

JVET-N0207

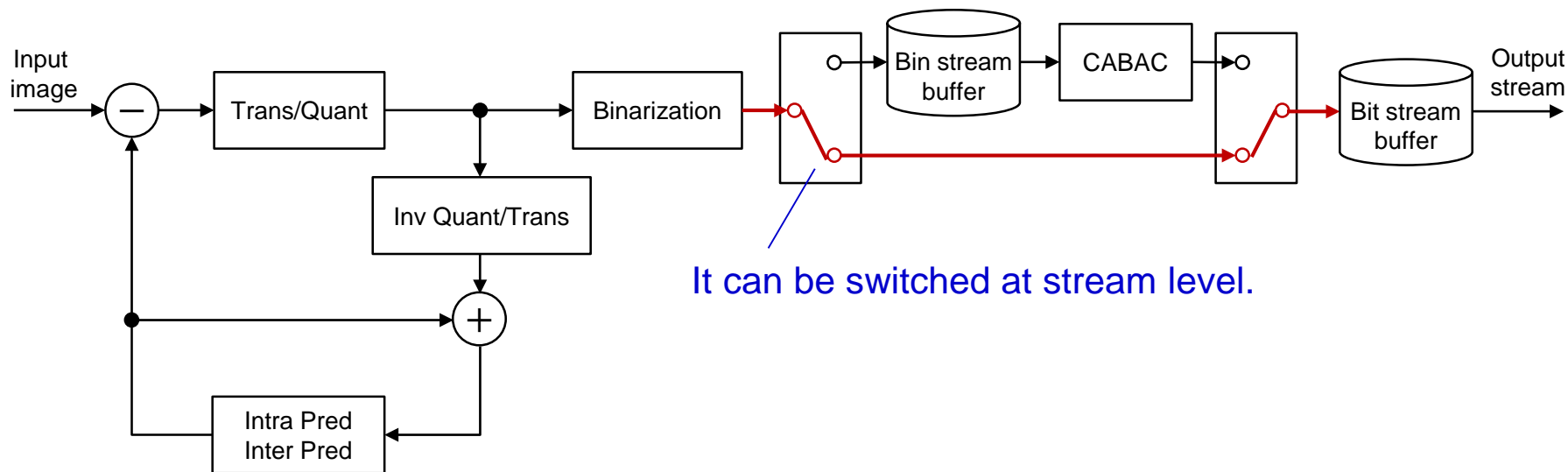
AHG14 : CABAC skip mode

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Proposal

Introduce CABAC skip mode which directly outputs binarized bins. It is originally proposed by JVET-M0089.

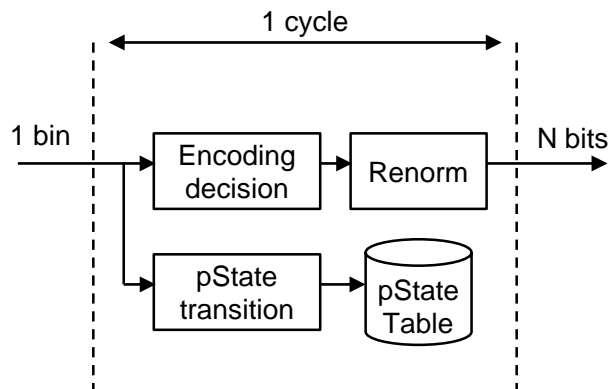


It can avoid processing delay caused by CABAC throughput.

CABAC throughput issue

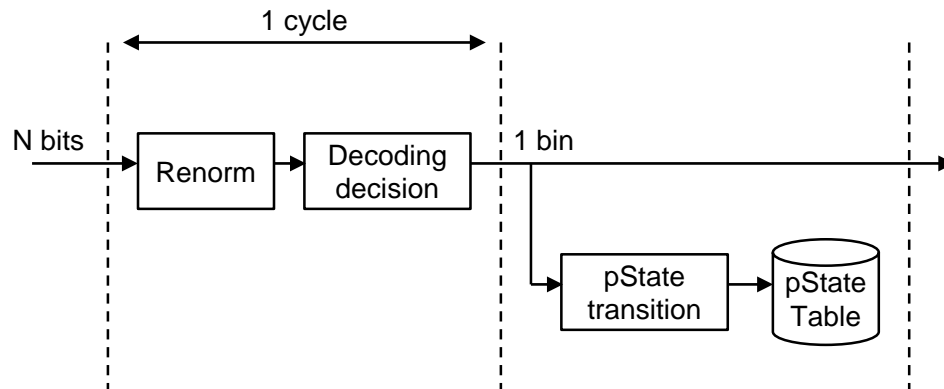
■ Example of CABAC throughput (assume low performance HW)

Encoder



➡ 1bin per 1cycle

Decoder



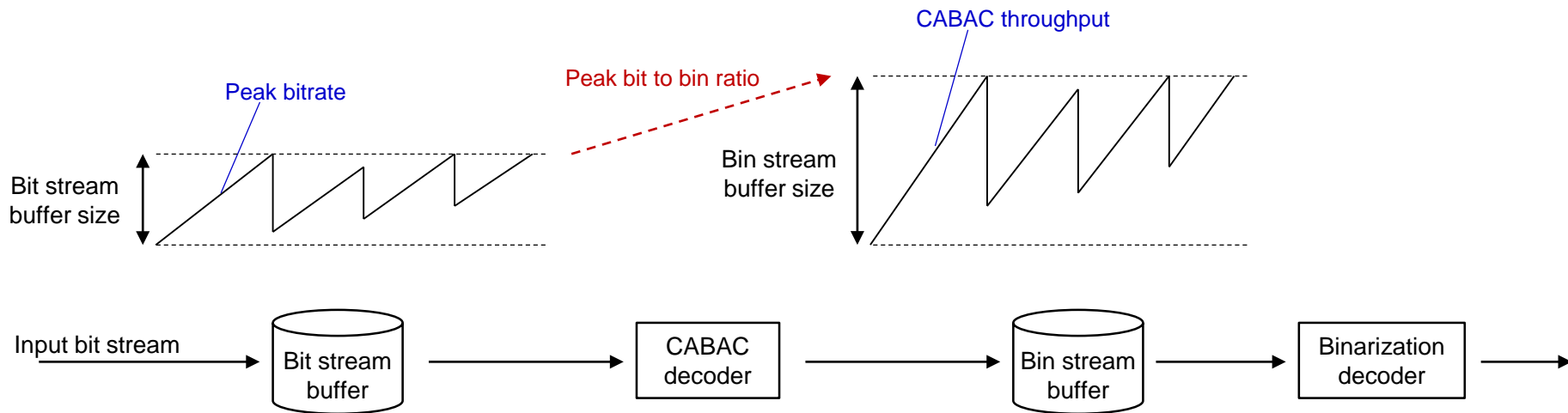
➡ 1bin per 2cycle

※High performance HW might be able to improve it with parallel scheme.

Decoder performance tends to be the bottleneck.

CABAC throughput issue

Guarantee condition of decode buffer



“CABAC throughput” has to be greater than “Peak bitrate” × “Peak bit to bin ratio”

CABAC throughput issue

Assumption1 (Broadcasting TV)



HW core (per 1ch) : 400MHz, > 1000mW
Delay : 500msec
Stream : 30Mbps, 4K/60p, RA
Peak bit to bin ratio : < 1.5 (at I-Picture)

1bin/2cycle with 400MHz

OK

$$\begin{array}{ccccc} 200\text{M} & > & 30\text{M} & \times & 1.5 \\ \text{(throughput)} & & \text{(bitrate)} & & \text{(bit to bin ratio)} \end{array}$$

It is assumed experientially, but below the limitation of specification.

Assumption2 (Automotive camera system)



HW core (per 1ch) : 400MHz, < 500mW
Delay : 3msec
Stream : 160Mbps, 4K/60p, AI
Peak bit to bin ratio : > 1.5 (at I-Picture)

NG

$$\begin{array}{ccccc} 200\text{M} & < & 160\text{M} & \times & 1.5 \\ \text{(throughput)} & & \text{(bitrate)} & & \text{(bit to bin ratio)} \end{array}$$

difficult to improve it

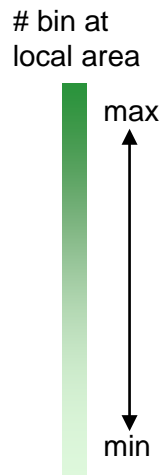
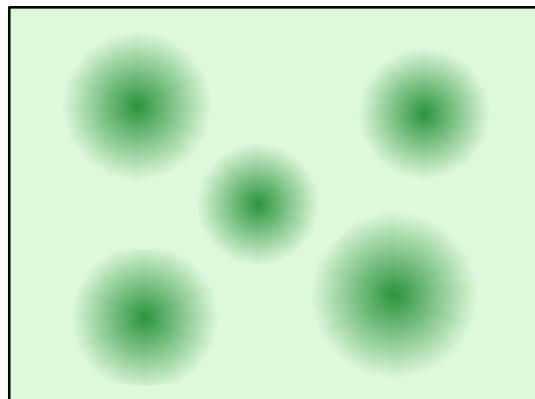
It might be more large since the limitation of specification will be greater in this condition.

This issue will occurs with low performance HW & high bitrate use cases.

CABAC throughput issue

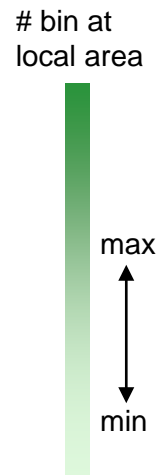
- CABAC throughput issue is more significant for low delay

Non low delay



Local bin peak is acceptable if it is guaranteed by picture level.

Low delay



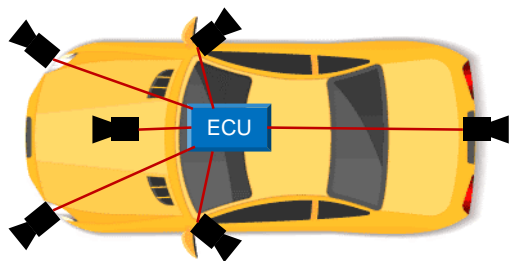
Total bin has to be guaranteed by each tile (bin peak is not acceptable).

➡ Image quality degradation

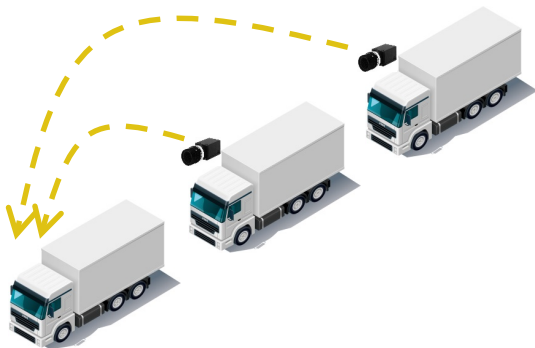
Example of CABAC skip mode use cases

Delay of several milliseconds is required for video codec in these fields. But bitrate is not so critical for some cases. Some applications in these fields still use H.264 with CAVLC due to the mentioned issue.

ex1) Automotive camera



ex2) Cooperative driving



ex3) Remote operation



CABAC skip mode is useful for these use cases.

Simulation results

Anchor : VTM-4.0

Test : Proposed CABAC skip mode

	All Intra Main10				
	Y	U	V	EncT	DecT
Class A1	30.23%	21.59%	24.13%	129%	101%
Class A2	26.76%	21.68%	24.25%	110%	103%
Class B	25.35%	22.96%	22.21%	111%	100%
Class C	21.70%	20.67%	20.51%	96%	100%
Class E	21.89%	19.90%	19.69%	109%	99%
Overall	25.01%	21.50%	22.07%	110%	101%
Class D	22.07%	20.38%	20.80%	93%	98%
Class F	22.14%	22.67%	22.39%	104%	94%

Random Access Main 10				
Y	U	V	EncT	DecT
28.68%	24.60%	22.14%	101%	91%
26.46%	17.20%	20.72%	94%	94%
28.01%	17.48%	16.93%	97%	93%
24.01%	17.30%	16.75%	97%	95%
26.77%	18.80%	18.68%	97%	93%
23.06%	15.00%	15.84%	94%	96%
24.93%	23.80%	24.34%	102%	97%

Low delay B Main10				
Y	U	V	EncT	DecT
33.03%	11.69%	10.58%	87%	100%
29.25%	16.15%	15.21%	87%	101%
28.87%	12.16%	10.85%	93%	109%
30.73%	13.29%	12.19%	89%	102%
27.87%	9.79%	11.14%	86%	99%
32.24%	25.48%	25.16%	99%	116%

The loss is large, but it still keeps higher gain compared to HEVC.

Additional information1

Anchor : H.264/CABAC (JM-19.0)

Test : H.264/CAVLC (JM-19.0)

	Random Access Main 10				
	Y	U	V	EncT	DecT
Class A1	35.41%	25.00%	23.75%	91%	97%
Class A2	29.90%	19.21%	17.67%	95%	113%
Class B	25.08%	13.79%	14.62%	98%	98%
Class C	16.36%	10.86%	11.09%	108%	95%
Class E					
Overall	25.78%	16.33%	16.12%	99%	100%
Class D	13.91%	7.70%	7.92%	115%	91%
Class F					

Bits increasing of proposal is almost same as that of H.264/CAVLC.

Additional information2

Anchor : H.264/CAVLC (JM-19.0)

Test : VTM-4.0 + Proposal

	Random Access Main 10				
	Y	U	V	EncT	DecT
Class A1	-70.68%	-72.53%	-74.61%	739%	155%
Class A2	-68.70%	-68.30%	-64.25%	786%	157%
Class B	-61.66%	-68.07%	-70.13%	676%	166%
Class C	-50.47%	-56.56%	-57.93%	693%	235%
Class E					
Overall	-61.89%	-65.94%	-66.60%	714%	178%
Class D	-46.55%	-55.15%	-56.20%	640%	274%
Class F					

Proposal already has enough benefit compared to H.264/CAVLC.

Conclusions

- CABAC skip mode can avoid the delay caused by CABAC throughput.
- It is useful for the use case of high bitrate with low performance HW.
(mainly for low delay)
- 25%, 27%, 31% bits increasing for AI, RA, LDB on VTM-4.0.
It still keeps higher gain compared to HEVC, and it is twice as high performance as H.264 with CAVLC.

We propose to introduce CABAC skip mode into VVC.

Thanks Canon for cross-checking of the proposal.