

JVET-O0741

Context memory reduction via selective adaptation

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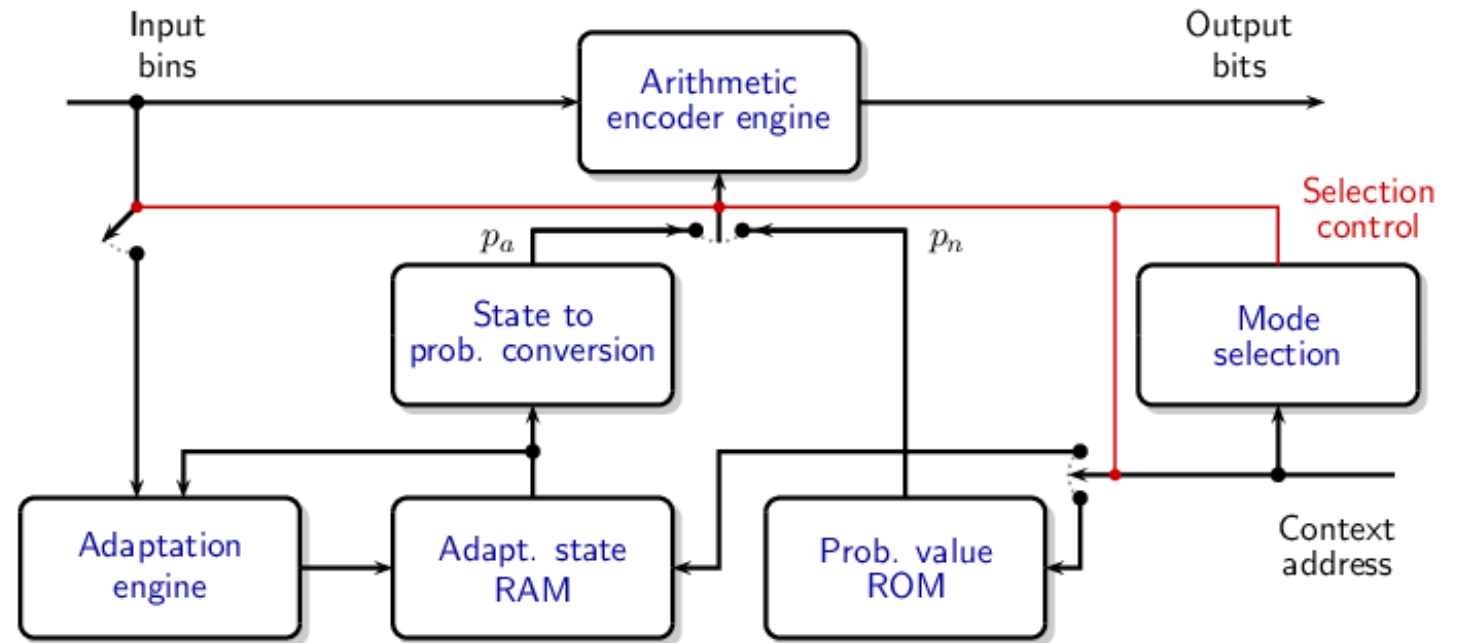
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Problem definition

- Arithmetic coding is a critical component for HW performance
 - Must have very high throughput
 - Its data has to be residing in very fast and expensive RAM
 - Costs proportional to the total number of contexts
- Possible cost reductions
 - Reduce the number of contexts
 - Very limited due to compression loss
 - Changes to code and standard text
 - Use non-adaptive contexts
 - Can use significantly cheaper ROM
 - Eliminates need for bus & bandwidth to write state
 - Substantial coding loss (2% ~ 3%)
 - ✓ Combine adaptive and non-adaptive contexts
 - ✓ This proposal

Selectively disabling adaptation

- Very few VTM modifications
 - Main engine unchanged
 - Single “ if ” to context update
 - Mode defined by initializers
- Probability value fixed for non-adaptive contexts
 - Independent of QP (for using ROM in HW)
 - Defined with at most 6 bits
 - Optimized by context initialization training program
 - Ranked by coding loss



Summary of results*

Prob. bits	Non-adapt contexts	AI			RA			LDB		
		Y	U	V	Y	U	V	Y	U	V
4	100	0.01%	0.00%	-0.01%	0.00%	0.00%	-0.05%	-0.03%	-0.10%	-0.12%
4	150	0.03%	-0.02%	-0.01%	0.03%	0.06%	0.00%	0.01%	-0.16%	-0.05%
4	175	0.03%	0.03%	0.03%	0.06%	0.09%	0.00%			
4	200	0.06%	-0.02%	-0.01%	0.10%	0.07%	0.08%	0.05%	-0.02%	-0.12%
4	250	0.14%	0.11%	0.09%	0.22%	0.35%	0.27%	0.17%	0.49%	-0.11%
6	150	0.01%	-0.02%	0.00%	0.01%	-0.02%	0.04%	0.03%	-0.25%	-0.01%
6	175	0.02%	-0.05%	-0.03%	0.03%	-0.03%	-0.06%	-0.01%	0.00%	0.27%
6	200	0.03%	0.00%	0.03%	0.05%	0.12%	0.09%	0.01%	0.20%	0.42%
6	250	0.06%	0.02%	-0.01%	0.15%	0.17%	0.21%	0.07%	0.45%	0.16%

*Partially cross-checked by HHI

Full results example

- 200 non-adaptive contexts, 6-bit probabilities

	All Intra Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.06%	0.08%	0.05%	102%	101%
Class A2	0.04%	0.07%	0.10%	101%	102%
Class B	0.02%	-0.04%	0.03%	100%	97%
Class C	0.04%	-0.04%	0.01%	99%	104%
Class E	0.02%	0.01%	-0.03%	101%	108%
Overall	0.03%	0.00%	0.03%	100%	102%
Class D	0.02%	0.20%	-0.05%	95%	86%
Class F	0.03%	0.10%	0.20%	101%	101%

	Random Access Main 10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.12%	0.28%	0.34%	99%	99%
Class A2	0.06%	0.25%	0.27%	98%	98%
Class B	0.05%	0.11%	-0.05%	99%	97%
Class C	0.00%	-0.06%	-0.05%	101%	107%
Class E					
Overall	0.05%	0.12%	0.09%	99%	100%
Class D	0.06%	0.10%	0.16%	99%	95%
Class F	0.01%	0.00%	0.28%	100%	98%

Memory usage

- Number of bits used for all contexts

Prob. bits	Non-adaptive contexts	RAM	Prob. ROM	Adap. ROM	Total ROM
	0	10,176	0	1,696	1,696
4	100	7,776	400	1,296	1,696
4	150	6,576	600	1,096	1,696
4	175	5,976	700	996	1,696
4	200	5,376	800	896	1,696
4	250	4,176	1,000	696	1,696
6	150	6,576	900	1,096	1,996
6	175	5,976	1,050	996	2,046
6	200	5,376	1,200	896	2,096
6	250	4,176	1,500	696	2,196

Context usage

- Fraction of bins decoded with non-adaptive contexts

Non-adaptive contexts	AI		RA	
	QP = 27	QP = 32	QP = 27	QP = 32
100	1.5%	0.9%	1.6%	1.0%
150	6.1%	4.7%	5.9%	4.7%
200	11.9%	9.5%	11.7%	9.8%
250	22.6%	18.75	22.6%	19.4%

Recommendation

- New CE on CABAC context cost reduction
 - Decision on choices for non-adaptive context identification
 - Constraints on context classes?
 - Identification of maximum acceptable loss
 - Measurement of SW throughput after some optimizations