

# JCTVC-G441

## Redundancy Removal of Explicit Weighted Prediction Syntax

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# Overall Summary

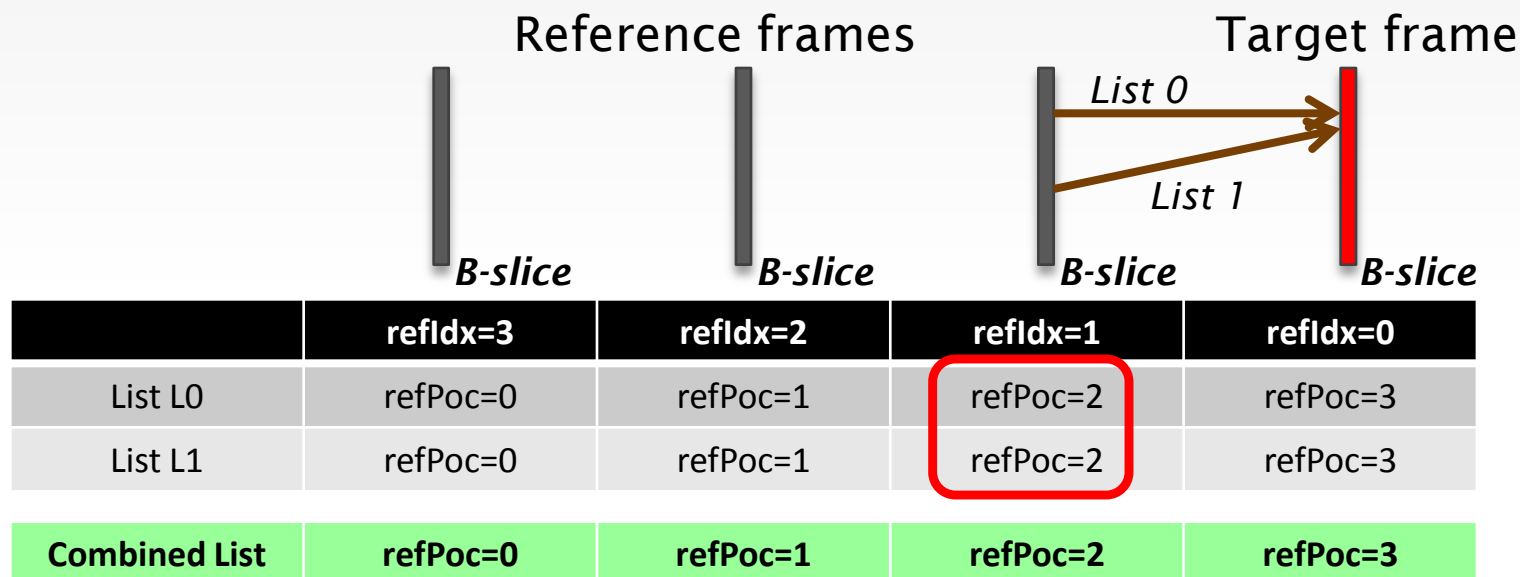
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- **Weighted Prediction in HEVC**
  - AVC based WP (AVCWP) was adopted in HM4/WD4
  - AVCWP has redundant representation of syntax in B-slice
- **Proposal:**
  - Redundancy removal of explicit weighted prediction syntax
    - Proposal 1:
      - Unifying 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

slice_header() {	Descriptor
...	
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.

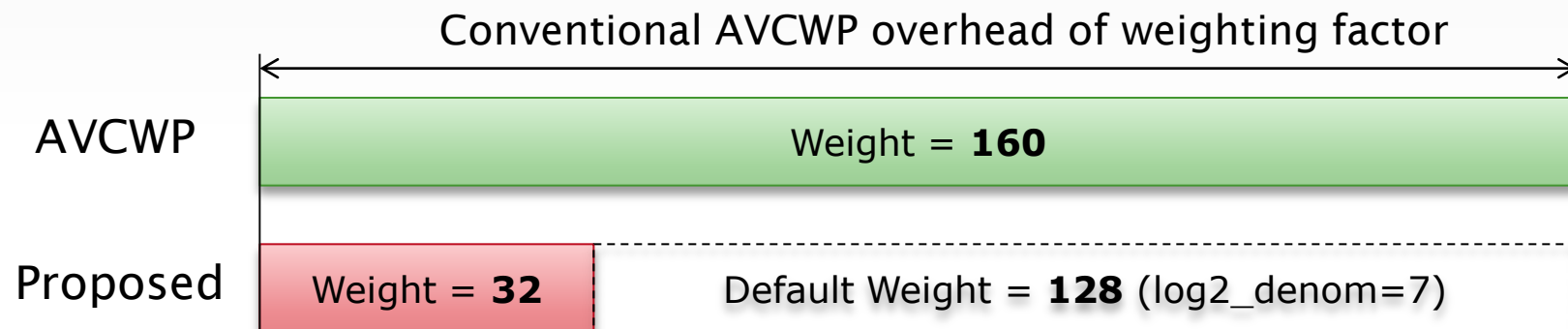
combined_pred_weight_table() {	Descriptor
luma_log2_weight_denom	ue(v)
if( chroma_format_idc != MONO_IDX )	
chroma_log2_weight_denom	ue(v)
for( i = 0; i <= num_ref_com_le_active_minus1; i++ ) {	
luma_weight_common_flag	u(1)
if( luma_weight_common_flag ) {	
luma_weight_common[ i ]	
luma_offset_common[ 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**

$\text{delta\_luma\_weight\_common}[i] = \text{luma\_weight\_common}[i] -$

$(1 \ll \text{luma\_log2\_weight\_denom})$

$\text{delta\_chroma\_weight\_common}[i] = \text{crhoma\_weight\_common}[i] -$

$(1 \ll \text{chroma\_log2\_weight\_denom})$

- **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

	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						
<b>Overall</b>	-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%		

	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%
<b>Overall</b>	-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 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%
<b>Overall</b>	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%		

## 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%	0.0%	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						
<b>Overall</b>	-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	-0.7%	-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%
<b>Overall</b>	-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%
<b>Overall</b>	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						
<b>Overall</b>	-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%
<b>Overall</b>	-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%
<b>Overall</b>	-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						
<b>Overall</b>	-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%
<b>Overall</b>	-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%
<b>Overall</b>	-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						
<b>Overall</b>	-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%
<b>Overall</b>	-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%
<b>Overall</b>	-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						
<b>Overall</b>	-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%
<b>Overall</b>	-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%
<b>Overall</b>	-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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**TOSHIBA**  
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