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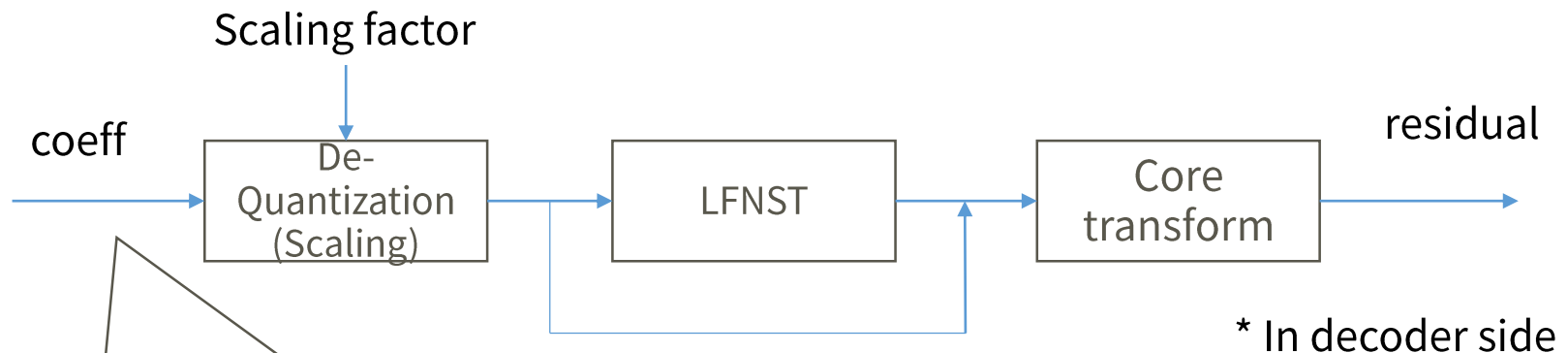
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JVET-P0293

AHG15:  
Signaling scaling matrix for LFNST case

Tomonori Hashimoto  
Eiichi Sasaki  
Tomohiro Ikai

- Scaling matrices are applied even in the case of LFNST mode in WD6.
  - It would be wrong since LFNST's coefficient does not correspond to conventional transform coefficients in spatial frequency meaning.



Not normal spatial coefficient domain  
in LFNST case

- Signal LFNST specific matrix in APS
  - Max matrixId from 5 to 8.
  - Support two LFNST sizes
    - sizeId = 2: LFNST scaling matrices for 4xN or Nx4 blocks
    - sizeId = 3: LFNST scaling matrices for other blocks

sizeId	CuPredMode	cldx (Colour component)	lfnstIdx	matrixId
2, 3, 4, 5, 6	MODE_INTRA	0 (Y)	0	0
1, 2, 3, 4, 5, 6	MODE_INTRA	1 (Cb)	0	1
1, 2, 3, 4, 5, 6	MODE_INTRA	2 (Cr)	0	2
2, 3, 4, 5, 6	MODE_INTER, MODE_IBC	0 (Y)	0	3
1, 2, 3, 4, 5, 6	MODE_INTER, MODE_IBC	1 (Cb)	0	4
1, 2, 3, 4, 5, 6	MODE_INTER, MODE_IBC	2 (Cr)	0	5
2, 3	MODE_INTRA	0 (Y)	1,2	6
2, 3	MODE_INTRA	1 (Cb)	1,2	7
2, 3	MODE_INTRA	2 (Cr)	1,2	8

- Signal LFNST specific matrices in APS
  - Signal only 16 weighting values for both case
    - The number of LFNST coefficients is up to 16 regardless of block sizes.
- Apply scaling once in the usual position
  - both in LFNST on and off
  - apply LFNST specific matrix, only apply 16 coeff.



– Otherwise if `lfnst_idx[ xTbY ][ yTbY ]` is not equal to 0 and both `nTbW` and `nTbH` are greater than or equal to 4, the following applies:

• `log2LfnstSize = ( nTbW >= 8 && nTbH >= 8 ) ? 3 : 2`

• `m[ x ][ y ] = x < 4 && y < 4 ?`

`ScalingFactor[ log2LfnstSize ][ log2LfnstSize ][ matrixId ][ x ][ y ] : 0`

with `matrixId` as specified in Table 7-5

- Straight forward way to support transform coefficient control capability for LFNST case
  - Decouple weird interaction between two transforms
  - LFNST specific one is necessary because LFNST coefficients are different characteristics from other coefficients.
- No additional stage is required (reuse the current scaling method).

- Size of increased weighting values
  - Current size : 1406 elements
  - Proposed : 1502 elements
  - Signal six 4x4 matrices for LFNST case brings only 7% signaling increase.

sizeId	CuPredMode	cldx	matrixId
2, 3, 4, 5, 6	MODE_INTRA	0 (Y)	0
1, 2, 3, 4, 5, 6	MODE_INTRA	1 (Cb)	1
1, 2, 3, 4, 5, 6	MODE_INTRA	2 (Cr)	2
2, 3, 4, 5, 6	MODE_INTER, MODE_IBC	0 (Y)	3
1, 2, 3, 4, 5, 6	MODE_INTER, MODE_IBC	1 (Cb)	4
1, 2, 3, 4, 5, 6	MODE_INTER, MODE_IBC	2 (Cr)	5

## Conventional

Four 2x2 matrices = 16 elements  
 Six 4x4 matrices = 96 elements  
 Six 8x8 matrices = 384 elements  
 Fourteen 8x8 matrices and DCs  
 = 896 + 14 = 910 elements  
 Total : 1406 elements

## Proposal

Six additional 4x4 matrices = 96 elements  
 Total : 1502 elements (about 7% increase)

# Example of scaling matrices

INTRA8X8 LUMA =

16, 16, 16, 16, 17, 18, 21, 24,  
16, 16, 16, 16, 17, 19, 22, 25,  
16, 16, 17, 18, 20, 22, 25, 29,  
16, 16, 18, 21, 24, 27, 31, 36,  
17, 17, 20, 24, 30, 35, 41, 47,  
18, 19, 22, 27, 35, 44, 54, 65,  
21, 22, 25, 31, 41, 54, 70, 88,  
24, 25, 29, 36, 47, 65, 88, 115,

Scaling factors to LFNST coefficients in WD6

16, 16, 16, 16, 16, 16, 16, 16

It is difficult to control scaling weights for LFNST in WD6.

Newly introduced scaling matrix

LFNST8X8 LUMA =

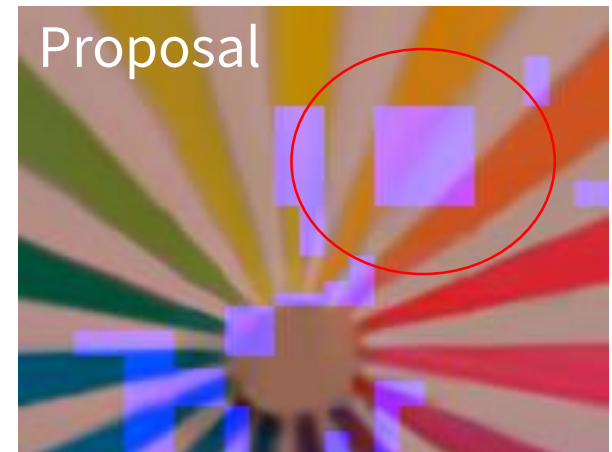
16, 16, 20, 24,  
16, 20, 24, 27,  
20, 24, 27, 30,  
24, 27, 30, 34,

Scaling factors to LFNST coefficients in proposal

16, 16, 16, 20, 20, 20, 24, 24

# Visual quality check

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- We propose to signal scaling matrix for LFNST case.
- The proposed method provides transform coefficient control capability in all conventional and LFNST transform cases.
- It is recommended to adopt this method in the next VVC WD and VTM software.

- JVET-P0110 proposes an efficient syntax to transmit scaling matrices.
  - Our proposal can be combined with P0110 easily.
  - A option/WD with JVET-P0110 is provided.

Y	INTRA	0		6		12		18		24-29	30	
	INTER	1		7		13		19			31	
Cb	INTRA		2		8		14		20	See 2nd table		32
	INTER		3		9		15		21			33
Cr	INTRA		4		10		16		22			34
	INTER		5		11		17		23			35
TU size: luma max(width,height)		64		32		16		8		LNFST	4	
Block size: max(width,height)		64	32		16		8		4		4	2
Signalled QM size		8x8 + DC					8x8		4x4			2x2

Y	LNFST #0	24
	LNFST #1	25
Cb	LNFST #0	26
	LNFST #1	27
Cr	LNFST #0	28
	LNFST #1	29
Signalled QM size		4x4

LNFST specific ids:

LNFST #0 = blocks with width and height >= 8

LNFST #1 = 4xN and Nx4 blocks

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adaptation_parameter_set_rbsp( ) {	<b>Descriptor</b>
...	
else if( aps_params_type == SCALING_APS )	
scaling_list_data( )	
else if( aps_params_type == LFNST_SCALING_APS )	
lfnst_scaling_list_data()	
...	

lfnst_scaling_list_data( ) {	<b>Descriptor</b>
for( sizeId = 2; sizeId < 4; sizeId++ )	
for( matrixId = 6; matrixId < 9; matrixId ++ ) {	
scaling_list_pred_mode_flag[ sizeId ][ matrixId ]	u(1)
if( !scaling_list_pred_mode_flag[ sizeId ][ matrixId ] )	
scaling_list_pred_matrix_id_delta[ sizeId ][ matrixId ]	ue(v)
else {	
coefNum = 16	
nextCoef = 8	
for( i = 0; i < coefNum; i++ ) {	
x = DiagScanOrder[ 2 ][ 2 ][ i ][ 0 ]	
y = DiagScanOrder[ 2 ][ 2 ][ i ][ 1 ]	
scaling_list_delta_coef	se(v)
nextCoef = ( nextCoef + scaling_list_delta_coef + 256 ) % 256	
ScalingList[ sizeId ][ matrixId ][ i ] = nextCoef	
}	
}	
}	
}	
}	

## 8.7.3 Scaling process for transform coefficients

...

- The intermediate scaling factor  $m[x][y]$  is derived as follows:
  - If one or more of the following conditions are true,  $m[x][y]$  is set equal to 16:
    - `sps_scaling_list_enabled_flag` is equal to 0.
    - `transform_skip_flag[xTbY][yTbY]` is equal to 1.
    - Otherwise if `lfnst_idx[xTbY][yTbY]` is not equal to 0 and both `nTbW` and `nTbH` are greater than or equal to 4, the following applies:
      - $\text{log2LfnstSize} = (\text{nTbW} \geq 8 \ \&\& \ \text{nTbH} \geq 8) ? 3 : 2$
      - $m[x][y] = \text{ScalingFactor}[\text{log2LfnstSize}][\text{log2LfnstSize}][\text{matrixId}][x][y]$ ,  
     with `matrixId` as specified in Table 7-5
    - Otherwise, the following applies:
 
$$m[x][y] = \text{ScalingFactor}[\text{Log2}(\text{nTbW})][\text{Log2}(\text{nTbH})][\text{matrixId}][x][y],$$
     with `matrixId` as specified in Table 7-5 (8-958)
- The scaling factor  $ls[x][y]$  is derived as follows:

...