

# JCTVC-H0066

## **CE8.a.2: ALF with LCU-based syntax**

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# Summary

- ALF with LCU-based syntax
- Suitable for both single-pass and low-delay encoders
- Simplifications:
  - Reduction in encoding/decode times: 5% - 29%
  - Reduction in code size: ~10 000 -> ~1000
- BD-rate results:
  - 8-bit: 0.0% – +0.6%
  - 10-bit: +1.0%

# LCU-based syntax

- New set of ALF parameters for each LCU
- ALF syntax elements are interleaved at the LCU level

# Implementation benefits

- Suitable for single-pass encoders
- Suitable for encoders with sub-frame (slice-level) delay
- Error resilience
- One block-size
  - Consistent processing of one LCU
  - No 4x4 block variance classification
  - No on/off flag at the CU level

# Parsing of ALF parameters

```
alf_enabled_flag           // ALF on/off for LCU
if (alf_enabled_flag)
{
    alf_chroma_enabled_flag // ALF on/off for chroma
    filter_shape_flag       // Indicate 5x5 snowflake or 9x9 cross shape
    alf_copy_flag           // Use coefficients from previous LCU or transmit new coefficients.
    if (alf_copy_flag)
    {
        alf_copy_id        // Choose between a maximum of 8 previous ALF coefficients
    }
    else
    {
        parse_ALF_coefficients()
    }
}
```

# Two pixel masks

## 5x5 star/snowflake

0		1		2
	3	4	5	
6	7	8	7	6
	5	4	3	
2		1		0

## 9x9 cross

				0				
				1				
				2				
				3				
4	5	6	7	8	7	6	5	4
				3				
				2				
				1				
				0				

# Quantization of ALF coefficients

- QP-dependent quantizer fidelity
- Transmit coefficients  $C_0 - C_{N-2}$
- Derive coefficient  $C_{N-1}$  as

$$C_{N-1} = 1 - 2*(C_0 + C_1 + \dots + C_{N-2})$$

# BD-rate results (%)

Class	AI-HE	RA-HE	LB-HE	LP-HE	RA_HE10
Class A	0.8	1.2			1.4
Class B	0.2	0.5	0.1	0.0	0.7
Class C	0.0	0.3	0.0	-0.1	
Class D	0.2	0.7	0.7	0.2	
Class E	0.4		-0.2	-0.1	
<b>Average</b>	<b>0.3</b>	<b>0.6</b>	<b>0.2</b>	<b>0.0</b>	<b>1.0</b>

# Simulation times

	AI-HE	RA-HE	LB-HE	LP-HE	RA_HE10
Encoder	71%	92%	95%	92%	92%
Decoder	96%	95%	97%	96%	92%

# Wavefront processing

- Emulation of wavefront processing.
- Reset table of previous ALF coefficients at each LCU row.

Class	AI-HE	RA-HE	LB-HE	LP-HE	RA_HE10
No reset	0.3	0.6	0.2	0.0	1.0
Reset	0.5	0.9	0.5	0.5	1.6

# Conclusion

- ALF with LCU-based syntax
- Suitable for both single-pass and low-delay encoders
- Significant simplification and reduction of code lines
- Significant reduction of simulation times
- BD-rate results:
  - 8-bit: 0.0% – +0.6%
  - 10-bit: +1.0%
- Proposal: Adoption in HM & WD