
}	

Syntax elements of list0 and list1 are combined.

Proposal 2

Background of Weighted Prediction (WP)

- Syntax elements of `pred_weight_table` are encoded directly
- Ex) if `log2_denom` is 7 and the ideal weighting factor is 1.25, then $1.25 * (1 \ll 7) = 160$ is encoded. However, by subtracting the default weighting factor ($(1 \ll 7) = 128$) from this value, the overhead can be reduced considerably.



- Proposal 2:
 - Introducing simple prediction based on default weighting parameters
 - Coding efficiency can be improved

Prediction of wp syntax elements

- **Weighting factor for Luma and chroma**

$$\text{delta_luma_weight_common}[i] = \text{luma_weight_common}[i] -$$

$$(1 \ll \text{luma_log2_weight_denom})$$

$$\text{delta_chroma_weight_common}[i] = \text{chroma_weight_common}[i] -$$

$$(1 \ll \text{chroma_log2_weight_denom})$$

- **Offset for chroma**

$$\text{delta_chroma_offset_common}[i] = (\text{chroma_offset_common}[i] -$$

$$(\text{Med} - (\text{Med} * \text{chroma_weight_common}[i]) \gg \text{chroma_log2_weight_denom}))$$

$$\text{Med} = (1 \ll (\text{bit_depth_chroma_minus8} + 7))$$

- **Denominator for chroma**

$$\text{delta_chroma_log2_weight_denom} = (\text{chroma_log2_weight_denom} -$$

$$\text{luma_log2_weight_denom})$$

Experimental results for Proposal 1 vs. HM4.0-dev WP

Black-fade sequences

White-fade sequences

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class B	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Class C	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Class D	-0.8%	-0.7%	-0.8%	-0.8%	-0.7%	-0.7%
Class E						
Overall	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
Enc Time[%]		100%			100%	
Dec Time[%]		101%			100%	

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	0.0%
Class B	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Class C	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
Class D	-1.0%	-0.9%	-0.9%	-0.9%	-0.8%	-0.8%
Class E						
Overall	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
Enc Time[%]		100%			100%	
Dec Time[%]		100%			100%	

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.6%	-0.5%	-0.5%	-0.5%	-0.5%	-0.4%
Class C	-1.3%	-1.2%	-1.2%	-1.2%	-1.1%	-1.1%
Class D	-4.1%	-3.7%	-3.8%	-3.8%	-3.4%	-3.5%
Class E	-4.3%	-3.8%	-3.9%	-3.6%	-3.1%	-3.1%
Overall	-2.3%	-2.1%	-2.1%	-2.1%	-1.8%	-1.9%
	-2.3%	-2.1%	-2.2%	-2.1%	-1.9%	-1.9%
Enc Time[%]		100%			100%	
Dec Time[%]		100%			100%	

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.7%	-0.6%	-0.6%	-0.6%	-0.5%	-0.5%
Class C	-1.5%	-1.4%	-1.4%	-1.4%	-1.3%	-1.3%
Class D	-4.6%	-4.2%	-4.3%	-4.3%	-3.9%	-4.0%
Class E	-4.8%	-4.2%	-4.3%	-4.0%	-3.5%	-3.5%
Overall	-2.6%	-2.4%	-2.4%	-2.4%	-2.1%	-2.1%
	-2.6%	-2.4%	-2.4%	-2.4%	-2.1%	-2.2%
Enc Time[%]		100%			100%	
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[%]		100%			100%	
Dec Time[%]		100%			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[%]		100%			100%	
Dec Time[%]		100%			101%	

Experimental results for Proposal 2 vs. HM4.0-dev WP

Black-fade sequences

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.1%	0.0%	0.0%	-0.1%	-0.1%	-0.1%
Class B	-0.2%	-0.1%	-0.1%	-0.3%	-0.2%	-0.2%
Class C	-0.4%	-0.3%	-0.3%	-0.6%	-0.6%	-0.6%
Class D	-1.1%	-1.0%	-1.0%	-2.1%	-1.9%	-1.9%
Class E						
Overall	-0.4%	-0.4%	-0.4%	-0.7%	-0.7%	-0.7%
	-0.4%	-0.4%	-0.4%	-0.7%	-0.7%	-0.7%
Enc Time[%]		100%		100%		
Dec Time[%]		99%		99%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.2%	-0.2%	-0.2%	-0.5%	-0.4%	-0.4%
Class C	-0.6%	-0.5%	-0.5%	-1.1%	-1.0%	-1.0%
Class D	-1.6%	-1.5%	-1.5%	-3.6%	-3.2%	-3.3%
Class E	-2.2%	-1.9%	-2.0%	-3.7%	-3.2%	-3.2%
Overall	-1.0%	-0.9%	-0.9%	-2.0%	-1.8%	-1.8%
	-1.0%	-0.9%	-1.0%	-2.0%	-1.8%	-1.9%
Enc Time[%]		100%		100%		
Dec Time[%]		99%		98%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-0.1%	-0.1%	-0.3%	-0.2%	-0.2%
Class C	-0.3%	-0.3%	-0.3%	-0.6%	-0.5%	-0.5%
Class D	-0.9%	-0.8%	-0.8%	-1.9%	-1.7%	-1.8%
Class E	-1.2%	-1.1%	-1.1%	-2.0%	-1.7%	-1.7%
Overall	-0.6%	-0.5%	-0.5%	-1.1%	-0.9%	-1.0%
	-0.6%	-0.5%	-0.5%	-1.1%	-1.0%	-1.0%
Enc Time[%]		100%		100%		
Dec Time[%]		100%		98%		

White-fade sequences

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Class B	-0.2%	-0.1%	-0.1%	-0.3%	-0.2%	-0.2%
Class C	-0.4%	-0.3%	-0.3%	-0.7%	-0.6%	-0.6%
Class D	-1.1%	-1.0%	-1.0%	-2.2%	-2.0%	-2.0%
Class E						
Overall	-0.4%	-0.4%	-0.4%	-0.8%	-0.7%	-0.7%
	-0.4%	-0.4%	-0.4%	-0.8%	-0.7%	-0.7%
Enc Time[%]		100%		100%		
Dec Time[%]		100%		98%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.2%	-0.2%	-0.2%	-0.5%	-0.4%	-0.4%
Class C	-0.6%	-0.5%	-0.5%	-1.2%	-1.1%	-1.1%
Class D	-1.6%	-1.5%	-1.5%	-3.6%	-3.3%	-3.4%
Class E	-2.2%	-1.9%	-1.9%	-3.7%	-3.2%	-3.2%
Overall	-1.0%	-0.9%	-0.9%	-2.1%	-1.8%	-1.9%
	-1.0%	-0.9%	-0.9%	-2.1%	-1.9%	-1.9%
Enc Time[%]		100%		100%		
Dec Time[%]		100%		99%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-0.1%	-0.1%	-0.3%	-0.2%	-0.2%
Class C	-0.3%	-0.3%	-0.3%	-0.6%	-0.6%	-0.6%
Class D	-0.9%	-0.8%	-0.8%	-2.0%	-1.7%	-1.8%
Class E	-1.2%	-1.1%	-1.1%	-2.0%	-1.7%	-1.7%
Overall	-0.6%	-0.5%	-0.5%	-1.1%	-1.0%	-1.0%
	-0.6%	-0.5%	-0.5%	-1.1%	-1.0%	-1.0%
Enc Time[%]		100%		100%		
Dec Time[%]		100%		99%		

Experimental results for Proposal 1&2 vs. HM4.0-dev WP

Black-fade sequences

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Class B	-0.2%	-0.2%	-0.2%	-0.3%	-0.3%	-0.3%
Class C	-0.6%	-0.5%	-0.5%	-0.7%	-0.7%	-0.7%
Class D	-1.8%	-1.6%	-1.6%	-2.5%	-2.3%	-2.3%
Class E						
Overall	-0.6%	-0.6%	-0.6%	-0.9%	-0.8%	-0.8%
	-0.7%	-0.6%	-0.6%	-0.9%	-0.8%	-0.8%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.8%	-0.7%	-0.6%	-0.8%	-0.7%	-0.7%
Class C	-1.6%	-1.5%	-1.5%	-1.7%	-1.6%	-1.6%
Class D	-4.9%	-4.5%	-4.6%	-5.7%	-5.1%	-5.2%
Class E	-5.4%	-4.8%	-4.9%	-5.5%	-4.7%	-4.8%
Overall	-2.9%	-2.6%	-2.6%	-3.1%	-2.8%	-2.8%
	-2.9%	-2.6%	-2.7%	-3.2%	-2.8%	-2.9%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-0.1%	-0.1%	-0.3%	-0.2%	-0.2%
Class C	-0.3%	-0.3%	-0.3%	-0.6%	-0.5%	-0.5%
Class D	-0.9%	-0.8%	-0.8%	-1.9%	-1.7%	-1.8%
Class E	-1.2%	-1.1%	-1.1%	-2.0%	-1.7%	-1.7%
Overall	-0.6%	-0.5%	-0.5%	-1.1%	-0.9%	-1.0%
	-0.6%	-0.5%	-0.5%	-1.1%	-1.0%	-1.0%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

White-fade sequences

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.1%	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%
Class B	-0.3%	-0.2%	-0.2%	-0.3%	-0.3%	-0.3%
Class C	-0.6%	-0.6%	-0.6%	-0.8%	-0.8%	-0.8%
Class D	-1.9%	-1.7%	-1.8%	-2.7%	-2.5%	-2.5%
Class E						
Overall	-0.7%	-0.6%	-0.6%	-1.0%	-0.9%	-0.9%
	-0.7%	-0.6%	-0.7%	-1.0%	-0.9%	-0.9%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.8%	-0.7%	-0.7%	-0.9%	-0.7%	-0.7%
Class C	-1.8%	-1.7%	-1.7%	-2.0%	-1.8%	-1.9%
Class D	-5.4%	-5.0%	-5.1%	-6.2%	-5.6%	-5.8%
Class E	-5.9%	-5.2%	-5.3%	-6.0%	-5.1%	-5.1%
Overall	-3.2%	-2.9%	-2.9%	-3.5%	-3.0%	-3.1%
	-3.2%	-2.9%	-2.9%	-3.5%	-3.1%	-3.1%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			100%		

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class A						
Class B	-0.1%	-0.1%	-0.1%	-0.3%	-0.2%	-0.2%
Class C	-0.3%	-0.3%	-0.3%	-0.6%	-0.6%	-0.6%
Class D	-0.9%	-0.8%	-0.8%	-2.0%	-1.7%	-1.8%
Class E	-1.2%	-1.1%	-1.1%	-2.0%	-1.7%	-1.7%
Overall	-0.6%	-0.5%	-0.5%	-1.1%	-1.0%	-1.0%
	-0.6%	-0.5%	-0.5%	-1.1%	-1.0%	-1.0%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			101%		

Conclusion

- Proposal:
 - Prop.1: Unifying pred_weight_table syntax to combined list management (JCTVC-D421)
 - Prop.2: Introducing simple prediction to pred_weight_table syntax elements
- Experimental Results:
 - For Black-fade and White-fade sequences
 - RA-HE: 0.6%/0.7% RA-LC: 0.9%/1.0%
 - LB-HE: 2.9%/3.2% LB-LC: 3.1%/3.5%
 - LP-HE: 0.6%/0.6% LP-LC: 1.1%/1.1%
 - Both proposals don't affect encoding/decoding time
- Suggestion:
 - Both two proposals are integrated to next version of HM.

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