

Joint Algorithm-Architecture Optimization of CABAC (JCTVC-E324/m19852)

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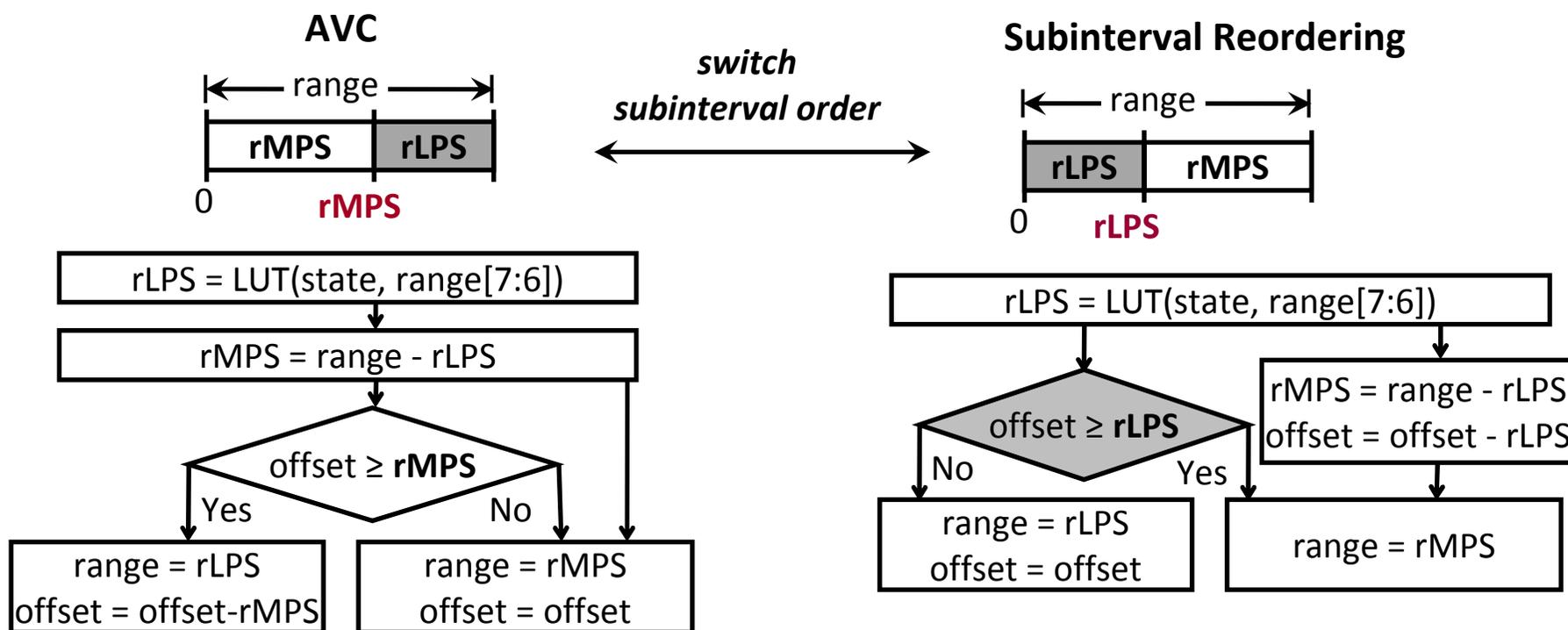
Algorithm and Architecture

- Joint optimization of both the algorithm and architecture for high coding efficiency to
 - Increase processing speed
 - Reduce memory requirements
- Propose two modifications to CABAC
 1. Subinterval Reordering
 2. Modified MVD context selection



Subinterval Reordering

- Placing rLPS at bottom of range enables parallel operations to increase speed
 - Subtract rLPS from range and offset (i.e. comparison) in parallel

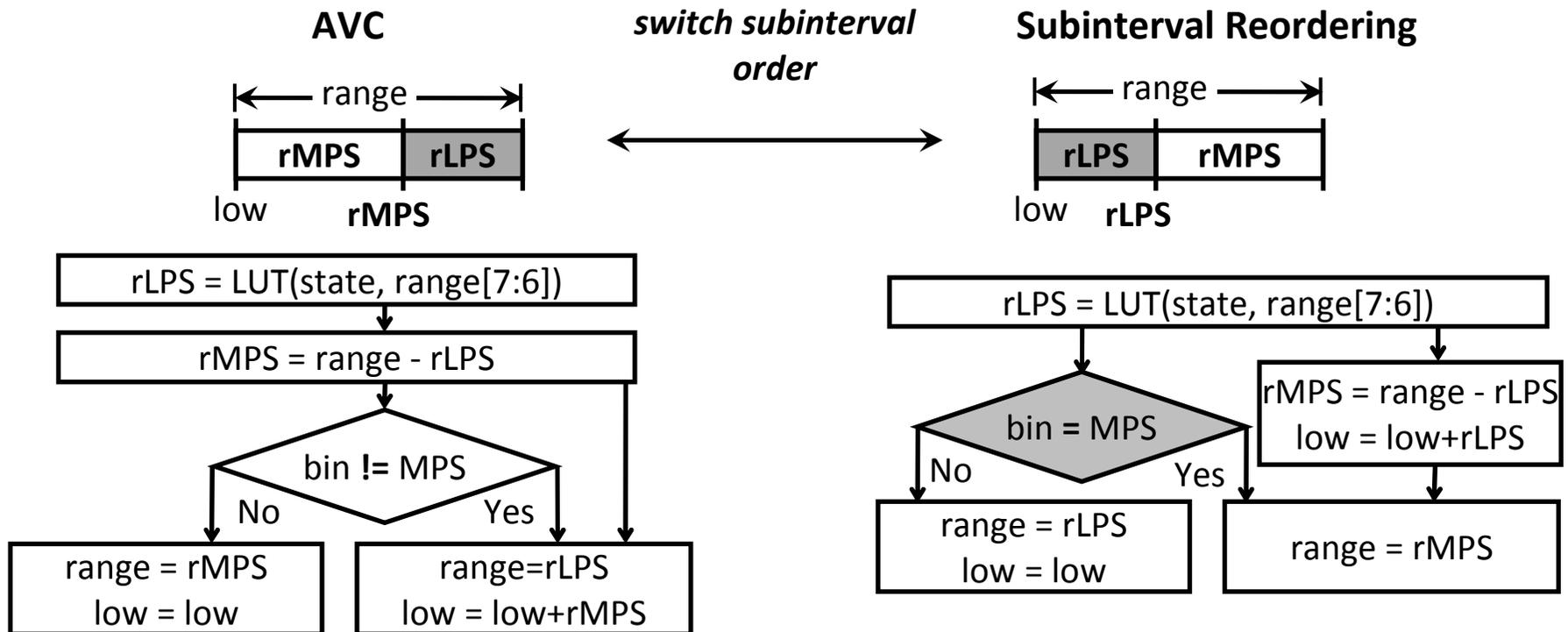


Reduce critical path delay by 14 to 22 %
No impact on coding efficiency



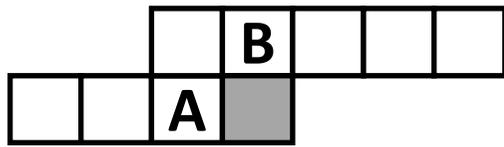
Subinterval Reordering

- Similar benefits at encoder





Modified MVD Context Selection



Context selection (χ_{incr}) dependent on A & B (4x4 blocks for *mvd*); as a result, last line buffer is required.

AVC

(1) SUM:

$$e(A,B) = |mvd(A)| + |mvd(B)|$$

(2) THRESHOLD:

$$\chi_{incr} \begin{cases} 0 \rightarrow \text{if } e(A,B) < 3 \\ 1 \rightarrow \text{if } 3 \leq e(A,B) \leq 32 \\ 2 \rightarrow \text{if } e(A,B) > 32 \end{cases}$$

This work

(1) THRESHOLD:

$$\text{threshA} = |mvd(A)| > 16$$

$$\text{threshB} = |mvd(B)| > 16$$

(2) SUM:

$$\chi_{incr} = \text{threshA} + \text{threshB}$$

If switch order, reduce from 6-bits to 1-bits stored per component

Reduce overall CABAC Last Line Buffer Size by 50%
Negligible impact on coding efficiency



Experiment Results

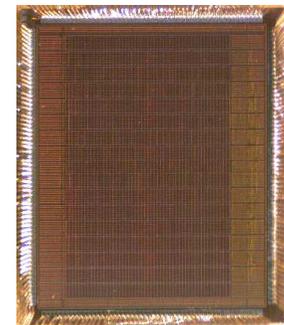
- HM-2.0 under common conditions
- Simulation platform is LSF equipped with Intel(R) Xeon(R) CPU X5570@2.93GHz 64 bits Linux machines
- Results cross-checked by HHI

Coding efficiency impact of joint optimizations

	Intra	Random Access	Low Delay
Subinterval reorder & modified mvd context selection	0.0	-0.01	-0.03

Optimizations Demonstrated in Hardware

- V. Sze, A. P. Chandrakasan, "A Highly Parallel and Scalable CABAC Decoder for Next-Generation Video Coding," IEEE International Conference on Solid-State Circuits (ISSCC), pp. 126-127, February 2011.



65-nm CMOS



Summary

- Speed up arithmetic coding engine by 14-22%
- Reduce last line buffer size in CABAC
- Negligible impact on coding efficiency
- Recommend for adoption into HEVC test model
 - Draft text available in contribution