



Early Termination of CU Encoding to Reduce HEVC Complexity

JCTVC-F045

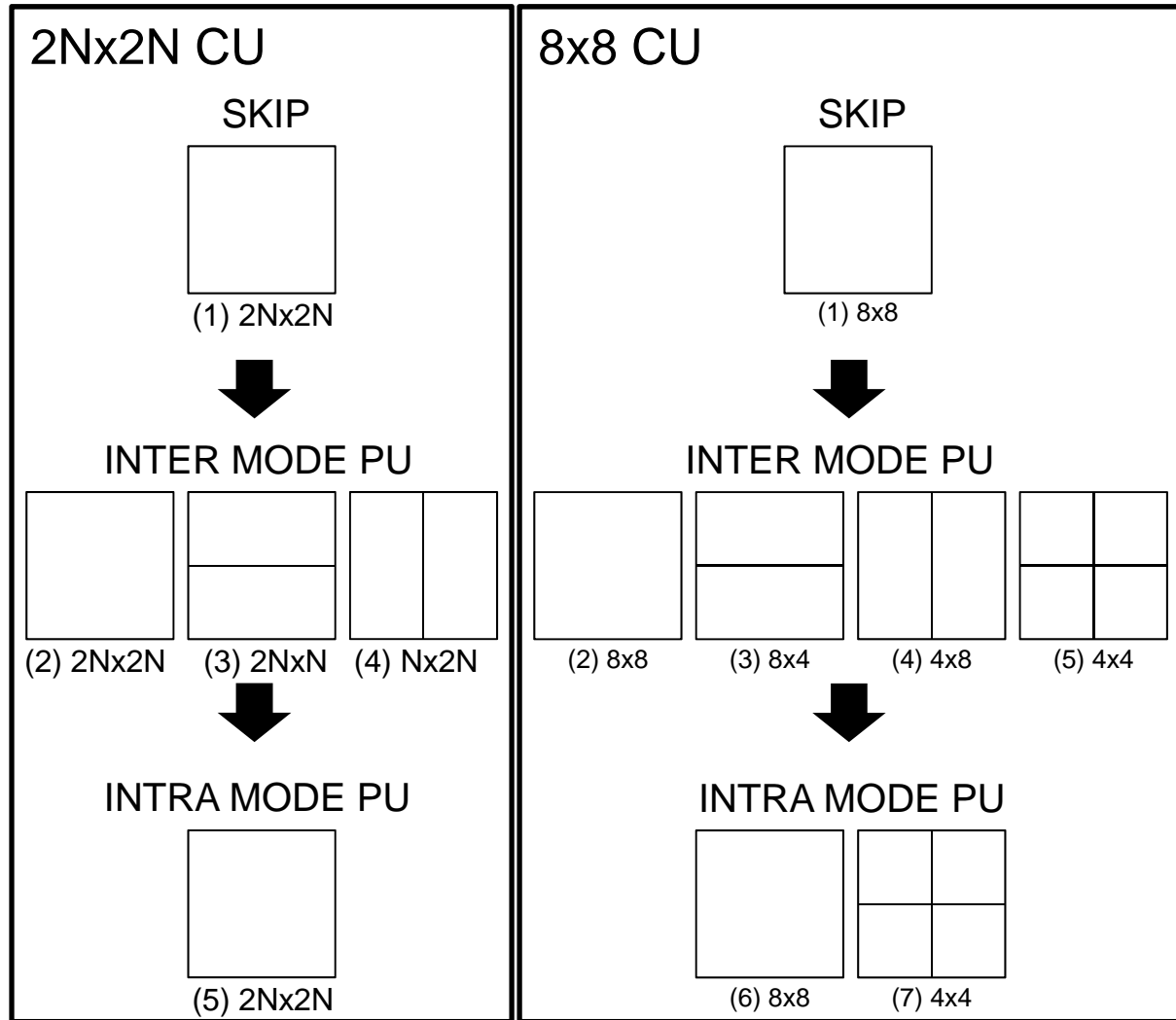
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HEVC encoder

- The increased computational complexity in HEVC compared with AVC
 - In one CU, every PU is encoded regardless of the performance of the previous PU
 - the RD costs for total 6 PUs are examined.
 - ✓ Inter $2N \times 2N$, Inter $2N \times N$, Inter $N \times 2N$, Inter $N \times N$, Intra $2N \times 2N$ and Intra $N \times N$.
- Prediction of low RD-cost of PU
 - cbf_luma
 - cbf_cb
 - cbf_cr

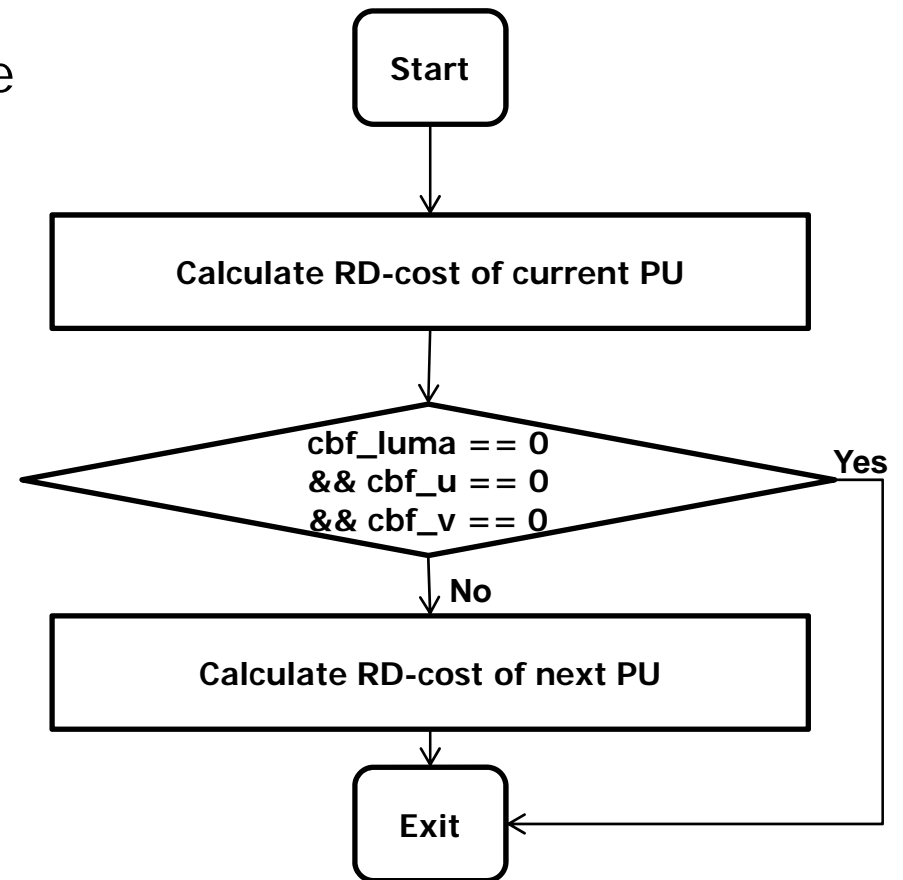
HEVC encoder

- Current process of CU encoding (HM3.2)



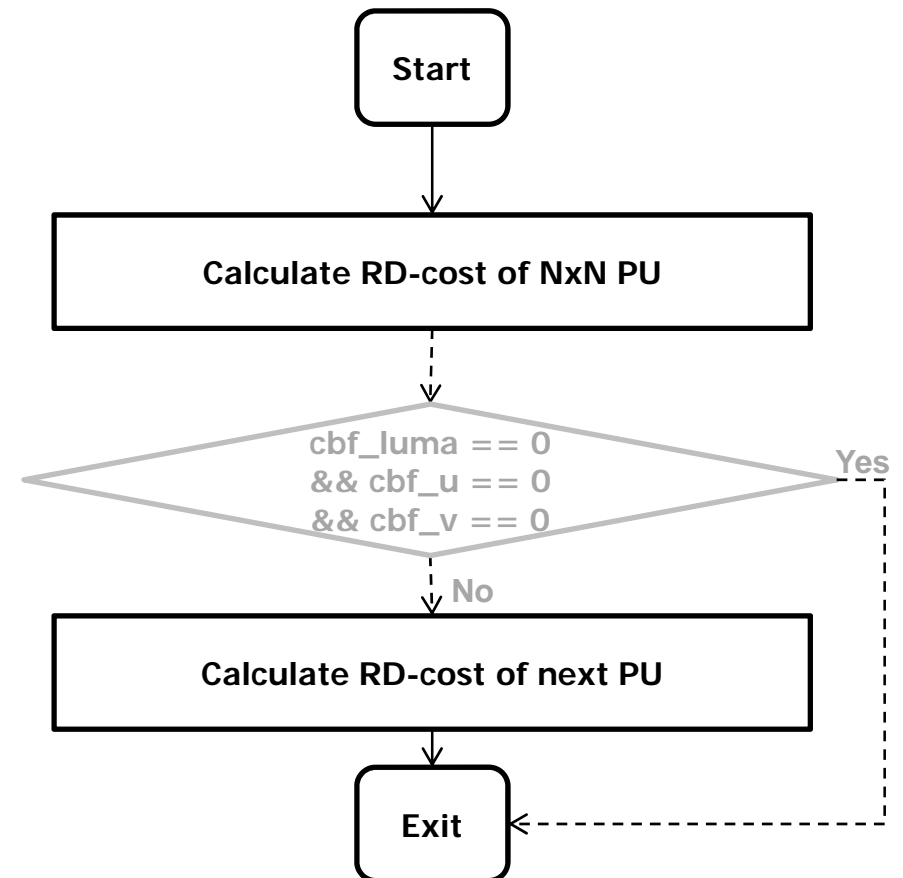
Fast encoding

- Speed up of HM3.2
 - if cbf of the current PU is zero, the CU is terminated



Fast encoding

- cbf of NxN is not considered
 - NxN PU is only in 8x8 CU
 - If cbf of NxN is considered, Y BD-rate loss is higher with similar complexity gain.



Experimental Results1

- Referenced
 - HM-3.2
- Proposed
 - proposed method when cbf of NxN not considered.

	Random access			Random access LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.56	0.01	0.02	0.74	0.12	-0.04
Class B	0.50	-0.06	-0.07	0.73	0.13	0.02
Class C	0.88	0.18	0.30	0.89	0.15	0.27
Class D	1.13	-0.14	0.08	1.01	0.04	0.14
Class E						
All	0.75	-0.01	0.07	0.84	0.11	0.10
Enc Time[%]	55%			57%		
Dec Time[%]	100%			100%		
	Low delay			Low delay LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.54	0.17	0.11	0.74	0.23	0.25
Class C	0.89	0.42	0.40	0.73	0.36	0.58
Class D	1.19	0.28	0.27	0.94	0.70	0.95
Class E	0.71	0.50	0.23	1.15	0.47	0.11
All	0.82	0.33	0.24	0.86	0.43	0.48
Enc Time[%]	60%			52%		
Dec Time[%]	100%			100%		
	Low delay P			Low delay LoCo P		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.73	-0.19	0.31	0.84	0.27	0.32
Class C	0.88	0.41	0.31	0.83	0.46	0.50
Class D	1.11	0.25	1.05	0.96	0.32	0.39
Class E	0.95	0.35	-0.39	1.10	0.75	0.21
All	0.90	0.17	0.36	0.91	0.42	0.36
Enc Time[%]	67%			60%		
Dec Time[%]	100%			100%		

Experimental Results2

- Referenced
 - HM-3.2
- Proposed
 - proposed method when cbf of NxN considered.

	Random access			Random access LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.63	0.11	0.13	0.84	0.20	0.13
Class B	0.57	-0.02	0.08	0.78	0.16	0.06
Class C	1.04	0.43	0.50	1.07	0.32	0.49
Class D	1.32	0.23	0.34	1.13	0.19	0.18
Class E						
All	0.87	0.18	0.25	0.94	0.21	0.21
Enc Time[%]	61%			57%		
Dec Time[%]	100%			100%		
	Low delay			Low delay LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.63	0.42	0.35	0.81	0.24	0.18
Class C	1.06	0.53	0.57	0.88	0.43	0.73
Class D	1.44	0.48	0.73	1.07	0.59	0.95
Class E	0.92	0.17	0.60	1.25	-0.04	0.30
All	0.99	0.42	0.55	0.98	0.32	0.54
Enc Time[%]	61%			56%		
Dec Time[%]	100%			100%		
	Low delay P			Low delay LoCo P		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.80	0.10	0.26	0.95	0.42	0.21
Class C	1.11	0.47	0.50	0.98	0.52	0.64
Class D	1.44	0.38	1.14	1.18	0.08	0.53
Class E	1.22	0.36	-0.10	1.45	0.70	0.42
All	1.12	0.31	0.47	1.11	0.41	0.44
Enc Time[%]	67%			61%		
Dec Time[%]	100%			100%		

Summary

- Early termination of CU encoding after encoding a PU in which cbf is zero(0) reduces the computational complexity of HEVC encoder.
- the computational complexity is reduced to about 58.8%
- the Y BD-rate loss is 0.85
- We propose to adopt the early termination of CU without considering cbf of NxN.