Complexity & Power Analysis

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An abstract is a brief summary of a research article, thesis, review, conference proceeding or any in-depth analysis of a particular subject or discipline, and is often used to help.

Contents

1 Analysis Summary

1.1 Encoding Summary

Table 1: Encoding Combination Used

Combination No.	Seq Name	Codec Name	Config Name	QP
1	RaceHorses_416x240_30.yuv	hm	encoder_intra_main.cfg	22
2	RaceHorses_416x240_30.yuv	hm	encoder_intra_main.cfg	27
3	RaceHorses_416x240_30.yuv	hm	encoder_intra_main.cfg	32
4	RaceHorses_416x240_30.yuv	hm	encoder_intra_main.cfg	37
5	Kimono_1920x1080_24.yuv	hm	encoder_intra_main.cfg	22
6	Kimono_1920x1080_24.yuv	hm	encoder_intra_main.cfg	27
7	Kimono_1920x1080_24.yuv	hm	encoder_intra_main.cfg	32
8	Kimono_1920x1080_24.yuv	hm	encoder_intra_main.cfg	37
9	BasketballPass_416x240_50.yuv	hm	encoder_intra_main.cfg	22
10	BasketballPass_416x240_50.yuv	hm	encoder_intra_main.cfg	27
11	BasketballPass_416x240_50.yuv	hm	encoder_intra_main.cfg	32
12	BasketballPass_416x240_50.yuv	hm	encoder_intra_main.cfg	37
13	RaceHorses_416x240_30.yuv	hm	encoder_lowdelay_main.cfg	22
14	RaceHorses_416x240_30.yuv	hm	encoder_lowdelay_main.cfg	27
15	RaceHorses_416x240_30.yuv	hm	encoder_lowdelay_main.cfg	32
16	RaceHorses_416x240_30.yuv	hm	encoder_lowdelay_main.cfg	37
17	Kimono_1920x1080_24.yuv	hm	encoder_lowdelay_main.cfg	22
18	Kimono_1920x1080_24.yuv	hm	encoder_lowdelay_main.cfg	27
19	Kimono_1920x1080_24.yuv	hm	encoder_lowdelay_main.cfg	32
20	Kimono_1920x1080_24.yuv	hm	encoder_lowdelay_main.cfg	37
21	BasketballPass_416x240_50.yuv	hm	encoder_lowdelay_main.cfg	22
22	BasketballPass_416x240_50.yuv	hm	encoder_lowdelay_main.cfg	27
23	BasketballPass_416x240_50.yuv	hm	encoder_lowdelay_main.cfg	32
24	BasketballPass_416x240_50.yuv	hm	encoder_lowdelay_main.cfg	37

Table 1: Encoding Combination Used

Combination No.	**Seq Name**	**Codec Name**	**Config Name**	**QP**
25	RaceHorses_416x240_30.yuv	hm	encoder_randomaccess_main.cfg	22
26	RaceHorses_416x240_30.yuv	hm	encoder_randomaccess_main.cfg	27
27	RaceHorses_416x240_30.yuv	hm	encoder_randomaccess_main.cfg	32
28	RaceHorses_416x240_30.yuv	hm	encoder_randomaccess_main.cfg	37
29	Kimono_1920x1080_24.yuv	hm	encoder_randomaccess_main.cfg	22
30	Kimono_1920x1080_24.yuv	hm	encoder_randomaccess_main.cfg	27
31	Kimono_1920x1080_24.yuv	hm	encoder_randomaccess_main.cfg	32
32	Kimono_1920x1080_24.yuv	hm	encoder_randomaccess_main.cfg	37
33	BasketballPass_416x240_50.yuv	hm	encoder_randomaccess_main.cfg	22
34	BasketballPass_416x240_50.yuv	hm	encoder_randomaccess_main.cfg	27
35	BasketballPass_416x240_50.yuv	hm	encoder_randomaccess_main.cfg	32
36	BasketballPass_416x240_50.yuv	hm	encoder_randomaccess_main.cfg	37

Table 2: Encoding Results

Combination No.	**Bitrate**	**Y-PSNR**	**CPU Time**	**Encoding_FPS/Frame_Rate**
1	5232.2400	42.2153	1.970s	0.034
2	3269.5200	38.0020	2.150s	0.031
3	1897.5600	33.9983	1.278s	0.052
4	1027.0800	30.5315	0.930s	0.072
5	13447.9680	43.0928	28.680s	0.003
6	8431.4880	41.7828	24.158s	0.003
7	5392.3200	39.9861	21.220s	0.004
8	3301.2480	37.5362	20.550s	0.004
9	5406.0000	42.5746	1.180s	0.034
10	3222.6000	39.0511	1.000s	0.04
11	1801.8000	35.5794	1.540s	0.026

Table 2: Encoding Results

Combination No.	**Bitrate**	**Y-PSNR**	**CPU Time**	**Encoding_FPS/Frame_Rate**
12	1002.8000	32.3685	0.730s	0.055
13	3428.7600	41.0101	4.280s	0.016
14	2044.8000	36.8827	3.190s	0.021
15	1188.9600	33.2687	2.960s	0.023
16	627.9600	30.0505	1.610s	0.041
17	9685.1520	42.6419	49.070s	0.002
18	5491.3920	40.9402	42.114s	0.002
19	3342.8160	38.8746	30.178s	0.003
20	1991.7120	36.4890	29.989s	0.003
21	3222.2000	42.3776	1.440s	0.028
22	1863.2000	38.8093	1.850s	0.022
23	1069.0000	35.5842	1.390s	0.029
24	574.6000	32.4722	0.830s	0.048
25	3811.3200	41.5252	4.140s	0.016
26	2387.7600	37.5561	2.870s	0.023
27	1423.2000	34.0626	2.270s	0.029
28	792.2400	30.9079	1.720s	0.039
29	12294.9120	42.7608	47.830s	0.002
30	6231.4560	40.9628	39.090s	0.002
31	3841.7280	39.1509	34.770s	0.002
32	2371.7760	36.9490	27.200s	0.003
33	3822.0000	43.2122	1.530s	0.026
34	2291.6000	39.7520	1.450s	0.028
35	1322.8000	36.6218	1.240s	0.032
36	731.2000	33.4731	1.000s	0.04

1.2 Decoding Summary

Table 3: Decoding Combination Used

Combination No.	**Seq Name**	**Codec Name**	**Config Name**
1	Kimono_1920x1080_24_QP_22_hm	hm	encoder_intra_main.cfg
2	Kimono_1920x1080_24_QP_27_hm	hm	encoder_intra_main.cfg
3	Kimono_1920x1080_24_QP_32_hm	hm	encoder_intra_main.cfg
4	Kimono_1920x1080_24_QP_37_hm	hm	encoder_intra_main.cfg
5	BasketballPass_416x240_50_QP_22_hm	hm	encoder_intra_main.cfg
6	BasketballPass_416x240_50_QP_27_hm	hm	encoder_intra_main.cfg
7	BasketballPass_416x240_50_QP_32_hm	hm	encoder_intra_main.cfg
8	BasketballPass_416x240_50_QP_37_hm	hm	encoder_intra_main.cfg
9	RaceHorses_416x240_30_QP_22_hm	hm	encoder_lowdelay_main.cfg
10	RaceHorses_416x240_30_QP_27_hm	hm	encoder_lowdelay_main.cfg
11	RaceHorses_416x240_30_QP_32_hm	hm	encoder_lowdelay_main.cfg
12	RaceHorses_416x240_30_QP_37_hm	hm	encoder_lowdelay_main.cfg
13	Kimono_1920x1080_24_QP_22_hm	hm	encoder_lowdelay_main.cfg
14	Kimono_1920x1080_24_QP_27_hm	hm	encoder_lowdelay_main.cfg
15	Kimono_1920x1080_24_QP_32_hm	hm	encoder_lowdelay_main.cfg
16	Kimono_1920x1080_24_QP_37_hm	hm	encoder_lowdelay_main.cfg
17	BasketballPass_416x240_50_QP_22_hm	hm	encoder_lowdelay_main.cfg
18	BasketballPass_416x240_50_QP_27_hm	hm	encoder_lowdelay_main.cfg
19	BasketballPass_416x240_50_QP_32_hm	hm	encoder_lowdelay_main.cfg
20	BasketballPass_416x240_50_QP_37_hm	hm	encoder_lowdelay_main.cfg
21	RaceHorses_416x240_30_QP_22_hm	hm	encoder_randomaccess_main.cfg
22	RaceHorses_416x240_30_QP_27_hm	hm	encoder_randomaccess_main.cfg
23	RaceHorses_416x240_30_QP_32_hm	hm	encoder_randomaccess_main.cfg
24	RaceHorses_416x240_30_QP_37_hm	hm	encoder_randomaccess_main.cfg
25	Kimono_1920x1080_24_QP_22_hm	hm	encoder_randomaccess_main.cfg
26	Kimono_1920x1080_24_QP_27_hm	hm	encoder_randomaccess_main.cfg
27	Kimono_1920x1080_24_QP_32_hm	hm	encoder_randomaccess_main.cfg
28	Kimono_1920x1080_24_QP_37_hm	hm	encoder_randomaccess_main.cfg

Table 3: Decoding Combination Used

Combination No.	**Seq Name**	**Codec Name**	**Config Name**
29	BasketballPass_416x240_50_QP_22_hm	hm	encoder_randomaccess_main.cfg
30	BasketballPass_416x240_50_QP_27_hm	hm	encoder_randomaccess_main.cfg
31	BasketballPass_416x240_50_QP_32_hm	hm	encoder_randomaccess_main.cfg
32	BasketballPass_416x240_50_QP_37_hm	hm	encoder_randomaccess_main.cfg

Table 4: Decoding Results

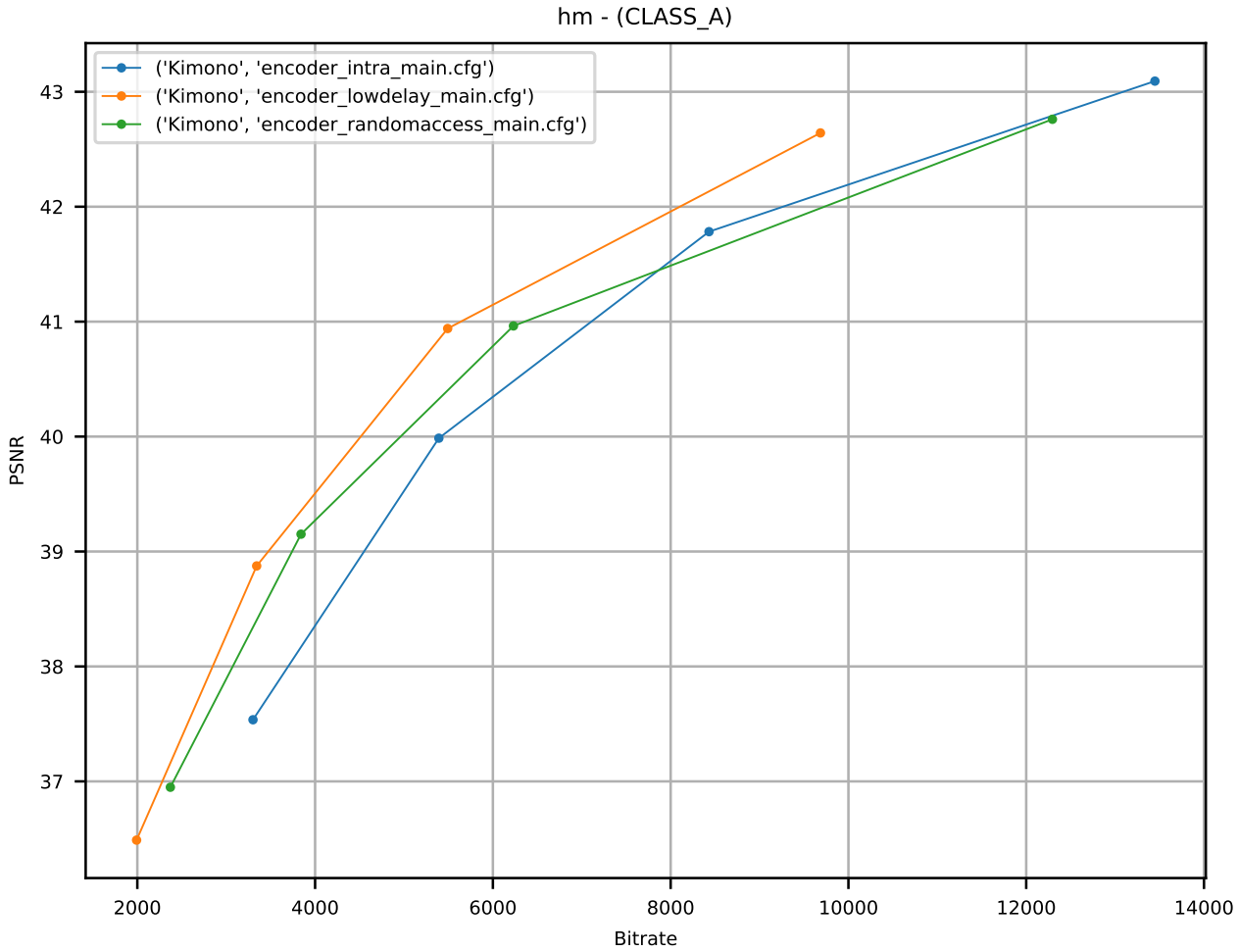
Combination No.	**Bitrate (kbps)**	**CPU Time**	**Power Consumption (in W)**
1	13447.968	0.300s	6.6165
2	8431.488	0.270s	5.96491
3	5392.32	0.250s	5.53552
4	3301.248	0.230s	4.99614
5	5406	0.040s	0.99229
6	3222.6	0.020s	0.89004
7	1801.8	0.010s	0.52232
8	1002.8	0.030s	0.37584
9	3428.76	0.040s	0.8681
10	2044.8	0.030s	0.53516
11	1188.96	0.010s	0.52685
12	627.96	0.030s	0.38749
13	9685.152	0.280s	6.30989
14	5491.392	0.230s	5.03116
15	3342.816	0.110s	4.28193
16	1991.712	0.100s	3.8531
17	3222.2	0.030s	0.57993
18	1863.2	0.010s	0.42998

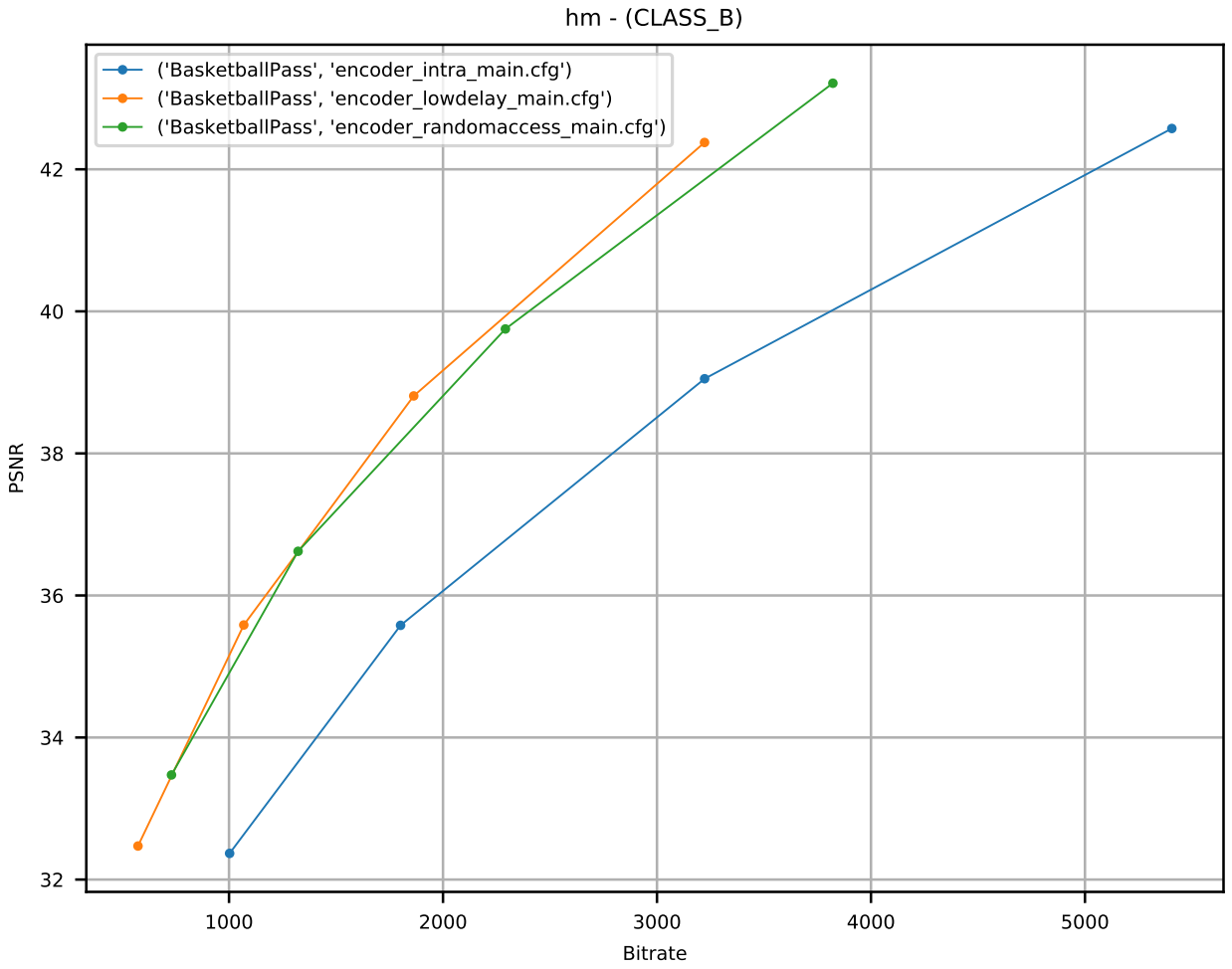
Table 4: Decoding Results

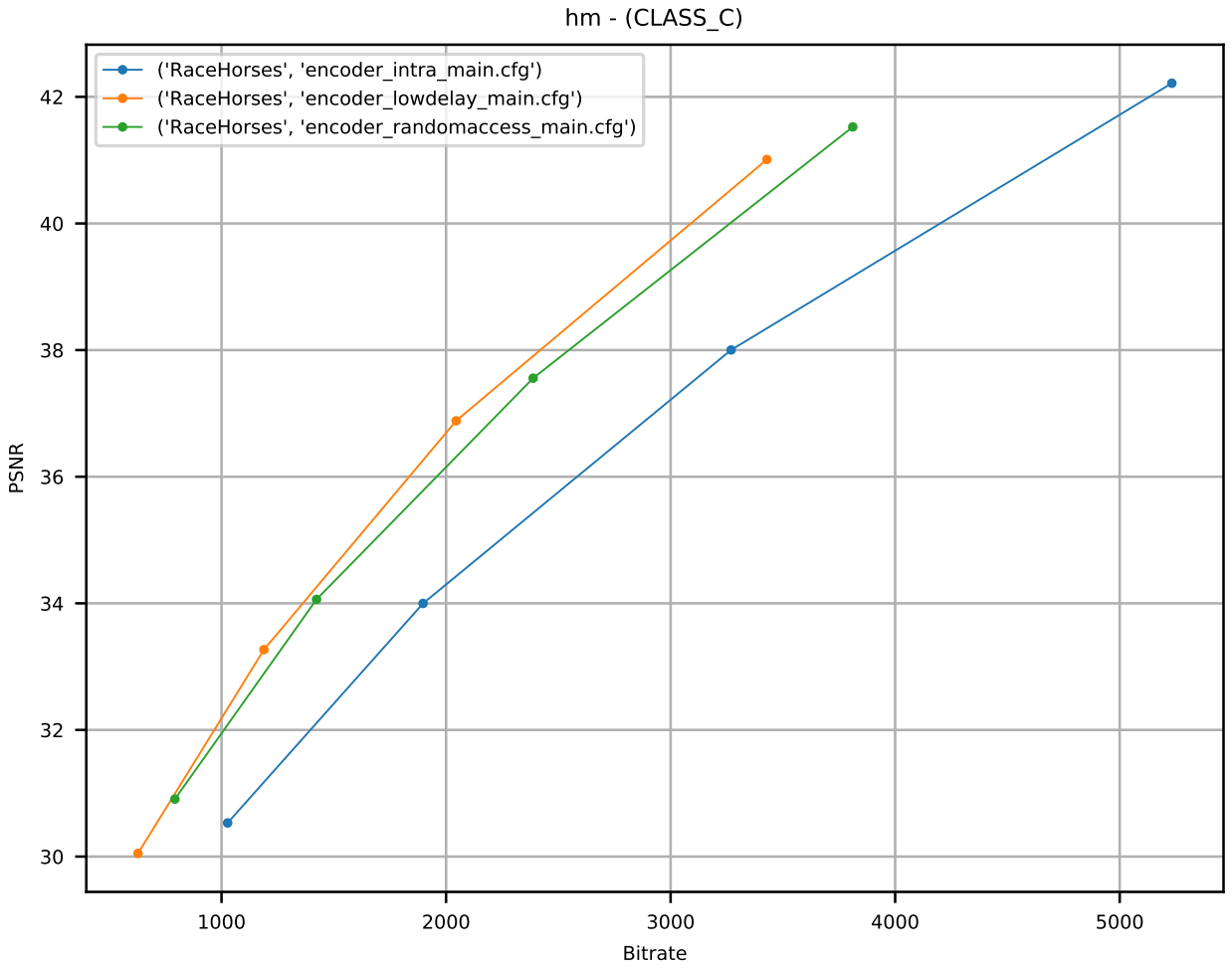
Combination No.	**Bitrate (kbps)**	**CPU Time**	**Power Consumption (in W)**
19	1069	0.030s	0.33287
20	574.6	0.020s	0.24417
21	3811.32	0.020s	1.02194
22	2387.76	0.040s	0.70799
23	1423.2	0.010s	0.44816
24	792.24	0.030s	0.45495
25	12294.912	0.300s	6.31422
26	6231.456	0.130s	4.90889
27	3841.728	0.200s	4.3945
28	2371.776	0.110s	4.25545
29	3822	0.040s	0.60707
30	2291.6	0.010s	0.45847
31	1322.8	0.010s	0.13216
32	731.2	0.010s	0.29878

2 Complexity Analysis - (Codec Name: HM)

2.1 HM ENCODER's Complexity




hm - (CLASS_B)
('BasketballPass', 'encoder_intra_main.cfg')
('BasketballPass', 'encoder_lowdelay_main.cfg')
('BasketballPass', 'encoder_randomaccess_main.cfg')
PSNR
Bitrate
32
34
36
38
40
42
1000
2000
3000
4000
5000


hm - (CLASS_C)
('RaceHorses', 'encoder_intra_main.cfg')
('RaceHorses', 'encoder_lowdelay_main.cfg')
('RaceHorses', 'encoder_randomaccess_main.cfg')
PSNR
Bitrate
30
32
34
36
38
40
42
1000
2000
3000
4000
5000

2.1.1 Config Name: encoder_intra_main.cfg, Class Name: CLASS_A

Table 5: Hotpots By Class (Kimono, QP =32)

Class	**CPU Time (%)**
xRateDistOptQuant	17.512
xPredIntraAng	9.764
xIntraCodingTUBlock	7.446
xCalcHADs4x4	2.243
estIntraPredLumaQT	2.13
initIntraPatternChType	1.923
estBit	1.904
codeCoeffNxN	1.489
codeIntraDirLumaAng	1.338
xRecurIntraCodingLumaQT	1.301
getIntraDirPredictor	1.301
predIntraAng	1.131
estLastSignificantPositionBit	1.093
xGetSSE8	0.961
xGetSSE16	0.924
encodeBin	0.905
xDeQuant	0.886
xT	0.867
xIT	0.811
getSigCtxInc	0.792

Table 6: Hotspots By Function
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	3.716086
TComPrediction::xPredIntraAng	2.072018
TEncSearch::xIntraCodingTUBlock	1.580011
___memmove_avx_unaligned_erms	0.961984
TComRdCost::xCalcHADs4x4	0.476007
partialButterflyInverse32	0.451992
TEncSearch::estIntraPredLumaQT	0.451979
fillReferenceSamples	0.420040
partialButterfly32	0.407983
TComPrediction::initIntraPatternChType	0.407958
___memset_avx2_unaligned_erms	0.404016
TEncSbac::estBit	0.403970
simdHADs8x8	0.376008
partialButterfly16	0.340043
TEncSbac::codeCoeffNxN	0.316016
partialButterfly8	0.307951
TEncSbac::codeIntraDirLumaAng	0.283981
TEncSearch::xRecurIntraCodingLumaQT	0.276011
TComDataCU::getIntraDirPredictor	0.275970
TComPrediction::predIntraAng	0.239972

Table 7: Memory Consumption
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 8: Performance Snapshot
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
Kimono QP = 22	2.108	14.6% (1.165 out of 8)	28.0% (1.120 out of 4)	56.7% of Pipeline Slots	1.1% of Packed FP Operations	0.9%
Kimono QP = 37	2.230	14.9% (1.193 out of 8)	28.6% (1.143 out of 4)	59.1% of Pipeline Slots	0.2% of Packed FP Operations	3.1%
Kimono QP = 32	2.275	14.4% (1.151 out of 8)	27.8% (1.111 out of 4)	61.1% of Pipeline Slots	0.4% of Packed FP Operations	0.9%
Kimono QP = 27	2.137	15.5% (1.243 out of 8)	29.5% (1.181 out of 4)	58.4% of Pipeline Slots	0.6% of Packed FP Operations	0.9%

Table 9: Instruction Mix
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
Kimono QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.093
Kimono QP = 37	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.083
Kimono QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.083
Kimono QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.083

Table 10: GPU Usage
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
Kimono QP = 22	21.6%	21.6%	27.8%	50.6%	32.3% of peak value
Kimono QP = 37	60.5%	60.5%	21.6%	17.9%	65.9% of peak value
Kimono QP = 32	22.5%	22.5%	28.8%	48.7%	33.2% of peak value
Kimono QP = 27	17.4%	17.4%	29.0%	53.5%	28.6% of peak value

Table 11: Memory Access Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
Kimono QP = 22	29.233s	5.0% of Clockticks	0.4% of Clockticks	0.5% of Clockticks	0.2% of Clockticks	0.8% of Clockticks	0	9
Kimono QP = 37	20.539s	4.0% of Clockticks	0.5% of Clockticks	0.4% of Clockticks	0.2% of Clockticks	1.0% of Clockticks	0	9
Kimono QP = 32	22.938s	4.2% of Clockticks	0.5% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	1.1% of Clockticks	0	9
Kimono QP = 27	24.784s	4.4% of Clockticks	0.5% of Clockticks	0.4% of Clockticks	0.1% of Clockticks	0.9% of Clockticks	0	9

Table 12: Micro Architecture Exploration
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
Kimono QP = 22	66,952,800,000	160,651,800,000	0.417	9.6% of Pipeline Slots	9.5% of Pipeline Slots	24.7%
Kimono QP = 37	49,671,000,000	127,409,400,000	0.390	5.3% of Pipeline Slots	5.3% of Pipeline Slots	24.5%
Kimono QP = 32	53,238,600,000	132,447,600,000	0.402	5.8% of Pipeline Slots	5.7% of Pipeline Slots	24.5%
Kimono QP = 27	57,843,000,000	140,349,600,000	0.412	7.0% of Pipeline Slots	6.9% of Pipeline Slots	24.6%

Table 13: Front-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
Kimono QP = 22	19.7% of Pipeline Slots	7.1% of Pipeline Slots	2.7% of Clockticks	0.2% of Clockticks	4.2% of Clockticks	12.6% of Pipeline Slots
Kimono QP = 37	18.2% of Pipeline Slots	5.7% of Pipeline Slots	2.4% of Clockticks	0.2% of Clockticks	2.4% of Clockticks	12.5% of Pipeline Slots
Kimono QP = 32	19.2% of Pipeline Slots	7.0% of Pipeline Slots	2.8% of Clockticks	1.0% of Clockticks	3.6% of Clockticks	12.3% of Pipeline Slots
Kimono QP = 27	21.1% of Pipeline Slots	8.1% of Pipeline Slots	3.2% of Clockticks	1.8% of Clockticks	4.9% of Clockticks	13.0% of Pipeline Slots

Table 14: Back-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
Kimono QP = 22	9.0% of Pipeline Slots	5.1% of Clockticks	0.4% of Clockticks	0.4% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	8.7% of Clockticks
Kimono QP = 37	10.1% of Pipeline Slots	4.1% of Clockticks	0.4% of Clockticks	0.3% of Clockticks	0.3% of Clockticks	1.1% of Clockticks	11.7% of Clockticks
Kimono QP = 32	11.4% of Pipeline Slots	4.4% of Clockticks	0.4% of Clockticks	0.6% of Clockticks	0.2% of Clockticks	0.9% of Clockticks	11.2% of Clockticks
Kimono QP = 27	8.9% of Pipeline Slots	5.1% of Clockticks	0.5% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.9% of Clockticks	10.2% of Clockticks

2.1.2 Config Name: encoder_intra_main.cfg, Class Name: CLASS_B

Table 15: Hotpots By Class (BasketballPass, QP =27)

Class	**CPU Time (%)**
xRateDistOptQuant	23.999
xPredIntraAng	12.802
codeCoeffNxN	4.0
xIntraCodingTUBlock	3.999
xPredIntraPlanar	3.6
getSigCtxInc	3.4
initIntraPatternChType	2.4
codeLastSignificantXY	2.4
xWriteCoefRemainExGolomb	2.0
xTransformSkip	2.0
estIntraPredLumaQT	1.999
resetBits	1.999
xQuant	1.802
xGetIntraBitsQT	1.2
rdpcmNxN	1.2
predIntraAng	1.2
xRecurIntraCodingLumaQT	1.2
codeIntraDirLumaAng	1.2
encodeBinsEP	1.2
copyState	1.2

Table 16: Hotspots By Function
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.239986
TComPrediction::xPredIntraAng	0.128018
___memmove_avx_unaligned_erms	0.067984
partialButterfly32	0.051953
TEncSbac::codeCoeffNxN	0.039997
TEncSearch::xIntraCodingTUBlock	0.039990
TComPrediction::xPredIntraPlanar	0.036003
TComTrQuant::getSigCtxInc	0.033997
TComPrediction::initIntraPatternChType	0.024002
TEncSbac::codeLastSignificantXY	0.023996
TEncSbac::xWriteCoefRemainExGolomb	0.020002
TComTrQuant::xTransformSkip	0.020001
partialButterfly4	0.020000
TEncSearch::estIntraPredLumaQT	0.019994
TComTrQuant::xQuant	0.018020
TEncSearch::xGetIntraBitsQT	0.012004
TComTrQuant::rdpcmNxN	0.012003
TComBitCounter::resetBits	0.012002
TComPrediction::predIntraAng	0.012002
partialButterflyInverse8	0.012002

Table 17: Memory Consumption
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 18: Performance Snapshot
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
BasketballPass QP = 37	2.078	16.2% (1.294 out of 8)	31.3% (1.252 out of 4)	54.8% of Pipeline Slots	0.7% of Packed FP Operations	2.0%
BasketballPass QP = 32	2.065	15.4% (1.232 out of 8)	30.0% (1.199 out of 4)	55.4% of Pipeline Slots	1.1% of Packed FP Operations	1.4%
BasketballPass QP = 22	1.978	15.0% (1.202 out of 8)	28.0% (1.118 out of 4)	53.4% of Pipeline Slots	2.6% of Packed FP Operations	1.3%
BasketballPass QP = 27	2.252	14.1% (1.126 out of 8)	27.4% (1.097 out of 4)	55.5% of Pipeline Slots	1.7% of Packed FP Operations	1.2%

Table 19: Instruction Mix
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
BasketballPass QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.045	0.090
BasketballPass QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.085
BasketballPass QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.7% of uOps	0.051	0.105
BasketballPass QP = 27	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.097

Table 20: GPU Usage
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
BasketballPass QP = 37	17.9%	17.9%	32.2%	49.9%	30.1% of peak value
BasketballPass QP = 32	18.1%	18.1%	30.0%	52.0%	30.5% of peak value
BasketballPass QP = 22	14.2%	14.2%	29.0%	56.8%	25.5% of peak value
BasketballPass QP = 27	16.8%	16.8%	29.8%	53.4%	28.1% of peak value

Table 21: Memory Access Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
BasketballPass QP = 37	0.773s	4.4% of Clockticks	0.9% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.9% of Clockticks	0	9
BasketballPass QP = 32	0.898s	5.3% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0	10
BasketballPass QP = 22	1.219s	6.1% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	0	9
BasketballPass QP = 27	1.499s	4.5% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	0	9

Table 22: Micro Architecture Exploration
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
BasketballPass QP = 37	2,746,800,000	6,699,600,000	0.410	7.4% of Pipeline Slots	7.4% of Pipeline Slots	25.0%
BasketballPass QP = 32	3,142,800,000	7,410,600,000	0.424	8.2% of Pipeline Slots	8.2% of Pipeline Slots	25.0%
BasketballPass QP = 22	4,329,000,000	9,484,200,000	0.456	14.8% of Pipeline Slots	14.8% of Pipeline Slots	25.0%
BasketballPass QP = 27	3,650,400,000	8,310,600,000	0.439	11.5% of Pipeline Slots	11.5% of Pipeline Slots	25.0%

Table 23: Front-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
BasketballPass QP = 37	18.7% of Pipeline Slots	5.9% of Pipeline Slots	2.0% of Clockticks	0.4% of Clockticks	2.0% of Clockticks	12.8% of Pipeline Slots
BasketballPass QP = 32	18.0% of Pipeline Slots	5.2% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	1.7% of Clockticks	12.9% of Pipeline Slots
BasketballPass QP = 22	21.6% of Pipeline Slots	7.7% of Pipeline Slots	1.2% of Clockticks	0.2% of Clockticks	4.3% of Clockticks	13.8% of Pipeline Slots
BasketballPass QP = 27	18.5% of Pipeline Slots	7.4% of Pipeline Slots	1.5% of Clockticks	0.1% of Clockticks	3.6% of Clockticks	11.1% of Pipeline Slots

Table 24: Back-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
BasketballPass QP = 37	12.5% of Pipeline Slots	3.9% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.1% of Clockticks
BasketballPass QP = 32	14.5% of Pipeline Slots	5.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.9% of Clockticks
BasketballPass QP = 22	4.4% of Pipeline Slots	6.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	5.7% of Clockticks
BasketballPass QP = 27	16.1% of Pipeline Slots	5.9% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	6.8% of Clockticks

2.1.3 Config Name: encoder_intra_main.cfg, Class Name: CLASS_C

Table 25: Hotpots By Class (RaceHorses, QP =22)

Class	**CPU Time (%)**
xRateDistOptQuant	30.051
codeCoeffNxN	12.994
xPredIntraAng	5.482
xIntraCodingTUBlock	3.857
getSigCtxInc	3.655
xWriteCoefRemainExGolomb	2.335
xGetSSE32	2.233
xCalcHADs4x4	2.031
encodeBin	2.03
initIntraPatternChType	1.422
getPUAboveRight	1.218
xEncSubdivCbfQT	1.218
getAddr	1.218
xT	1.015
xITransformSkip	1.015
encodeBinsEP	1.015
estBit	0.812
copyState	0.812
xGetSSE8	0.812
getPUBelowLeft	0.61

Table 26: Hotspots By Function
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.592000
TEncSbac::codeCoeffNxN	0.255991
TComPrediction::xPredIntraAng	0.107987
TEncSearch::xIntraCodingTUBlock	0.075991
TComTrQuant::getSigCtxInc	0.072007
TEncSbac::xWriteCoefRemainExGolomb	0.045997
__memset_avx2_unaligned_erms	0.043999
TComRdCost::xGetSSE32	0.043995
__memmove_avx_unaligned_erms	0.040005
simdHADs8x8	0.040003
TComRdCost::xCalcHADs4x4	0.040001
TEncBinCABACCounter::encodeBin	0.039989
partialButterflyInverse4	0.031998
TComPrediction::initIntraPatternChType	0.028007
TComDataCU::getPUAboveRight	0.024004
TEncSearch::xEncSubdivCbfQT	0.024002
TComYuv::getAddr	0.023997
partialButterfly16	0.023994
partialButterflyInverse8	0.020003
TComTrQuant::xT	0.020002

Table 27: Memory Consumption
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 28: Performance Snapshot
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
RaceHorses QP = 32	2.073	14.6% (1.169 out of 8)	28.2% (1.127 out of 4)	54.8% of Pipeline Slots	1.6% of Packed FP Operations	1.7%
RaceHorses QP = 27	1.960	14.9% (1.195 out of 8)	28.9% (1.157 out of 4)	54.4% of Pipeline Slots	2.4% of Packed FP Operations	1.2%
RaceHorses QP = 37	1.976	18.9% (1.513 out of 8)	35.0% (1.399 out of 4)	49.2% of Pipeline Slots	1.0% of Packed FP Operations	1.4%
RaceHorses QP = 22	1.950	14.7% (1.179 out of 8)	28.5% (1.141 out of 4)	51.7% of Pipeline Slots	2.8% of Packed FP Operations	1.3%

Table 29: Instruction Mix
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
RaceHorses QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.044	0.092
RaceHorses QP = 27	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.097
RaceHorses QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.039	0.078
RaceHorses QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.7% of uOps	0.049	0.104

Table 30: GPU Usage
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
RaceHorses QP = 32	16.4%	16.4%	30.1%	53.5%	28.2% of peak value
RaceHorses QP = 27	16.6%	16.6%	32.1%	51.3%	29.2% of peak value
RaceHorses QP = 37	15.4%	15.4%	31.0%	53.6%	27.4% of peak value
RaceHorses QP = 22	21.5%	21.5%	29.6%	48.9%	33.6% of peak value

Table 31: Memory Access Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
RaceHorses QP = 32	1.117s	5.2% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.7% of Clockticks	0	9
RaceHorses QP = 27	1.315s	6.0% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0	9
RaceHorses QP = 37	0.887s	4.6% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0	8
RaceHorses QP = 22	1.417s	6.7% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0	8

Table 32: Micro Architecture Exploration
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
RaceHorses QP = 32	3,749,400,000	8,337,600,000	0.450	11.2% of Pipeline Slots	11.2% of Pipeline Slots	25.0%
RaceHorses QP = 27	4,363,200,000	9,471,600,000	0.461	15.8% of Pipeline Slots	15.8% of Pipeline Slots	25.0%
RaceHorses QP = 37	3,101,400,000	7,363,800,000	0.421	7.8% of Pipeline Slots	7.8% of Pipeline Slots	25.0%
RaceHorses QP = 22	5,072,400,000	10,722,600,000	0.473	15.4% of Pipeline Slots	15.4% of Pipeline Slots	25.0%

Table 33: Front-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
RaceHorses QP = 32	20.6% of Pipeline Slots	7.5% of Pipeline Slots	1.4% of Clockticks	0.4% of Clockticks	5.0% of Clockticks	13.1% of Pipeline Slots
RaceHorses QP = 27	21.2% of Pipeline Slots	9.0% of Pipeline Slots	1.2% of Clockticks	0.2% of Clockticks	6.1% of Clockticks	12.2% of Pipeline Slots
RaceHorses QP = 37	19.6% of Pipeline Slots	7.0% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	4.3% of Clockticks	12.6% of Pipeline Slots
RaceHorses QP = 22	20.5% of Pipeline Slots	8.5% of Pipeline Slots	2.1% of Clockticks	0.2% of Clockticks	5.8% of Clockticks	12.0% of Pipeline Slots

Table 34: Back-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
RaceHorses QP = 32	9.0% of Pipeline Slots	5.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.9% of Clockticks
RaceHorses QP = 27	6.7% of Pipeline Slots	6.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	5.7% of Clockticks
RaceHorses QP = 37	12.1% of Pipeline Slots	7.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	6.4% of Clockticks
RaceHorses QP = 22	9.8% of Pipeline Slots	6.4% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	4.9% of Clockticks

2.1.4 Config Name: encoder_lowdelay_main.cfg, Class Name: CLASS_A

Table 35: Hotpots By Class (Kimono, QP =32)

Class	**CPU Time (%)**
xRateDistOptQuant	17.932
xPredIntraAng	3.764
filter<(int)8, (bool)1, (bool)0, (bool)1>	3.313
xIntraCodingTUBlock	3.101
xEstimateInterResidualQT	2.843
filter<(int)8, (bool)0, (bool)1, (bool)0>	2.73
xCalcHADs4x4	2.332
xGetSSE16	1.683
estBit	1.564
filterCopy	1.405
xGetSSE8	1.272
codeCoeffNxN	1.153
xGetSSE32	1.113
initIntraPatternChType	0.861
xGetHADs	0.808
xGetExpGolombNumberOfBits	0.795
estLastSignificantPositionBit	0.795
filter<(int)4, (bool)0, (bool)1, (bool)0>	0.742
encodeBin	0.729
xT	0.716

Table 36: Hotspots By Function
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	5.411486
__memmove_avx_unaligned_erms	1.157995
TComPrediction::xPredIntraAng	1.135853
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.999926
simdHADs8x8	0.983849
TEncSearch::xIntraCodingTUBlock	0.935862
__memset_avx2_unaligned_erms	0.859978
TEncSearch::xEstimateInterResidualQT	0.857948
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.823910
TComRdCost::xCalcHADs4x4	0.703899
partialButterfly32	0.599969
_Z15simd8x8HAD1D32bPDv2_xS0_	0.543914
TComRdCost::xGetSSE16	0.507970
partialButterflyInverse32	0.483965
TEncSbac::estBit	0.471968
partialButterfly8	0.439945
TComInterpolationFilter::filterCopy	0.423913
partialButterfly16	0.411991
TComRdCost::xGetSSE8	0.383941
TEncSbac::codeCoeffNxN	0.348035

Table 37: Memory Consumption
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 38: Performance Snapshot
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
Kimono QP = 22	2.172	14.4% (1.154 out of 8)	27.9% (1.115 out of 4)	58.6% of Pipeline Slots	0.8% of Packed FP Operations	0.9%
Kimono QP = 37	2.284	14.6% (1.164 out of 8)	28.0% (1.120 out of 4)	61.8% of Pipeline Slots	0.1% of Packed FP Operations	0.9%
Kimono QP = 32	2.245	14.5% (1.157 out of 8)	27.9% (1.116 out of 4)	61.1% of Pipeline Slots	0.2% of Packed FP Operations	0.9%
Kimono QP = 27	2.210	14.6% (1.167 out of 8)	28.1% (1.123 out of 4)	59.8% of Pipeline Slots	0.4% of Packed FP Operations	0.9%

Table 39: Instruction Mix
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
Kimono QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.044	0.098
Kimono QP = 37	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.089
Kimono QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.093
Kimono QP = 27	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.043	0.095

Table 40: GPU Usage
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
Kimono QP = 22	24.1%	24.1%	28.9%	47.0%	35.3% of peak value
Kimono QP = 37	21.7%	21.7%	28.4%	49.9%	32.6% of peak value
Kimono QP = 32	24.9%	24.9%	28.6%	46.6%	36.0% of peak value
Kimono QP = 27	22.0%	22.0%	27.8%	50.2%	32.8% of peak value

Table 41: Memory Access Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
Kimono QP = 22	53.797s	5.0% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.4% of Clockticks	0	9
Kimono QP = 37	25.737s	3.9% of Clockticks	0.6% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.8% of Clockticks	0	9
Kimono QP = 32	33.991s	4.2% of Clockticks	0.5% of Clockticks	0.8% of Clockticks	0.1% of Clockticks	1.9% of Clockticks	0	9
Kimono QP = 27	41.049s	4.4% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.7% of Clockticks	0	9

Table 42: Micro Architecture Exploration
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
Kimono QP = 22	123,305,400,000	295,851,600,000	0.417	7.9% of Pipeline Slots	7.8% of Pipeline Slots	24.8%
Kimono QP = 37	66,861,000,000	168,865,200,000	0.396	5.1% of Pipeline Slots	5.0% of Pipeline Slots	24.6%
Kimono QP = 32	77,470,200,000	194,022,000,000	0.399	5.5% of Pipeline Slots	5.4% of Pipeline Slots	24.7%
Kimono QP = 27	94,883,400,000	234,109,800,000	0.405	6.2% of Pipeline Slots	6.1% of Pipeline Slots	24.5%

Table 43: Front-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
Kimono QP = 22	18.0% of Pipeline Slots	7.1% of Pipeline Slots	3.2% of Clockticks	0.2% of Clockticks	3.8% of Clockticks	10.9% of Pipeline Slots
Kimono QP = 37	16.5% of Pipeline Slots	6.2% of Pipeline Slots	2.9% of Clockticks	0.3% of Clockticks	2.6% of Clockticks	10.3% of Pipeline Slots
Kimono QP = 32	17.3% of Pipeline Slots	6.2% of Pipeline Slots	3.0% of Clockticks	0.3% of Clockticks	2.7% of Clockticks	11.1% of Pipeline Slots
Kimono QP = 27	17.9% of Pipeline Slots	6.7% of Pipeline Slots	3.2% of Clockticks	0.5% of Clockticks	3.2% of Clockticks	11.2% of Pipeline Slots

Table 44: Back-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
Kimono QP = 22	12.2% of Pipeline Slots	5.0% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.4% of Clockticks	11.8% of Clockticks
Kimono QP = 37	13.3% of Pipeline Slots	4.4% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.8% of Clockticks	13.3% of Clockticks
Kimono QP = 32	12.2% of Pipeline Slots	4.2% of Clockticks	0.5% of Clockticks	0.8% of Clockticks	0.2% of Clockticks	1.9% of Clockticks	13.1% of Clockticks
Kimono QP = 27	11.5% of Pipeline Slots	4.6% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.7% of Clockticks	12.2% of Clockticks

2.1.5 Config Name: encoder_lowdelay_main.cfg, Class Name: CLASS_B

Table 45: Hotpots By Class (BasketballPass, QP =27)

Class	**CPU Time (%)**
xRateDistOptQuant	22.486
xEstimateInterResidualQT	3.677
codeCoeffNxN	3.676
filter<(int)8, (bool)1, (bool)0, (bool)1>	3.243
xTransformSkip	2.811
codeIntraDirLumaAng	2.163
xGetHADs	2.162
filter<(int)8, (bool)0, (bool)1, (bool)0>	1.946
codeQtCbf	1.945
codeLastSignificantXY	1.514
xCalcHADs4x4	1.514
encodeBin	1.514
xGetSSE32	1.513
xGetSSE16	1.298
initIntraPatternChType	1.297
xGetColMVP	1.297
filterCopy	1.297
rdpcmNxN	1.297
calcRdCost	1.081
xPredIntraAng	1.081

Table 46: Hotspots By Function
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.415986
simdHADs8x8	0.083994
TEncSearch::xEstimateInterResidualQT	0.068017
TEncSbac::codeCoeffNxN	0.068003
___memmove_avx_unaligned_erms	0.067993
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.059995
TComTrQuant::xTransformSkip	0.052000
TEncSbac::codeIntraDirLumaAng	0.040019
TComRdCost::xGetHADs	0.039998
partialButterfly4	0.036003
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.035997
TEncSbac::codeQtCbf	0.035986
TEncSbac::codeLastSignificantXY	0.028006
TComRdCost::xCalcHADs4x4	0.028003
___memset_avx2_unaligned_erms	0.027999
fillReferenceSamples	0.027996
TComRdCost::xGetSSE32	0.027991
partialButterfly8	0.024010
partialButterfly32	0.024007
TComRdCost::xGetSSE16	0.024007

Table 47: Memory Consumption
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 48: Performance Snapshot
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
BasketballPass QP = 37	2.262	15.0% (1.202 out of 8)	29.1% (1.164 out of 4)	62.5% of Pipeline Slots	0.4% of Packed FP Operations	1.0%
BasketballPass QP = 32	2.076	16.3% (1.305 out of 8)	31.4% (1.255 out of 4)	59.4% of Pipeline Slots	0.5% of Packed FP Operations	2.1%
BasketballPass QP = 22	1.988	14.8% (1.184 out of 8)	29.0% (1.160 out of 4)	52.8% of Pipeline Slots	1.6% of Packed FP Operations	1.2%
BasketballPass QP = 27	2.064	15.7% (1.253 out of 8)	29.9% (1.197 out of 4)	59.0% of Pipeline Slots	0.9% of Packed FP Operations	1.6%

Table 49: Instruction Mix
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
BasketballPass QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.043	0.093
BasketballPass QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.086
BasketballPass QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.103
BasketballPass QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.092

Table 50: GPU Usage
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
BasketballPass QP = 37	18.3%	18.3%	29.0%	52.7%	28.9% of peak value
BasketballPass QP = 32	47.9%	47.9%	21.9%	30.3%	56.0% of peak value
BasketballPass QP = 22	16.1%	16.1%	31.9%	52.0%	28.6% of peak value
BasketballPass QP = 27	15.8%	15.8%	30.8%	53.3%	27.9% of peak value

Table 51: Memory Access Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
BasketballPass QP = 37	0.887s	4.6% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	0	9
BasketballPass QP = 32	0.997s	4.1% of Clockticks	0.7% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.4% of Clockticks	0	9
BasketballPass QP = 22	1.927s	6.3% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.9% of Clockticks	0	8
BasketballPass QP = 27	1.273s	5.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	1.1% of Clockticks	0	10

Table 52: Micro Architecture Exploration
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
BasketballPass QP = 37	3,119,400,000	7,722,000,000	0.404	6.1% of Pipeline Slots	6.1% of Pipeline Slots	25.0%
BasketballPass QP = 32	3,542,400,000	8,575,200,000	0.413	5.7% of Pipeline Slots	5.7% of Pipeline Slots	25.0%
BasketballPass QP = 22	5,382,000,000	11,995,200,000	0.449	12.5% of Pipeline Slots	12.5% of Pipeline Slots	25.0%
BasketballPass QP = 27	4,280,400,000	10,006,200,000	0.428	8.5% of Pipeline Slots	8.5% of Pipeline Slots	25.0%

Table 53: Front-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
BasketballPass QP = 37	18.6% of Pipeline Slots	6.9% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	2.5% of Clockticks	11.7% of Pipeline Slots
BasketballPass QP = 32	17.1% of Pipeline Slots	6.1% of Pipeline Slots	1.5% of Clockticks	0.3% of Clockticks	2.2% of Clockticks	11.1% of Pipeline Slots
BasketballPass QP = 22	19.8% of Pipeline Slots	9.4% of Pipeline Slots	2.0% of Clockticks	1.0% of Clockticks	5.8% of Clockticks	10.4% of Pipeline Slots
BasketballPass QP = 27	18.0% of Pipeline Slots	6.6% of Pipeline Slots	1.3% of Clockticks	0.4% of Clockticks	3.7% of Clockticks	11.5% of Pipeline Slots

Table 54: Back-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
BasketballPass QP = 37	11.7% of Pipeline Slots	5.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	11.3% of Clockticks
BasketballPass QP = 32	13.1% of Pipeline Slots	4.6% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	16.0% of Clockticks
BasketballPass QP = 22	9.7% of Pipeline Slots	6.0% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.4% of Clockticks
BasketballPass QP = 27	9.5% of Pipeline Slots	5.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	9.3% of Clockticks

2.1.6 Config Name: encoder_lowdelay_main.cfg, Class Name: CLASS_C

Table 55: Hotpots By Class (RaceHorses, QP =22)

Class	**CPU Time (%)**
xRateDistOptQuant	25.279
codeCoeffNxN	7.57
encodeBin	4.86
filter<(int)8, (bool)0, (bool)1, (bool)0>	4.205
getSigCtxInc	4.112
xEstimateInterResidualQT	2.804
filter<(int)8, (bool)1, (bool)0, (bool)1>	2.71
xCalcHADs4x4	2.43
xWriteCoefRemainExGolomb	2.43
xPredIntraAng	2.056
xGetSSE16	1.682
nextSection	1.682
estBit	1.402
initIntraPatternChType	1.308
filterCopy	1.028
initEstData	0.935
codeLastSignificantXY	0.935
xPredInterUni	0.935
xGetSAD16	0.748
xGetSAD8	0.748

Table 56: Hotspots By Function
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	1.081938
TEncSbac::codeCoeffNxN	0.323995
TEncBinCABACCounter::encodeBin	0.207991
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.179983
TComTrQuant::getSigCtxInc	0.175986
TEncSearch::xEstimateInterResidualQT	0.120031
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.115998
TComRdCost::xCalcHADs4x4	0.104025
TEncSbac::xWriteCoefRemainExGolomb	0.104002
___memmove_avx_unaligned_erms	0.100003
TComPrediction::xPredIntraAng	0.088006
simdHADs8x8	0.088002
___memset_avx2_unaligned_erms	0.072005
TComRdCost::xGetSSE16	0.072000
TComTURecurse::nextSection	0.071988
TEncSbac::estBit	0.060000
TComPrediction::initIntraPatternChType	0.055982
_Z15simd8x8HAD1D32bPDv2_xS0_	0.051993
partialButterfly32	0.048016
TComInterpolationFilter::filterCopy	0.044003

Table 57: Memory Consumption
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 58: Performance Snapshot
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
RaceHorses QP = 32	1.927	16.1% (1.286 out of 8)	30.9% (1.235 out of 4)	54.0% of Pipeline Slots	0.9% of Packed FP Operations	1.6%
RaceHorses QP = 27	2.051	14.4% (1.153 out of 8)	28.0% (1.121 out of 4)	53.9% of Pipeline Slots	1.4% of Packed FP Operations	1.4%
RaceHorses QP = 37	2.200	14.6% (1.166 out of 8)	28.2% (1.129 out of 4)	57.1% of Pipeline Slots	0.6% of Packed FP Operations	1.3%
RaceHorses QP = 22	1.809	16.1% (1.284 out of 8)	30.6% (1.224 out of 4)	49.5% of Pipeline Slots	2.1% of Packed FP Operations	1.4%

Table 59: Instruction Mix
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
RaceHorses QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.044	0.095
RaceHorses QP = 27	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.101
RaceHorses QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.042	0.094
RaceHorses QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.105

Table 60: GPU Usage
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
RaceHorses QP = 32	38.2%	38.2%	23.9%	37.8%	46.8% of peak value
RaceHorses QP = 27	39.3%	39.3%	26.6%	34.1%	48.1% of peak value
RaceHorses QP = 37	18.2%	18.2%	32.7%	49.1%	30.7% of peak value
RaceHorses QP = 22	24.3%	24.3%	26.8%	48.9%	34.1% of peak value

Table 61: Memory Access Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
RaceHorses QP = 32	2.976s	5.0% of Clockticks	0.9% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	1.4% of Clockticks	0	8
RaceHorses QP = 27	3.820s	6.0% of Clockticks	0.0% of Clockticks	1.1% of Clockticks	0.0% of Clockticks	0.7% of Clockticks	0	9
RaceHorses QP = 37	1.211s	4.5% of Clockticks	0.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	0	9
RaceHorses QP = 22	3.582s	6.4% of Clockticks	0.3% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0	8

Table 62: Micro Architecture Exploration
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
RaceHorses QP = 32	5,270,400,000	12,362,400,000	0.426	9.5% of Pipeline Slots	9.5% of Pipeline Slots	25.0%
RaceHorses QP = 27	6,879,600,000	15,361,200,000	0.448	11.8% of Pipeline Slots	11.8% of Pipeline Slots	25.0%
RaceHorses QP = 37	4,320,000,000	10,402,200,000	0.415	7.2% of Pipeline Slots	7.2% of Pipeline Slots	25.0%
RaceHorses QP = 22	9,365,400,000	20,181,600,000	0.464	13.8% of Pipeline Slots	13.8% of Pipeline Slots	25.0%

Table 63: Front-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
RaceHorses QP = 32	17.4% of Pipeline Slots	7.2% of Pipeline Slots	2.0% of Clockticks	0.2% of Clockticks	3.5% of Clockticks	10.2% of Pipeline Slots
RaceHorses QP = 27	18.2% of Pipeline Slots	7.8% of Pipeline Slots	2.4% of Clockticks	0.3% of Clockticks	5.0% of Clockticks	10.4% of Pipeline Slots
RaceHorses QP = 37	18.4% of Pipeline Slots	6.3% of Pipeline Slots	2.5% of Clockticks	0.3% of Clockticks	3.1% of Clockticks	12.2% of Pipeline Slots
RaceHorses QP = 22	19.3% of Pipeline Slots	8.1% of Pipeline Slots	1.7% of Clockticks	0.3% of Clockticks	5.7% of Clockticks	11.2% of Pipeline Slots

Table 64: Back-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
RaceHorses QP = 32	10.9% of Pipeline Slots	6.1% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	9.5% of Clockticks
RaceHorses QP = 27	12.9% of Pipeline Slots	5.5% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	8.0% of Clockticks
RaceHorses QP = 37	10.9% of Pipeline Slots	6.3% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	10.4% of Clockticks
RaceHorses QP = 22	11.3% of Pipeline Slots	5.8% of Clockticks	0.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	7.4% of Clockticks

2.1.7 Config Name: encoder_randomaccess_main.cfg, Class Name: CLASS_A

Table 65: Hotpots By Class (Kimono, QP =32)

Class	**CPU Time (%)**
xRateDistOptQuant	17.135
filter<(int)8, (bool)1, (bool)0, (bool)1>	3.681
xPredIntraAng	3.497
xIntraCodingTUBlock	3.261
filter<(int)8, (bool)0, (bool)1, (bool)0>	2.278
xEstimateInterResidualQT	2.094
xCalcHADs4x4	1.852
estBit	1.679
codeCoeffNxN	1.634
filterCopy	1.587
xGetSSE32	1.392
xT	1.208
xGetSSE16	1.139
xGetSSE8	1.093
estLastSignificantPositionBit	0.909
initIntraPatternChType	0.84
xGetHADs	0.794
encodeBin	0.713
transformNxN	0.702
copyState	0.679

Table 66: Hotspots By Function
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	5.957930
___memset_avx2_unaligned_erms	1.372045
___memmove_avx_unaligned_erms	1.310133
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	1.280035
TComPrediction::xPredIntraAng	1.216045
TEncSearch::xIntraCodingTUBlock	1.133998
simdHADs8x8	1.071959
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.791989
TEncSearch::xEstimateInterResidualQT	0.727980
TComRdCost::xCalcHADs4x4	0.644065
partialButterfly16	0.604012
partialButterfly32	0.595957
TEncSbac::estBit	0.583924
TEncSbac::codeCoeffNxN	0.568051
TComInterpolationFilter::filterCopy	0.551949
partialButterfly8	0.532038
TComRdCost::xGetSSE32	0.484003
_Z15simd8x8HAD1D32bPDv2_xS0_	0.471952
___memset_avx2_erms	0.447977
partialButterflyInverse32	0.444113

Table 67: Memory Consumption
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 68: Performance Snapshot
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
Kimono QP = 22	2.154	14.3% (1.144 out of 8)	27.5% (1.101 out of 4)	58.4% of Pipeline Slots	0.8% of Packed FP Operations	0.1%
Kimono QP = 37	1.733	21.7% (1.738 out of 8)	37.6% (1.502 out of 4)	51.2% of Pipeline Slots	0.3% of Packed FP Operations	6.7%
Kimono QP = 32	1.844	19.1% (1.526 out of 8)	34.8% (1.391 out of 4)	52.8% of Pipeline Slots	0.3% of Packed FP Operations	11.1%
Kimono QP = 27	1.767	20.8% (1.663 out of 8)	36.5% (1.460 out of 4)	52.3% of Pipeline Slots	0.4% of Packed FP Operations	12.5%

Table 69: Instruction Mix
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
Kimono QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.100
Kimono QP = 37	0.0% of uOps	0.9% of uOps	0.1% of uOps	99.0% of uOps	0.036	0.079
Kimono QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	99.0% of uOps	0.039	0.086
Kimono QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	99.0% of uOps	0.038	0.086

Table 70: GPU Usage
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
Kimono QP = 22	61.6%	61.6%	20.7%	17.8%	67.6% of peak value
Kimono QP = 37	16.8%	16.8%	15.4%	67.8%	28.0% of peak value
Kimono QP = 32	20.9%	20.9%	21.1%	58.0%	29.9% of peak value
Kimono QP = 27	13.1%	13.1%	17.6%	69.3%	22.4% of peak value

Table 71: Memory Access Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
Kimono QP = 22	47.174s	5.0% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.4% of Clockticks	0	9
Kimono QP = 37	27.481s	4.4% of Clockticks	0.7% of Clockticks	0.7% of Clockticks	0.2% of Clockticks	1.8% of Clockticks	1,200,084	10
Kimono QP = 32	32.695s	4.9% of Clockticks	0.7% of Clockticks	0.9% of Clockticks	0.2% of Clockticks	1.7% of Clockticks	1,200,084	9
Kimono QP = 27	42.225s	5.5% of Clockticks	0.6% of Clockticks	0.9% of Clockticks	0.2% of Clockticks	1.5% of Clockticks	2,400,168	9

Table 72: Micro Architecture Exploration
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
Kimono QP = 22	122,317,200,000	289,823,400,000	0.422	8.5% of Pipeline Slots	8.4% of Pipeline Slots	24.6%
Kimono QP = 37	66,762,000,000	167,518,800,000	0.399	5.4% of Pipeline Slots	5.3% of Pipeline Slots	24.6%
Kimono QP = 32	79,291,800,000	189,667,800,000	0.418	5.6% of Pipeline Slots	5.4% of Pipeline Slots	24.7%
Kimono QP = 27	92,982,600,000	224,316,000,000	0.415	6.3% of Pipeline Slots	6.2% of Pipeline Slots	25.0%

Table 73: Front-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
Kimono QP = 22	18.0% of Pipeline Slots	7.3% of Pipeline Slots	3.2% of Clockticks	0.2% of Clockticks	4.0% of Clockticks	10.8% of Pipeline Slots
Kimono QP = 37	17.6% of Pipeline Slots	6.5% of Pipeline Slots	3.0% of Clockticks	0.3% of Clockticks	2.7% of Clockticks	11.1% of Pipeline Slots
Kimono QP = 32	18.6% of Pipeline Slots	7.7% of Pipeline Slots	3.7% of Clockticks	0.4% of Clockticks	3.1% of Clockticks	10.9% of Pipeline Slots
Kimono QP = 27	18.4% of Pipeline Slots	7.2% of Pipeline Slots	3.4% of Clockticks	0.3% of Clockticks	3.3% of Clockticks	11.2% of Pipeline Slots

Table 74: Back-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
Kimono QP = 22	11.2% of Pipeline Slots	5.2% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.2% of Clockticks	1.5% of Clockticks	11.4% of Clockticks
Kimono QP = 37	11.2% of Pipeline Slots	4.4% of Clockticks	0.5% of Clockticks	0.8% of Clockticks	0.2% of Clockticks	1.9% of Clockticks	12.2% of Clockticks
Kimono QP = 32	10.2% of Pipeline Slots	5.1% of Clockticks	0.5% of Clockticks	0.9% of Clockticks	0.3% of Clockticks	1.8% of Clockticks	13.2% of Clockticks
Kimono QP = 27	10.9% of Pipeline Slots	5.0% of Clockticks	0.5% of Clockticks	0.9% of Clockticks	0.2% of Clockticks	1.6% of Clockticks	13.0% of Clockticks

2.1.8 Config Name: encoder_randomaccess_main.cfg, Class Name: CLASS_B

Table 75: Hotpots By Class (BasketballPass, QP =27)

Class	**CPU Time (%)**
xRateDistOptQuant	21.523
xCalcHADs4x4	3.864
codeCoeffNxN	3.035
xGetSSE32	2.76
transformNxN	2.757
xEstimateInterResidualQT	2.483
xGetSSE16	1.932
filter<(int)8, (bool)1, (bool)0, (bool)1>	1.932
xPredInterUni	1.929
xGetExpGolombNumberOfBits	1.929
resetBits	1.656
getSigCtxInc	1.655
xGetSAD8	1.655
filterCopy	1.653
setCrossComponentPredictionAlphaPartRange	1.38
encodeBin	1.38
filter<(int)8, (bool)0, (bool)1, (bool)0>	1.379
codeIntraDirLumaAng	1.379
xGetHADs	1.104
predInterSearch	1.103

Table 76: Hotspots By Function
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.312078
___memset_avx2_unaligned_erms	0.063988
simdHADs8x8	0.063981
TComRdCost::xCalcHADs4x4	0.056023
TEncSbac::codeCoeffNxN	0.044001
___memmove_avx_unaligned_erms	0.043988
TComRdCost::xGetSSE32	0.040018
TComTrQuant::transformNxN	0.039983
TEncSearch::xEstimateInterResidualQT	0.036007
TComRdCost::xGetSSE16	0.028016
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.028010
TComPrediction::xPredInterUni	0.027973
TComRdCost::xGetExpGolombNumberOfBits	0.027971
TComTrQuant::getSigCtxInc	0.023994
TComRdCost::xGetSAD8	0.023992
___memset_avx2_erms	0.023974
TComInterpolationFilter::filterCopy	0.023966
TComDataCU::setCrossComponentPredictionAlphaPartRange	0.020011
TEncBinCABACCounter::encodeBin	0.020010
partialButterfly32	0.020007

Table 77: Memory Consumption
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 78: Performance Snapshot
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
BasketballPass QP = 37	1.992	18.0% (1.436 out of 8)	33.5% (1.341 out of 4)	54.1% of Pipeline Slots	0.7% of Packed FP Operations	2.5%
BasketballPass QP = 32	1.951	21.8% (1.741 out of 8)	40.5% (1.622 out of 4)	43.2% of Pipeline Slots	0.7% of Packed FP Operations	21.7%
BasketballPass QP = 22	1.679	17.6% (1.411 out of 8)	33.0% (1.321 out of 4)	48.7% of Pipeline Slots	1.6% of Packed FP Operations	1.4%
BasketballPass QP = 27	1.928	17.8% (1.427 out of 8)	33.0% (1.320 out of 4)	52.6% of Pipeline Slots	1.4% of Packed FP Operations	1.7%

Table 79: Instruction Mix
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
BasketballPass QP = 37	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.040	0.085
BasketballPass QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.040	0.086
BasketballPass QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.099
BasketballPass QP = 27	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.043	0.091

Table 80: GPU Usage
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
BasketballPass QP = 37	40.6%	40.6%	22.1%	37.3%	49.1% of peak value
BasketballPass QP = 32	13.3%	13.3%	15.8%	70.8%	24.7% of peak value
BasketballPass QP = 22	50.4%	50.4%	13.7%	35.8%	59.7% of peak value
BasketballPass QP = 27	33.5%	33.5%	23.5%	43.0%	42.7% of peak value

Table 81: Memory Access Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
BasketballPass QP = 37	1.018s	4.4% of Clockticks	1.5% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	0	9
BasketballPass QP = 32	1.118s	5.3% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	0	9
BasketballPass QP = 22	1.626s	5.9% of Clockticks	0.9% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0.9% of Clockticks	0	8
BasketballPass QP = 27	1.435s	6.5% of Clockticks	0.5% of Clockticks	1.1% of Clockticks	0.0% of Clockticks	1.6% of Clockticks	0	9

Table 82: Micro Architecture Exploration
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
BasketballPass QP = 37	3,202,200,000	7,803,000,000	0.410	6.3% of Pipeline Slots	6.3% of Pipeline Slots	25.0%
BasketballPass QP = 32	3,627,000,000	8,654,400,000	0.419	6.3% of Pipeline Slots	6.3% of Pipeline Slots	25.0%
BasketballPass QP = 22	5,419,800,000	11,754,000,000	0.461	12.3% of Pipeline Slots	12.3% of Pipeline Slots	25.0%
BasketballPass QP = 27	4,305,600,000	9,905,400,000	0.435	9.8% of Pipeline Slots	9.8% of Pipeline Slots	25.0%

Table 83: Front-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
BasketballPass QP = 37	16.4% of Pipeline Slots	5.1% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	2.4% of Clockticks	11.4% of Pipeline Slots
BasketballPass QP = 32	18.6% of Pipeline Slots	6.0% of Pipeline Slots	1.5% of Clockticks	0.1% of Clockticks	3.6% of Clockticks	12.7% of Pipeline Slots
BasketballPass QP = 22	20.3% of Pipeline Slots	8.5% of Pipeline Slots	2.0% of Clockticks	0.3% of Clockticks	4.9% of Clockticks	11.7% of Pipeline Slots
BasketballPass QP = 27	19.9% of Pipeline Slots	6.5% of Pipeline Slots	2.5% of Clockticks	0.4% of Clockticks	3.1% of Clockticks	13.4% of Pipeline Slots

Table 84: Back-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
BasketballPass QP = 37	18.2% of Pipeline Slots	5.1% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	11.0% of Clockticks
BasketballPass QP = 32	12.2% of Pipeline Slots	6.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	11.0% of Clockticks
BasketballPass QP = 22	7.7% of Pipeline Slots	6.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	9.3% of Clockticks
BasketballPass QP = 27	6.4% of Pipeline Slots	5.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	1.3% of Clockticks	9.3% of Clockticks

2.1.9 Config Name: encoder_randomaccess_main.cfg, Class Name: CLASS_C

Table 85: Hotpots By Class (RaceHorses, QP =22)

Class	**CPU Time (%)**
xRateDistOptQuant	27.632
codeCoeffNxN	7.246
getSigCtxInc	4.541
encodeBin	3.092
filter<(int)8, (bool)1, (bool)0, (bool)1>	2.898
xCalcHADs4x4	2.126
xIntraCodingTUBlock	1.739
xPredIntraAng	1.642
xEstimateInterResidualQT	1.546
xWriteCoefRemainExGolomb	1.449
xGetSSE32	1.353
estBit	1.256
xGetSSE8	1.063
xDeQuant	1.063
xTransformSkip	0.966
countNonZeroCoeffs	0.87
filter<(int)8, (bool)0, (bool)1, (bool)0>	0.87
filterCopy	0.869
codeLastSignificantXY	0.869
nextSection	0.773

Table 86: Hotspots By Function
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	1.143950
TEncSbac::codeCoeffNxN	0.299999
TComTrQuant::getSigCtxInc	0.187998
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.119996
TEncBinCABACCounter::encodeBin	0.119988
___memmove_avx_unaligned_erms	0.095988
TComRdCost::xCalcHADs4x4	0.088009
TEncSearch::xIntraCodingTUBlock	0.071981
___memset_avx2_unaligned_erms	0.067999
TComPrediction::xPredIntraAng	0.067996
simdHADs8x8	0.067985
TEncSearch::xEstimateInterResidualQT	0.064009
TEncSbac::xWriteCoefRemainExGolomb	0.059994
TComRdCost::xGetSSE32	0.055996
TEncSbac::estBit	0.052005
partialButterflyInverse32	0.048011
TComRdCost::xGetSSE8	0.044003
TComTrQuant::xDeQuant	0.043995
getTUEntropyCodingParameters	0.040003
TComTrQuant::xTransformSkip	0.039998

Table 87: Memory Consumption
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 88: Performance Snapshot
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
RaceHorses QP = 32	2.068	15.2% (1.213 out of 8)	29.5% (1.179 out of 4)	54.6% of Pipeline Slots	1.1% of Packed FP Operations	0.6%
RaceHorses QP = 27	2.038	14.5% (1.157 out of 8)	28.2% (1.129 out of 4)	56.1% of Pipeline Slots	1.7% of Packed FP Operations	0.4%
RaceHorses QP = 37	2.198	14.5% (1.158 out of 8)	28.3% (1.132 out of 4)	57.0% of Pipeline Slots	0.6% of Packed FP Operations	0.7%
RaceHorses QP = 22	1.974	14.2% (1.136 out of 8)	27.6% (1.104 out of 4)	53.3% of Pipeline Slots	2.2% of Packed FP Operations	0.2%

Table 89: Instruction Mix
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
RaceHorses QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.043	0.095
RaceHorses QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.096
RaceHorses QP = 37	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.099
RaceHorses QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.102

Table 90: GPU Usage
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
RaceHorses QP = 32	31.4%	31.4%	24.8%	43.8%	42.4% of peak value
RaceHorses QP = 27	38.2%	38.2%	21.9%	39.9%	48.1% of peak value
RaceHorses QP = 37	19.1%	19.1%	30.8%	50.1%	30.2% of peak value
RaceHorses QP = 22	18.9%	18.9%	33.7%	47.4%	31.3% of peak value

Table 91: Memory Access Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
RaceHorses QP = 32	1.470s	5.5% of Clockticks	0.5% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	1.4% of Clockticks	0	9
RaceHorses QP = 27	2.990s	5.9% of Clockticks	0.4% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.1% of Clockticks	0	9
RaceHorses QP = 37	1.204s	5.0% of Clockticks	0.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	0	8
RaceHorses QP = 22	4.137s	6.6% of Clockticks	0.3% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0	9

Table 92: Micro Architecture Exploration
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
RaceHorses QP = 32	5,221,800,000	12,177,000,000	0.429	9.0% of Pipeline Slots	9.0% of Pipeline Slots	25.0%
RaceHorses QP = 27	6,458,400,000	14,610,600,000	0.442	10.9% of Pipeline Slots	10.9% of Pipeline Slots	25.0%
RaceHorses QP = 37	4,336,200,000	10,382,400,000	0.418	7.8% of Pipeline Slots	7.8% of Pipeline Slots	25.0%
RaceHorses QP = 22	8,825,400,000	19,085,400,000	0.462	14.0% of Pipeline Slots	14.0% of Pipeline Slots	25.0%

Table 93: Front-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
RaceHorses QP = 32	18.1% of Pipeline Slots	7.2% of Pipeline Slots	2.1% of Clockticks	0.4% of Clockticks	3.6% of Clockticks	10.9% of Pipeline Slots
RaceHorses QP = 27	17.1% of Pipeline Slots	7.5% of Pipeline Slots	2.5% of Clockticks	0.3% of Clockticks	4.9% of Clockticks	9.6% of Pipeline Slots
RaceHorses QP = 37	16.8% of Pipeline Slots	7.5% of Pipeline Slots	2.5% of Clockticks	0.1% of Clockticks	3.1% of Clockticks	9.3% of Pipeline Slots
RaceHorses QP = 22	19.9% of Pipeline Slots	8.1% of Pipeline Slots	1.8% of Clockticks	0.2% of Clockticks	5.4% of Clockticks	11.8% of Pipeline Slots

Table 94: Back-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
RaceHorses QP = 32	12.9% of Pipeline Slots	5.2% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	8.6% of Clockticks
RaceHorses QP = 27	13.7% of Pipeline Slots	5.9% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	8.5% of Clockticks
RaceHorses QP = 37	15.3% of Pipeline Slots	3.7% of Clockticks	1.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.2% of Clockticks	10.3% of Clockticks
RaceHorses QP = 22	8.0% of Pipeline Slots	7.3% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	7.3% of Clockticks

2.2 HM DECODER's Complexity

2.2.1 Config Name: encoder_intra_main.cfg, Class Name: CLASS_A

Table 95: Hotpots By Class (Kimono, QP =32)

Class	**CPU Time (%)**
xRateDistOptQuant	17.512
xPredIntraAng	9.764
xIntraCodingTUBlock	7.446
xCalcHADs4x4	2.243
estIntraPredLumaQT	2.13
initIntraPatternChType	1.923
estBit	1.904
codeCoeffNxN	1.489
codeIntraDirLumaAng	1.338
xRecurIntraCodingLumaQT	1.301
getIntraDirPredictor	1.301
predIntraAng	1.131
estLastSignificantPositionBit	1.093
xGetSSE8	0.961
xGetSSE16	0.924
encodeBin	0.905
xDeQuant	0.886
xT	0.867
xIT	0.811
getSigCtxInc	0.792

Table 96: Hotspots By Function
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	3.716086
TComPrediction::xPredIntraAng	2.072018
TEncSearch::xIntraCodingTUBlock	1.580011
___memmove_avx_unaligned_erms	0.961984
TComRdCost::xCalcHADs4x4	0.476007
partialButterflyInverse32	0.451992
TEncSearch::estIntraPredLumaQT	0.451979
fillReferenceSamples	0.420040
partialButterfly32	0.407983
TComPrediction::initIntraPatternChType	0.407958
___memset_avx2_unaligned_erms	0.404016
TEncSbac::estBit	0.403970
simdHADs8x8	0.376008
partialButterfly16	0.340043
TEncSbac::codeCoeffNxN	0.316016
partialButterfly8	0.307951
TEncSbac::codeIntraDirLumaAng	0.283981
TEncSearch::xRecurIntraCodingLumaQT	0.276011
TComDataCU::getIntraDirPredictor	0.275970
TComPrediction::predIntraAng	0.239972

Table 97: Memory Consumption
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 98: Performance Snapshot
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
Kimono QP = 22	2.108	14.6% (1.165 out of 8)	28.0% (1.120 out of 4)	56.7% of Pipeline Slots	1.1% of Packed FP Operations	0.9%
Kimono QP = 37	2.230	14.9% (1.193 out of 8)	28.6% (1.143 out of 4)	59.1% of Pipeline Slots	0.2% of Packed FP Operations	3.1%
Kimono QP = 32	2.275	14.4% (1.151 out of 8)	27.8% (1.111 out of 4)	61.1% of Pipeline Slots	0.4% of Packed FP Operations	0.9%
Kimono QP = 27	2.137	15.5% (1.243 out of 8)	29.5% (1.181 out of 4)	58.4% of Pipeline Slots	0.6% of Packed FP Operations	0.9%

Table 99: Instruction Mix
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
Kimono QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.093
Kimono QP = 37	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.083
Kimono QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.083
Kimono QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.083

Table 100: GPU Usage
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
Kimono QP = 22	21.6%	21.6%	27.8%	50.6%	32.3% of peak value
Kimono QP = 37	60.5%	60.5%	21.6%	17.9%	65.9% of peak value
Kimono QP = 32	22.5%	22.5%	28.8%	48.7%	33.2% of peak value
Kimono QP = 27	17.4%	17.4%	29.0%	53.5%	28.6% of peak value

Table 101: Memory Access Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
Kimono QP = 22	29.233s	5.0% of Clockticks	0.4% of Clockticks	0.5% of Clockticks	0.2% of Clockticks	0.8% of Clockticks	0	9
Kimono QP = 37	20.539s	4.0% of Clockticks	0.5% of Clockticks	0.4% of Clockticks	0.2% of Clockticks	1.0% of Clockticks	0	9
Kimono QP = 32	22.938s	4.2% of Clockticks	0.5% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	1.1% of Clockticks	0	9
Kimono QP = 27	24.784s	4.4% of Clockticks	0.5% of Clockticks	0.4% of Clockticks	0.1% of Clockticks	0.9% of Clockticks	0	9

Table 102: Micro Architecture Exploration
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
Kimono QP = 22	66,952,800,000	160,651,800,000	0.417	9.6% of Pipeline Slots	9.5% of Pipeline Slots	24.7%
Kimono QP = 37	49,671,000,000	127,409,400,000	0.390	5.3% of Pipeline Slots	5.3% of Pipeline Slots	24.5%
Kimono QP = 32	53,238,600,000	132,447,600,000	0.402	5.8% of Pipeline Slots	5.7% of Pipeline Slots	24.5%
Kimono QP = 27	57,843,000,000	140,349,600,000	0.412	7.0% of Pipeline Slots	6.9% of Pipeline Slots	24.6%

Table 103: Front-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
Kimono QP = 22	19.7% of Pipeline Slots	7.1% of Pipeline Slots	2.7% of Clockticks	0.2% of Clockticks	4.2% of Clockticks	12.6% of Pipeline Slots
Kimono QP = 37	18.2% of Pipeline Slots	5.7% of Pipeline Slots	2.4% of Clockticks	0.2% of Clockticks	2.4% of Clockticks	12.5% of Pipeline Slots
Kimono QP = 32	19.2% of Pipeline Slots	7.0% of Pipeline Slots	2.8% of Clockticks	1.0% of Clockticks	3.6% of Clockticks	12.3% of Pipeline Slots
Kimono QP = 27	21.1% of Pipeline Slots	8.1% of Pipeline Slots	3.2% of Clockticks	1.8% of Clockticks	4.9% of Clockticks	13.0% of Pipeline Slots

Table 104: Back-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_A

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
Kimono QP = 22	9.0% of Pipeline Slots	5.1% of Clockticks	0.4% of Clockticks	0.4% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	8.7% of Clockticks
Kimono QP = 37	10.1% of Pipeline Slots	4.1% of Clockticks	0.4% of Clockticks	0.3% of Clockticks	0.3% of Clockticks	1.1% of Clockticks	11.7% of Clockticks
Kimono QP = 32	11.4% of Pipeline Slots	4.4% of Clockticks	0.4% of Clockticks	0.6% of Clockticks	0.2% of Clockticks	0.9% of Clockticks	11.2% of Clockticks
Kimono QP = 27	8.9% of Pipeline Slots	5.1% of Clockticks	0.5% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.9% of Clockticks	10.2% of Clockticks

2.2.2 Config Name: encoder_intra_main.cfg, Class Name: CLASS_B

Table 105: Hotpots By Class (BasketballPass, QP =27)

Class	**CPU Time (%)**
xRateDistOptQuant	23.999
xPredIntraAng	12.802
codeCoeffNxN	4.0
xIntraCodingTUBlock	3.999
xPredIntraPlanar	3.6
getSigCtxInc	3.4
initIntraPatternChType	2.4
codeLastSignificantXY	2.4
xWriteCoefRemainExGolomb	2.0
xTransformSkip	2.0
estIntraPredLumaQT	1.999
resetBits	1.999
xQuant	1.802
xGetIntraBitsQT	1.2
rdpcmNxN	1.2
predIntraAng	1.2
xRecurIntraCodingLumaQT	1.2
codeIntraDirLumaAng	1.2
encodeBinsEP	1.2
copyState	1.2

Table 106: Hotspots By Function
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.239986
TComPrediction::xPredIntraAng	0.128018
___memmove_avx_unaligned_erms	0.067984
partialButterfly32	0.051953
TEncSbac::codeCoeffNxN	0.039997
TEncSearch::xIntraCodingTUBlock	0.039990
TComPrediction::xPredIntraPlanar	0.036003
TComTrQuant::getSigCtxInc	0.033997
TComPrediction::initIntraPatternChType	0.024002
TEncSbac::codeLastSignificantXY	0.023996
TEncSbac::xWriteCoefRemainExGolomb	0.020002
TComTrQuant::xTransformSkip	0.020001
partialButterfly4	0.020000
TEncSearch::estIntraPredLumaQT	0.019994
TComTrQuant::xQuant	0.018020
TEncSearch::xGetIntraBitsQT	0.012004
TComTrQuant::rdpcmNxN	0.012003
TComBitCounter::resetBits	0.012002
TComPrediction::predIntraAng	0.012002
partialButterflyInverse8	0.012002

Table 107: Memory Consumption
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 108: Performance Snapshot
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
BasketballPass QP = 37	2.078	16.2% (1.294 out of 8)	31.3% (1.252 out of 4)	54.8% of Pipeline Slots	0.7% of Packed FP Operations	2.0%
BasketballPass QP = 32	2.065	15.4% (1.232 out of 8)	30.0% (1.199 out of 4)	55.4% of Pipeline Slots	1.1% of Packed FP Operations	1.4%
BasketballPass QP = 22	1.978	15.0% (1.202 out of 8)	28.0% (1.118 out of 4)	53.4% of Pipeline Slots	2.6% of Packed FP Operations	1.3%
BasketballPass QP = 27	2.252	14.1% (1.126 out of 8)	27.4% (1.097 out of 4)	55.5% of Pipeline Slots	1.7% of Packed FP Operations	1.2%

Table 109: Instruction Mix
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
BasketballPass QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.045	0.090
BasketballPass QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.085
BasketballPass QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.7% of uOps	0.051	0.105
BasketballPass QP = 27	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.097

Table 110: GPU Usage
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
BasketballPass QP = 37	17.9%	17.9%	32.2%	49.9%	30.1% of peak value
BasketballPass QP = 32	18.1%	18.1%	30.0%	52.0%	30.5% of peak value
BasketballPass QP = 22	14.2%	14.2%	29.0%	56.8%	25.5% of peak value
BasketballPass QP = 27	16.8%	16.8%	29.8%	53.4%	28.1% of peak value

Table 111: Memory Access Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
BasketballPass QP = 37	0.773s	4.4% of Clockticks	0.9% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.9% of Clockticks	0	9
BasketballPass QP = 32	0.898s	5.3% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0	10
BasketballPass QP = 22	1.219s	6.1% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	0	9
BasketballPass QP = 27	1.499s	4.5% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	0	9

Table 112: Micro Architecture Exploration
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
BasketballPass QP = 37	2,746,800,000	6,699,600,000	0.410	7.4% of Pipeline Slots	7.4% of Pipeline Slots	25.0%
BasketballPass QP = 32	3,142,800,000	7,410,600,000	0.424	8.2% of Pipeline Slots	8.2% of Pipeline Slots	25.0%
BasketballPass QP = 22	4,329,000,000	9,484,200,000	0.456	14.8% of Pipeline Slots	14.8% of Pipeline Slots	25.0%
BasketballPass QP = 27	3,650,400,000	8,310,600,000	0.439	11.5% of Pipeline Slots	11.5% of Pipeline Slots	25.0%

Table 113: Front-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
BasketballPass QP = 37	18.7% of Pipeline Slots	5.9% of Pipeline Slots	2.0% of Clockticks	0.4% of Clockticks	2.0% of Clockticks	12.8% of Pipeline Slots
BasketballPass QP = 32	18.0% of Pipeline Slots	5.2% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	1.7% of Clockticks	12.9% of Pipeline Slots
BasketballPass QP = 22	21.6% of Pipeline Slots	7.7% of Pipeline Slots	1.2% of Clockticks	0.2% of Clockticks	4.3% of Clockticks	13.8% of Pipeline Slots
BasketballPass QP = 27	18.5% of Pipeline Slots	7.4% of Pipeline Slots	1.5% of Clockticks	0.1% of Clockticks	3.6% of Clockticks	11.1% of Pipeline Slots

Table 114: Back-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_B

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
BasketballPass QP = 37	12.5% of Pipeline Slots	3.9% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.1% of Clockticks
BasketballPass QP = 32	14.5% of Pipeline Slots	5.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.9% of Clockticks
BasketballPass QP = 22	4.4% of Pipeline Slots	6.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	5.7% of Clockticks
BasketballPass QP = 27	16.1% of Pipeline Slots	5.9% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	6.8% of Clockticks

2.2.3 Config Name: encoder_intra_main.cfg, Class Name: CLASS_C

Table 115: Hotpots By Class (RaceHorses, QP =22)

Class	**CPU Time (%)**
xRateDistOptQuant	30.051
codeCoeffNxN	12.994
xPredIntraAng	5.482
xIntraCodingTUBlock	3.857
getSigCtxInc	3.655
xWriteCoefRemainExGolomb	2.335
xGetSSE32	2.233
xCalcHADs4x4	2.031
encodeBin	2.03
initIntraPatternChType	1.422
getPUAboveRight	1.218
xEncSubdivCbfQT	1.218
getAddr	1.218
xT	1.015
xITransformSkip	1.015
encodeBinsEP	1.015
estBit	0.812
copyState	0.812
xGetSSE8	0.812
getPUBelowLeft	0.61

Table 116: Hotspots By Function
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.592000
TEncSbac::codeCoeffNxN	0.255991
TComPrediction::xPredIntraAng	0.107987
TEncSearch::xIntraCodingTUBlock	0.075991
TComTrQuant::getSigCtxInc	0.072007
TEncSbac::xWriteCoefRemainExGolomb	0.045997
__memset_avx2_unaligned_erms	0.043999
TComRdCost::xGetSSE32	0.043995
__memmove_avx_unaligned_erms	0.040005
simdHADs8x8	0.040003
TComRdCost::xCalcHADs4x4	0.040001
TEncBinCABACCounter::encodeBin	0.039989
partialButterflyInverse4	0.031998
TComPrediction::initIntraPatternChType	0.028007
TComDataCU::getPUAboveRight	0.024004
TEncSearch::xEncSubdivCbfQT	0.024002
TComYuv::getAddr	0.023997
partialButterfly16	0.023994
partialButterflyInverse8	0.020003
TComTrQuant::xT	0.020002

Table 117: Memory Consumption
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 118: Performance Snapshot
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
RaceHorses QP = 32	2.073	14.6% (1.169 out of 8)	28.2% (1.127 out of 4)	54.8% of Pipeline Slots	1.6% of Packed FP Operations	1.7%
RaceHorses QP = 27	1.960	14.9% (1.195 out of 8)	28.9% (1.157 out of 4)	54.4% of Pipeline Slots	2.4% of Packed FP Operations	1.2%
RaceHorses QP = 37	1.976	18.9% (1.513 out of 8)	35.0% (1.399 out of 4)	49.2% of Pipeline Slots	1.0% of Packed FP Operations	1.4%
RaceHorses QP = 22	1.950	14.7% (1.179 out of 8)	28.5% (1.141 out of 4)	51.7% of Pipeline Slots	2.8% of Packed FP Operations	1.3%

Table 119: Instruction Mix
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
RaceHorses QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.044	0.092
RaceHorses QP = 27	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.097
RaceHorses QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.039	0.078
RaceHorses QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.7% of uOps	0.049	0.104

Table 120: GPU Usage
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
RaceHorses QP = 32	16.4%	16.4%	30.1%	53.5%	28.2% of peak value
RaceHorses QP = 27	16.6%	16.6%	32.1%	51.3%	29.2% of peak value
RaceHorses QP = 37	15.4%	15.4%	31.0%	53.6%	27.4% of peak value
RaceHorses QP = 22	21.5%	21.5%	29.6%	48.9%	33.6% of peak value

Table 121: Memory Access Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
RaceHorses QP = 32	1.117s	5.2% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.7% of Clockticks	0	9
RaceHorses QP = 27	1.315s	6.0% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0	9
RaceHorses QP = 37	0.887s	4.6% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0	8
RaceHorses QP = 22	1.417s	6.7% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0	8

Table 122: Micro Architecture Exploration
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
RaceHorses QP = 32	3,749,400,000	8,337,600,000	0.450	11.2% of Pipeline Slots	11.2% of Pipeline Slots	25.0%
RaceHorses QP = 27	4,363,200,000	9,471,600,000	0.461	15.8% of Pipeline Slots	15.8% of Pipeline Slots	25.0%
RaceHorses QP = 37	3,101,400,000	7,363,800,000	0.421	7.8% of Pipeline Slots	7.8% of Pipeline Slots	25.0%
RaceHorses QP = 22	5,072,400,000	10,722,600,000	0.473	15.4% of Pipeline Slots	15.4% of Pipeline Slots	25.0%

Table 123: Front-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
RaceHorses QP = 32	20.6% of Pipeline Slots	7.5% of Pipeline Slots	1.4% of Clockticks	0.4% of Clockticks	5.0% of Clockticks	13.1% of Pipeline Slots
RaceHorses QP = 27	21.2% of Pipeline Slots	9.0% of Pipeline Slots	1.2% of Clockticks	0.2% of Clockticks	6.1% of Clockticks	12.2% of Pipeline Slots
RaceHorses QP = 37	19.6% of Pipeline Slots	7.0% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	4.3% of Clockticks	12.6% of Pipeline Slots
RaceHorses QP = 22	20.5% of Pipeline Slots	8.5% of Pipeline Slots	2.1% of Clockticks	0.2% of Clockticks	5.8% of Clockticks	12.0% of Pipeline Slots

Table 124: Back-End Bound Analysis
Config Name: encoder_intra_main.cfg,
Class Name: CLASS_C

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
RaceHorses QP = 32	9.0% of Pipeline Slots	5.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.9% of Clockticks
RaceHorses QP = 27	6.7% of Pipeline Slots	6.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	5.7% of Clockticks
RaceHorses QP = 37	12.1% of Pipeline Slots	7.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	6.4% of Clockticks
RaceHorses QP = 22	9.8% of Pipeline Slots	6.4% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	4.9% of Clockticks

2.2.4 Config Name: encoder_lowdelay_main.cfg, Class Name: CLASS_A

Table 125: Hotpots By Class (Kimono, QP =32)

Class	CPU Time (%)
xRateDistOptQuant	17.932
xPredIntraAng	3.764
filter<(int)8, (bool)1, (bool)0, (bool)1>	3.313
xIntraCodingTUBlock	3.101
xEstimateInterResidualQT	2.843
filter<(int)8, (bool)0, (bool)1, (bool)0>	2.73
xCalcHADs4x4	2.332
xGetSSE16	1.683
estBit	1.564
filterCopy	1.405
xGetSSE8	1.272
codeCoeffNxN	1.153
xGetSSE32	1.113
initIntraPatternChType	0.861
xGetHADs	0.808
xGetExpGolombNumberOfBits	0.795
estLastSignificantPositionBit	0.795
filter<(int)4, (bool)0, (bool)1, (bool)0>	0.742
encodeBin	0.729
xT	0.716

Table 126: Hotspots By Function
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	5.411486
__memmove_avx_unaligned_erms	1.157995
TComPrediction::xPredIntraAng	1.135853
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.999926
simdHADs8x8	0.983849
TEncSearch::xIntraCodingTUBlock	0.935862
__memset_avx2_unaligned_erms	0.859978
TEncSearch::xEstimateInterResidualQT	0.857948
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.823910
TComRdCost::xCalcHADs4x4	0.703899
partialButterfly32	0.599969
_Z15simd8x8HAD1D32bPDv2_xS0_	0.543914
TComRdCost::xGetSSE16	0.507970
partialButterflyInverse32	0.483965
TEncSbac::estBit	0.471968
partialButterfly8	0.439945
TComInterpolationFilter::filterCopy	0.423913
partialButterfly16	0.411991
TComRdCost::xGetSSE8	0.383941
TEncSbac::codeCoeffNxN	0.348035

Table 127: Memory Consumption
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
___libc_csu_init	1040.000000
___static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
___register_frame	480.000000
_GLOBAL___sub_I___ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 128: Performance Snapshot
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**IPC**	**Effective Logical Core Utilization**	**Effective Physical Core Utilization**	**Microarchitecture Usage**	**Vectorization**	**GPU Active Time**
Kimono QP = 22	2.172	14.4% (1.154 out of 8)	27.9% (1.115 out of 4)	58.6% of Pipeline Slots	0.8% of Packed FP Operations	0.9%
Kimono QP = 37	2.284	14.6% (1.164 out of 8)	28.0% (1.120 out of 4)	61.8% of Pipeline Slots	0.1% of Packed FP Operations	0.9%
Kimono QP = 32	2.245	14.5% (1.157 out of 8)	27.9% (1.116 out of 4)	61.1% of Pipeline Slots	0.2% of Packed FP Operations	0.9%
Kimono QP = 27	2.210	14.6% (1.167 out of 8)	28.1% (1.123 out of 4)	59.8% of Pipeline Slots	0.4% of Packed FP Operations	0.9%

Table 129: Instruction Mix
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**SP FLOPs**	**DP FLOPs**	**x87 FLOPs**	**Non-FP**	**FP Arith/Mem Rd Instr. Ratio**	**FP Arith/Mem Wr Instr. Ratio**
Kimono QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.044	0.098
Kimono QP = 37	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.089
Kimono QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.093
Kimono QP = 27	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.043	0.095

Table 130: GPU Usage
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
Kimono QP = 22	24.1%	24.1%	28.9%	47.0%	35.3% of peak value
Kimono QP = 37	21.7%	21.7%	28.4%	49.9%	32.6% of peak value
Kimono QP = 32	24.9%	24.9%	28.6%	46.6%	36.0% of peak value
Kimono QP = 27	22.0%	22.0%	27.8%	50.2%	32.8% of peak value

Table 131: Memory Access Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
Kimono QP = 22	53.797s	5.0% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.4% of Clockticks	0	9
Kimono QP = 37	25.737s	3.9% of Clockticks	0.6% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.8% of Clockticks	0	9
Kimono QP = 32	33.991s	4.2% of Clockticks	0.5% of Clockticks	0.8% of Clockticks	0.1% of Clockticks	1.9% of Clockticks	0	9
Kimono QP = 27	41.049s	4.4% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.7% of Clockticks	0	9

Table 132: Micro Architecture Exploration
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**Clockticks**	**Instructions Retired**	**CPI Rate**	**Bad Speculation**	**Branch Mispredict**	**Vector Capacity Usage (FPU)**
Kimono QP = 22	123,305,400,000	295,851,600,000	0.417	7.9% of Pipeline Slots	7.8% of Pipeline Slots	24.8%
Kimono QP = 37	66,861,000,000	168,865,200,000	0.396	5.1% of Pipeline Slots	5.0% of Pipeline Slots	24.6%
Kimono QP = 32	77,470,200,000	194,022,000,000	0.399	5.5% of Pipeline Slots	5.4% of Pipeline Slots	24.7%
Kimono QP = 27	94,883,400,000	234,109,800,000	0.405	6.2% of Pipeline Slots	6.1% of Pipeline Slots	24.5%

Table 133: Front-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**Front-End Bound**	**Front-End Latency**	**ICache Misses**	**ITLB Overhead**	**Branch Resteers**	**Front-End Bandwidth**
Kimono QP = 22	18.0% of Pipeline Slots	7.1% of Pipeline Slots	3.2% of Clockticks	0.2% of Clockticks	3.8% of Clockticks	10.9% of Pipeline Slots
Kimono QP = 37	16.5% of Pipeline Slots	6.2% of Pipeline Slots	2.9% of Clockticks	0.3% of Clockticks	2.6% of Clockticks	10.3% of Pipeline Slots
Kimono QP = 32	17.3% of Pipeline Slots	6.2% of Pipeline Slots	3.0% of Clockticks	0.3% of Clockticks	2.7% of Clockticks	11.1% of Pipeline Slots
Kimono QP = 27	17.9% of Pipeline Slots	6.7% of Pipeline Slots	3.2% of Clockticks	0.5% of Clockticks	3.2% of Clockticks	11.2% of Pipeline Slots

Table 134: Back-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_A

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
Kimono QP = 22	12.2% of Pipeline Slots	5.0% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.4% of Clockticks	11.8% of Clockticks
Kimono QP = 37	13.3% of Pipeline Slots	4.4% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.8% of Clockticks	13.3% of Clockticks
Kimono QP = 32	12.2% of Pipeline Slots	4.2% of Clockticks	0.5% of Clockticks	0.8% of Clockticks	0.2% of Clockticks	1.9% of Clockticks	13.1% of Clockticks
Kimono QP = 27	11.5% of Pipeline Slots	4.6% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.7% of Clockticks	12.2% of Clockticks

2.2.5 Config Name: encoder_lowdelay_main.cfg, Class Name: CLASS_B

Table 135: Hotpots By Class (BasketballPass, QP =27)

Class	**CPU Time (%)**
xRateDistOptQuant	22.486
xEstimateInterResidualQT	3.677
codeCoeffNxN	3.676
filter<(int)8, (bool)1, (bool)0, (bool)1>	3.243
xTransformSkip	2.811
codeIntraDirLumaAng	2.163
xGetHADs	2.162
filter<(int)8, (bool)0, (bool)1, (bool)0>	1.946
codeQtCbf	1.945
codeLastSignificantXY	1.514
xCalcHADs4x4	1.514
encodeBin	1.514
xGetSSE32	1.513
xGetSSE16	1.298
initIntraPatternChType	1.297
xGetColMVP	1.297
filterCopy	1.297
rdpcmNxN	1.297
calcRdCost	1.081
xPredIntraAng	1.081

Table 136: Hotspots By Function
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.415986
simdHADs8x8	0.083994
TEncSearch::xEstimateInterResidualQT	0.068017
TEncSbac::codeCoeffNxN	0.068003
___memmove_avx_unaligned_erms	0.067993
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.059995
TComTrQuant::xTransformSkip	0.052000
TEncSbac::codeIntraDirLumaAng	0.040019
TComRdCost::xGetHADs	0.039998
partialButterfly4	0.036003
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.035997
TEncSbac::codeQtCbf	0.035986
TEncSbac::codeLastSignificantXY	0.028006
TComRdCost::xCalcHADs4x4	0.028003
___memset_avx2_unaligned_erms	0.027999
fillReferenceSamples	0.027996
TComRdCost::xGetSSE32	0.027991
partialButterfly8	0.024010
partialButterfly32	0.024007
TComRdCost::xGetSSE16	0.024007

Table 137: Memory Consumption
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 138: Performance Snapshot
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
BasketballPass QP = 37	2.262	15.0% (1.202 out of 8)	29.1% (1.164 out of 4)	62.5% of Pipeline Slots	0.4% of Packed FP Operations	1.0%
BasketballPass QP = 32	2.076	16.3% (1.305 out of 8)	31.4% (1.255 out of 4)	59.4% of Pipeline Slots	0.5% of Packed FP Operations	2.1%
BasketballPass QP = 22	1.988	14.8% (1.184 out of 8)	29.0% (1.160 out of 4)	52.8% of Pipeline Slots	1.6% of Packed FP Operations	1.2%
BasketballPass QP = 27	2.064	15.7% (1.253 out of 8)	29.9% (1.197 out of 4)	59.0% of Pipeline Slots	0.9% of Packed FP Operations	1.6%

Table 139: Instruction Mix
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
BasketballPass QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.043	0.093
BasketballPass QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.041	0.086
BasketballPass QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.103
BasketballPass QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.092

Table 140: GPU Usage
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
BasketballPass QP = 37	18.3%	18.3%	29.0%	52.7%	28.9% of peak value
BasketballPass QP = 32	47.9%	47.9%	21.9%	30.3%	56.0% of peak value
BasketballPass QP = 22	16.1%	16.1%	31.9%	52.0%	28.6% of peak value
BasketballPass QP = 27	15.8%	15.8%	30.8%	53.3%	27.9% of peak value

Table 141: Memory Access Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
BasketballPass QP = 37	0.887s	4.6% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	0	9
BasketballPass QP = 32	0.997s	4.1% of Clockticks	0.7% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.4% of Clockticks	0	9
BasketballPass QP = 22	1.927s	6.3% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.9% of Clockticks	0	8
BasketballPass QP = 27	1.273s	5.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	1.1% of Clockticks	0	10

Table 142: Micro Architecture Exploration
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
BasketballPass QP = 37	3,119,400,000	7,722,000,000	0.404	6.1% of Pipeline Slots	6.1% of Pipeline Slots	25.0%
BasketballPass QP = 32	3,542,400,000	8,575,200,000	0.413	5.7% of Pipeline Slots	5.7% of Pipeline Slots	25.0%
BasketballPass QP = 22	5,382,000,000	11,995,200,000	0.449	12.5% of Pipeline Slots	12.5% of Pipeline Slots	25.0%
BasketballPass QP = 27	4,280,400,000	10,006,200,000	0.428	8.5% of Pipeline Slots	8.5% of Pipeline Slots	25.0%

Table 143: Front-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
BasketballPass QP = 37	18.6% of Pipeline Slots	6.9% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	2.5% of Clockticks	11.7% of Pipeline Slots
BasketballPass QP = 32	17.1% of Pipeline Slots	6.1% of Pipeline Slots	1.5% of Clockticks	0.3% of Clockticks	2.2% of Clockticks	11.1% of Pipeline Slots
BasketballPass QP = 22	19.8% of Pipeline Slots	9.4% of Pipeline Slots	2.0% of Clockticks	1.0% of Clockticks	5.8% of Clockticks	10.4% of Pipeline Slots
BasketballPass QP = 27	18.0% of Pipeline Slots	6.6% of Pipeline Slots	1.3% of Clockticks	0.4% of Clockticks	3.7% of Clockticks	11.5% of Pipeline Slots

Table 144: Back-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_B

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
BasketballPass QP = 37	11.7% of Pipeline Slots	5.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	11.3% of Clockticks
BasketballPass QP = 32	13.1% of Pipeline Slots	4.6% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	16.0% of Clockticks
BasketballPass QP = 22	9.7% of Pipeline Slots	6.0% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	7.4% of Clockticks
BasketballPass QP = 27	9.5% of Pipeline Slots	5.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	9.3% of Clockticks

2.2.6 Config Name: encoder_lowdelay_main.cfg, Class Name: CLASS_C

Table 145: Hotpots By Class (RaceHorses, QP =22)

Class	**CPU Time (%)**
xRateDistOptQuant	25.279
codeCoeffNxN	7.57
encodeBin	4.86
filter<(int)8, (bool)0, (bool)1, (bool)0>	4.205
getSigCtxInc	4.112
xEstimateInterResidualQT	2.804
filter<(int)8, (bool)1, (bool)0, (bool)1>	2.71
xCalcHADs4x4	2.43
xWriteCoefRemainExGolomb	2.43
xPredIntraAng	2.056
xGetSSE16	1.682
nextSection	1.682
estBit	1.402
initIntraPatternChType	1.308
filterCopy	1.028
initEstData	0.935
codeLastSignificantXY	0.935
xPredInterUni	0.935
xGetSAD16	0.748
xGetSAD8	0.748

Table 146: Hotspots By Function
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	1.081938
TEncSbac::codeCoeffNxN	0.323995
TEncBinCABACCounter::encodeBin	0.207991
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.179983
TComTrQuant::getSigCtxInc	0.175986
TEncSearch::xEstimateInterResidualQT	0.120031
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.115998
TComRdCost::xCalcHADs4x4	0.104025
TEncSbac::xWriteCoefRemainExGolomb	0.104002
___memmove_avx_unaligned_erms	0.100003
TComPrediction::xPredIntraAng	0.088006
simdHADs8x8	0.088002
___memset_avx2_unaligned_erms	0.072005
TComRdCost::xGetSSE16	0.072000
TComTURecurse::nextSection	0.071988
TEncSbac::estBit	0.060000
TComPrediction::initIntraPatternChType	0.055982
_Z15simd8x8HAD1D32bPDv2_xS0_	0.051993
partialButterfly32	0.048016
TComInterpolationFilter::filterCopy	0.044003

Table 147: Memory Consumption
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 148: Performance Snapshot
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
RaceHorses QP = 32	1.927	16.1% (1.286 out of 8)	30.9% (1.235 out of 4)	54.0% of Pipeline Slots	0.9% of Packed FP Operations	1.6%
RaceHorses QP = 27	2.051	14.4% (1.153 out of 8)	28.0% (1.121 out of 4)	53.9% of Pipeline Slots	1.4% of Packed FP Operations	1.4%
RaceHorses QP = 37	2.200	14.6% (1.166 out of 8)	28.2% (1.129 out of 4)	57.1% of Pipeline Slots	0.6% of Packed FP Operations	1.3%
RaceHorses QP = 22	1.809	16.1% (1.284 out of 8)	30.6% (1.224 out of 4)	49.5% of Pipeline Slots	2.1% of Packed FP Operations	1.4%

Table 149: Instruction Mix
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
RaceHorses QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.044	0.095
RaceHorses QP = 27	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.101
RaceHorses QP = 37	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.042	0.094
RaceHorses QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.105

Table 150: GPU Usage
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
RaceHorses QP = 32	38.2%	38.2%	23.9%	37.8%	46.8% of peak value
RaceHorses QP = 27	39.3%	39.3%	26.6%	34.1%	48.1% of peak value
RaceHorses QP = 37	18.2%	18.2%	32.7%	49.1%	30.7% of peak value
RaceHorses QP = 22	24.3%	24.3%	26.8%	48.9%	34.1% of peak value

Table 151: Memory Access Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
RaceHorses QP = 32	2.976s	5.0% of Clockticks	0.9% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	1.4% of Clockticks	0	8
RaceHorses QP = 27	3.820s	6.0% of Clockticks	0.0% of Clockticks	1.1% of Clockticks	0.0% of Clockticks	0.7% of Clockticks	0	9
RaceHorses QP = 37	1.211s	4.5% of Clockticks	0.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	0	9
RaceHorses QP = 22	3.582s	6.4% of Clockticks	0.3% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0	8

Table 152: Micro Architecture Exploration
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
RaceHorses QP = 32	5,270,400,000	12,362,400,000	0.426	9.5% of Pipeline Slots	9.5% of Pipeline Slots	25.0%
RaceHorses QP = 27	6,879,600,000	15,361,200,000	0.448	11.8% of Pipeline Slots	11.8% of Pipeline Slots	25.0%
RaceHorses QP = 37	4,320,000,000	10,402,200,000	0.415	7.2% of Pipeline Slots	7.2% of Pipeline Slots	25.0%
RaceHorses QP = 22	9,365,400,000	20,181,600,000	0.464	13.8% of Pipeline Slots	13.8% of Pipeline Slots	25.0%

Table 153: Front-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
RaceHorses QP = 32	17.4% of Pipeline Slots	7.2% of Pipeline Slots	2.0% of Clockticks	0.2% of Clockticks	3.5% of Clockticks	10.2% of Pipeline Slots
RaceHorses QP = 27	18.2% of Pipeline Slots	7.8% of Pipeline Slots	2.4% of Clockticks	0.3% of Clockticks	5.0% of Clockticks	10.4% of Pipeline Slots
RaceHorses QP = 37	18.4% of Pipeline Slots	6.3% of Pipeline Slots	2.5% of Clockticks	0.3% of Clockticks	3.1% of Clockticks	12.2% of Pipeline Slots
RaceHorses QP = 22	19.3% of Pipeline Slots	8.1% of Pipeline Slots	1.7% of Clockticks	0.3% of Clockticks	5.7% of Clockticks	11.2% of Pipeline Slots

Table 154: Back-End Bound Analysis
Config Name: encoder_lowdelay_main.cfg,
Class Name: CLASS_C

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
RaceHorses QP = 32	10.9% of Pipeline Slots	6.1% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	9.5% of Clockticks
RaceHorses QP = 27	12.9% of Pipeline Slots	5.5% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	8.0% of Clockticks
RaceHorses QP = 37	10.9% of Pipeline Slots	6.3% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	10.4% of Clockticks
RaceHorses QP = 22	11.3% of Pipeline Slots	5.8% of Clockticks	0.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	7.4% of Clockticks

2.2.7 Config Name: encoder_randomaccess_main.cfg, Class Name: CLASS_A

Table 155: Hotpots By Class (Kimono, QP =32)

Class	CPU Time (%)
xRateDistOptQuant	17.135
filter<(int)8, (bool)1, (bool)0, (bool)1>	3.681
xPredIntraAng	3.497
xIntraCodingTUBlock	3.261
filter<(int)8, (bool)0, (bool)1, (bool)0>	2.278
xEstimateInterResidualQT	2.094
xCalcHADs4x4	1.852
estBit	1.679
codeCoeffNxN	1.634
filterCopy	1.587
xGetSSE32	1.392
xT	1.208
xGetSSE16	1.139
xGetSSE8	1.093
estLastSignificantPositionBit	0.909
initIntraPatternChType	0.84
xGetHADs	0.794
encodeBin	0.713
transformNxN	0.702
copyState	0.679

Table 156: Hotspots By Function
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	5.957930
___memset_avx2_unaligned_erms	1.372045
___memmove_avx_unaligned_erms	1.310133
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	1.280035
TComPrediction::xPredIntraAng	1.216045
TEncSearch::xIntraCodingTUBlock	1.133998
simdHADs8x8	1.071959
TComInterpolationFilter::filter<(int)8, (bool)0, (bool)1, (bool)0>	0.791989
TEncSearch::xEstimateInterResidualQT	0.727980
TComRdCost::xCalcHADs4x4	0.644065
partialButterfly16	0.604012
partialButterfly32	0.595957
TEncSbac::estBit	0.583924
TEncSbac::codeCoeffNxN	0.568051
TComInterpolationFilter::filterCopy	0.551949
partialButterfly8	0.532038
TComRdCost::xGetSSE32	0.484003
_Z15simd8x8HAD1D32bPDv2_xS0_	0.471952
___memset_avx2_erms	0.447977
partialButterflyInverse32	0.444113

Table 157: Memory Consumption
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
___libc_csu_init	1040.000000
___static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
___register_frame	480.000000
_GLOBAL___sub_I___ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 158: Performance Snapshot
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
Kimono QP = 22	2.154	14.3% (1.144 out of 8)	27.5% (1.101 out of 4)	58.4% of Pipeline Slots	0.8% of Packed FP Operations	0.1%
Kimono QP = 37	1.733	21.7% (1.738 out of 8)	37.6% (1.502 out of 4)	51.2% of Pipeline Slots	0.3% of Packed FP Operations	6.7%
Kimono QP = 32	1.844	19.1% (1.526 out of 8)	34.8% (1.391 out of 4)	52.8% of Pipeline Slots	0.3% of Packed FP Operations	11.1%
Kimono QP = 27	1.767	20.8% (1.663 out of 8)	36.5% (1.460 out of 4)	52.3% of Pipeline Slots	0.4% of Packed FP Operations	12.5%

Table 159: Instruction Mix
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
Kimono QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.100
Kimono QP = 37	0.0% of uOps	0.9% of uOps	0.1% of uOps	99.0% of uOps	0.036	0.079
Kimono QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	99.0% of uOps	0.039	0.086
Kimono QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	99.0% of uOps	0.038	0.086

Table 160: GPU Usage
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
Kimono QP = 22	61.6%	61.6%	20.7%	17.8%	67.6% of peak value
Kimono QP = 37	16.8%	16.8%	15.4%	67.8%	28.0% of peak value
Kimono QP = 32	20.9%	20.9%	21.1%	58.0%	29.9% of peak value
Kimono QP = 27	13.1%	13.1%	17.6%	69.3%	22.4% of peak value

Table 161: Memory Access Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
Kimono QP = 22	47.174s	5.0% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.1% of Clockticks	1.4% of Clockticks	0	9
Kimono QP = 37	27.481s	4.4% of Clockticks	0.7% of Clockticks	0.7% of Clockticks	0.2% of Clockticks	1.8% of Clockticks	1,200,084	10
Kimono QP = 32	32.695s	4.9% of Clockticks	0.7% of Clockticks	0.9% of Clockticks	0.2% of Clockticks	1.7% of Clockticks	1,200,084	9
Kimono QP = 27	42.225s	5.5% of Clockticks	0.6% of Clockticks	0.9% of Clockticks	0.2% of Clockticks	1.5% of Clockticks	2,400,168	9

Table 162: Micro Architecture Exploration
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
Kimono QP = 22	122,317,200,000	289,823,400,000	0.422	8.5% of Pipeline Slots	8.4% of Pipeline Slots	24.6%
Kimono QP = 37	66,762,000,000	167,518,800,000	0.399	5.4% of Pipeline Slots	5.3% of Pipeline Slots	24.6%
Kimono QP = 32	79,291,800,000	189,667,800,000	0.418	5.6% of Pipeline Slots	5.4% of Pipeline Slots	24.7%
Kimono QP = 27	92,982,600,000	224,316,000,000	0.415	6.3% of Pipeline Slots	6.2% of Pipeline Slots	25.0%

Table 163: Front-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
Kimono QP = 22	18.0% of Pipeline Slots	7.3% of Pipeline Slots	3.2% of Clockticks	0.2% of Clockticks	4.0% of Clockticks	10.8% of Pipeline Slots
Kimono QP = 37	17.6% of Pipeline Slots	6.5% of Pipeline Slots	3.0% of Clockticks	0.3% of Clockticks	2.7% of Clockticks	11.1% of Pipeline Slots
Kimono QP = 32	18.6% of Pipeline Slots	7.7% of Pipeline Slots	3.7% of Clockticks	0.4% of Clockticks	3.1% of Clockticks	10.9% of Pipeline Slots
Kimono QP = 27	18.4% of Pipeline Slots	7.2% of Pipeline Slots	3.4% of Clockticks	0.3% of Clockticks	3.3% of Clockticks	11.2% of Pipeline Slots

Table 164: Back-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_A

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
Kimono QP = 22	11.2% of Pipeline Slots	5.2% of Clockticks	0.5% of Clockticks	0.7% of Clockticks	0.2% of Clockticks	1.5% of Clockticks	11.4% of Clockticks
Kimono QP = 37	11.2% of Pipeline Slots	4.4% of Clockticks	0.5% of Clockticks	0.8% of Clockticks	0.2% of Clockticks	1.9% of Clockticks	12.2% of Clockticks
Kimono QP = 32	10.2% of Pipeline Slots	5.1% of Clockticks	0.5% of Clockticks	0.9% of Clockticks	0.3% of Clockticks	1.8% of Clockticks	13.2% of Clockticks
Kimono QP = 27	10.9% of Pipeline Slots	5.0% of Clockticks	0.5% of Clockticks	0.9% of Clockticks	0.2% of Clockticks	1.6% of Clockticks	13.0% of Clockticks

2.2.8 Config Name: encoder_randomaccess_main.cfg, Class Name: CLASS_B

Table 165: Hotpots By Class (BasketballPass, QP =27)

Class	**CPU Time (%)**
xRateDistOptQuant	21.523
xCalcHADs4x4	3.864
codeCoeffNxN	3.035
xGetSSE32	2.76
transformNxN	2.757
xEstimateInterResidualQT	2.483
xGetSSE16	1.932
filter<(int)8, (bool)1, (bool)0, (bool)1>	1.932
xPredInterUni	1.929
xGetExpGolombNumberOfBits	1.929
resetBits	1.656
getSigCtxInc	1.655
xGetSAD8	1.655
filterCopy	1.653
setCrossComponentPredictionAlphaPartRange	1.38
encodeBin	1.38
filter<(int)8, (bool)0, (bool)1, (bool)0>	1.379
codeIntraDirLumaAng	1.379
xGetHADs	1.104
predInterSearch	1.103

Table 166: Hotspots By Function
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	0.312078
___memset_avx2_unaligned_erms	0.063988
simdHADs8x8	0.063981
TComRdCost::xCalcHADs4x4	0.056023
TEncSbac::codeCoeffNxN	0.044001
___memmove_avx_unaligned_erms	0.043988
TComRdCost::xGetSSE32	0.040018
TComTrQuant::transformNxN	0.039983
TEncSearch::xEstimateInterResidualQT	0.036007
TComRdCost::xGetSSE16	0.028016
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.028010
TComPrediction::xPredInterUni	0.027973
TComRdCost::xGetExpGolombNumberOfBits	0.027971
TComTrQuant::getSigCtxInc	0.023994
TComRdCost::xGetSAD8	0.023992
___memset_avx2_erms	0.023974
TComInterpolationFilter::filterCopy	0.023966
TComDataCU::setCrossComponentPredictionAlphaPartRange	0.020011
TEncBinCABACCounter::encodeBin	0.020010
partialButterfly32	0.020007

Table 167: Memory Consumption
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B
(BasketballPass, QP =27)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 168: Performance Snapshot
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
BasketballPass QP = 37	1.992	18.0% (1.436 out of 8)	33.5% (1.341 out of 4)	54.1% of Pipeline Slots	0.7% of Packed FP Operations	2.5%
BasketballPass QP = 32	1.951	21.8% (1.741 out of 8)	40.5% (1.622 out of 4)	43.2% of Pipeline Slots	0.7% of Packed FP Operations	21.7%
BasketballPass QP = 22	1.679	17.6% (1.411 out of 8)	33.0% (1.321 out of 4)	48.7% of Pipeline Slots	1.6% of Packed FP Operations	1.4%
BasketballPass QP = 27	1.928	17.8% (1.427 out of 8)	33.0% (1.320 out of 4)	52.6% of Pipeline Slots	1.4% of Packed FP Operations	1.7%

Table 169: Instruction Mix
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
BasketballPass QP = 37	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.040	0.085
BasketballPass QP = 32	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.040	0.086
BasketballPass QP = 22	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.099
BasketballPass QP = 27	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.8% of uOps	0.043	0.091

Table 170: GPU Usage
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
BasketballPass QP = 37	40.6%	40.6%	22.1%	37.3%	49.1% of peak value
BasketballPass QP = 32	13.3%	13.3%	15.8%	70.8%	24.7% of peak value
BasketballPass QP = 22	50.4%	50.4%	13.7%	35.8%	59.7% of peak value
BasketballPass QP = 27	33.5%	33.5%	23.5%	43.0%	42.7% of peak value

Table 171: Memory Access Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
BasketballPass QP = 37	1.018s	4.4% of Clockticks	1.5% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	0	9
BasketballPass QP = 32	1.118s	5.3% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	0	9
BasketballPass QP = 22	1.626s	5.9% of Clockticks	0.9% of Clockticks	0.0% of Clockticks	0.5% of Clockticks	0.9% of Clockticks	0	8
BasketballPass QP = 27	1.435s	6.5% of Clockticks	0.5% of Clockticks	1.1% of Clockticks	0.0% of Clockticks	1.6% of Clockticks	0	9

Table 172: Micro Architecture Exploration
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
BasketballPass QP = 37	3,202,200,000	7,803,000,000	0.410	6.3% of Pipeline Slots	6.3% of Pipeline Slots	25.0%
BasketballPass QP = 32	3,627,000,000	8,654,400,000	0.419	6.3% of Pipeline Slots	6.3% of Pipeline Slots	25.0%
BasketballPass QP = 22	5,419,800,000	11,754,000,000	0.461	12.3% of Pipeline Slots	12.3% of Pipeline Slots	25.0%
BasketballPass QP = 27	4,305,600,000	9,905,400,000	0.435	9.8% of Pipeline Slots	9.8% of Pipeline Slots	25.0%

Table 173: Front-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
BasketballPass QP = 37	16.4% of Pipeline Slots	5.1% of Pipeline Slots	1.7% of Clockticks	0.2% of Clockticks	2.4% of Clockticks	11.4% of Pipeline Slots
BasketballPass QP = 32	18.6% of Pipeline Slots	6.0% of Pipeline Slots	1.5% of Clockticks	0.1% of Clockticks	3.6% of Clockticks	12.7% of Pipeline Slots
BasketballPass QP = 22	20.3% of Pipeline Slots	8.5% of Pipeline Slots	2.0% of Clockticks	0.3% of Clockticks	4.9% of Clockticks	11.7% of Pipeline Slots
BasketballPass QP = 27	19.9% of Pipeline Slots	6.5% of Pipeline Slots	2.5% of Clockticks	0.4% of Clockticks	3.1% of Clockticks	13.4% of Pipeline Slots

Table 174: Back-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_B

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
BasketballPass QP = 37	18.2% of Pipeline Slots	5.1% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	11.0% of Clockticks
BasketballPass QP = 32	12.2% of Pipeline Slots	6.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.5% of Clockticks	11.0% of Clockticks
BasketballPass QP = 22	7.7% of Pipeline Slots	6.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	9.3% of Clockticks
BasketballPass QP = 27	6.4% of Pipeline Slots	5.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.3% of Clockticks	1.3% of Clockticks	9.3% of Clockticks

2.2.9 Config Name: encoder_randomaccess_main.cfg, Class Name: CLASS_C

Table 175: Hotpots By Class (RaceHorses, QP =22)

Class	CPU Time (%)
xRateDistOptQuant	27.632
codeCoeffNxN	7.246
getSigCtxInc	4.541
encodeBin	3.092
filter<(int)8, (bool)1, (bool)0, (bool)1>	2.898
xCalcHADs4x4	2.126
xIntraCodingTUBlock	1.739
xPredIntraAng	1.642
xEstimateInterResidualQT	1.546
xWriteCoefRemainExGolomb	1.449
xGetSSE32	1.353
estBit	1.256
xGetSSE8	1.063
xDeQuant	1.063
xTransformSkip	0.966
countNonZeroCoeffs	0.87
filter<(int)8, (bool)0, (bool)1, (bool)0>	0.87
filterCopy	0.869
codeLastSignificantXY	0.869
nextSection	0.773

Table 176: Hotspots By Function
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**CPU Time**
TComTrQuant::xRateDistOptQuant	1.143950
TEncSbac::codeCoeffNxN	0.299999
TComTrQuant::getSigCtxInc	0.187998
TComInterpolationFilter::filter<(int)8, (bool)1, (bool)0, (bool)1>	0.119996
TEncBinCABACCounter::encodeBin	0.119988
___memmove_avx_unaligned_erms	0.095988
TComRdCost::xCalcHADs4x4	0.088009
TEncSearch::xIntraCodingTUBlock	0.071981
___memset_avx2_unaligned_erms	0.067999
TComPrediction::xPredIntraAng	0.067996
simdHADs8x8	0.067985
TEncSearch::xEstimateInterResidualQT	0.064009
TEncSbac::xWriteCoefRemainExGolomb	0.059994
TComRdCost::xGetSSE32	0.055996
TEncSbac::estBit	0.052005
partialButterflyInverse32	0.048011
TComRdCost::xGetSSE8	0.044003
TComTrQuant::xDeQuant	0.043995
getTUEntropyCodingParameters	0.040003
TComTrQuant::xTransformSkip	0.039998

Table 177: Memory Consumption
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C
(RaceHorses, QP =22)

Function	**Allocation/Deallocation Delta**
func@0x8f3f0	72704.000000
main	4096.000000
__libc_csu_init	1040.000000
__static_initialization_and_destruction_0.constprop.69	1040.000000
EnvVar::EnvVar	690.000000
__register_frame	480.000000
_GLOBAL__sub_I__ZN3SEI19prefix_sei_messagesE	212.000000
indentNewLines	210.000000
TAppEncCfg::parseCfg	0.0
TAppEncCfg::xCheckParameter	0.0
TAppEncTop::encode	0.0
TAppEncTop::xGetBuffer	0.0
TComCUMvField::create	0.0
TComDataCU::create	0.0
TComLoopFilter::create	0.0
TComOutputBitstream::addSubstream	0.0
TComOutputBitstream::write	0.0
TComPic::create	0.0
TComPic::prepareForReconstruction	0.0
TComPicSym::TComPicSym	0.0

Table 178: Performance Snapshot
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	IPC	Effective Logical Core Utilization	Effective Physical Core Utilization	Microarchitecture Usage	Vectorization	GPU Active Time
RaceHorses QP = 32	2.068	15.2% (1.213 out of 8)	29.5% (1.179 out of 4)	54.6% of Pipeline Slots	1.1% of Packed FP Operations	0.6%
RaceHorses QP = 27	2.038	14.5% (1.157 out of 8)	28.2% (1.129 out of 4)	56.1% of Pipeline Slots	1.7% of Packed FP Operations	0.4%
RaceHorses QP = 37	2.198	14.5% (1.158 out of 8)	28.3% (1.132 out of 4)	57.0% of Pipeline Slots	0.6% of Packed FP Operations	0.7%
RaceHorses QP = 22	1.974	14.2% (1.136 out of 8)	27.6% (1.104 out of 4)	53.3% of Pipeline Slots	2.2% of Packed FP Operations	0.2%

Table 179: Instruction Mix
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	SP FLOPs	DP FLOPs	x87 FLOPs	Non-FP	FP Arith/Mem Rd Instr. Ratio	FP Arith/Mem Wr Instr. Ratio
RaceHorses QP = 32	0.0% of uOps	1.1% of uOps	0.1% of uOps	98.9% of uOps	0.043	0.095
RaceHorses QP = 27	0.0% of uOps	1.0% of uOps	0.1% of uOps	98.9% of uOps	0.042	0.096
RaceHorses QP = 37	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.045	0.099
RaceHorses QP = 22	0.0% of uOps	1.2% of uOps	0.1% of uOps	98.8% of uOps	0.046	0.102

Table 180: GPU Usage
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	**GPU Utilization when Busy**	**Active**	**Stalled**	**Idle**	**Occupancy**
RaceHorses QP = 32	31.4%	31.4%	24.8%	43.8%	42.4% of peak value
RaceHorses QP = 27	38.2%	38.2%	21.9%	39.9%	48.1% of peak value
RaceHorses QP = 37	19.1%	19.1%	30.8%	50.1%	30.2% of peak value
RaceHorses QP = 22	18.9%	18.9%	33.7%	47.4%	31.3% of peak value

Table 181: Memory Access Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	**CPU Time**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**LLC Miss Count**	**Average Latency (cycles)**
RaceHorses QP = 32	1.470s	5.5% of Clockticks	0.5% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	1.4% of Clockticks	0	9
RaceHorses QP = 27	2.990s	5.9% of Clockticks	0.4% of Clockticks	0.7% of Clockticks	0.0% of Clockticks	1.1% of Clockticks	0	9
RaceHorses QP = 37	1.204s	5.0% of Clockticks	0.6% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	1.7% of Clockticks	0	8
RaceHorses QP = 22	4.137s	6.6% of Clockticks	0.3% of Clockticks	0.5% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	0	9

Table 182: Micro Architecture Exploration
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	Clockticks	Instructions Retired	CPI Rate	Bad Speculation	Branch Mispredict	Vector Capacity Usage (FPU)
RaceHorses QP = 32	5,221,800,000	12,177,000,000	0.429	9.0% of Pipeline Slots	9.0% of Pipeline Slots	25.0%
RaceHorses QP = 27	6,458,400,000	14,610,600,000	0.442	10.9% of Pipeline Slots	10.9% of Pipeline Slots	25.0%
RaceHorses QP = 37	4,336,200,000	10,382,400,000	0.418	7.8% of Pipeline Slots	7.8% of Pipeline Slots	25.0%
RaceHorses QP = 22	8,825,400,000	19,085,400,000	0.462	14.0% of Pipeline Slots	14.0% of Pipeline Slots	25.0%

Table 183: Front-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	Front-End Bound	Front-End Latency	ICache Misses	ITLB Overhead	Branch Resteers	Front-End Bandwidth
RaceHorses QP = 32	18.1% of Pipeline Slots	7.2% of Pipeline Slots	2.1% of Clockticks	0.4% of Clockticks	3.6% of Clockticks	10.9% of Pipeline Slots
RaceHorses QP = 27	17.1% of Pipeline Slots	7.5% of Pipeline Slots	2.5% of Clockticks	0.3% of Clockticks	4.9% of Clockticks	9.6% of Pipeline Slots
RaceHorses QP = 37	16.8% of Pipeline Slots	7.5% of Pipeline Slots	2.5% of Clockticks	0.1% of Clockticks	3.1% of Clockticks	9.3% of Pipeline Slots
RaceHorses QP = 22	19.9% of Pipeline Slots	8.1% of Pipeline Slots	1.8% of Clockticks	0.2% of Clockticks	5.4% of Clockticks	11.8% of Pipeline Slots

Table 184: Back-End Bound Analysis
Config Name: encoder_randomaccess_main.cfg,
Class Name: CLASS_C

Seq Name	**Back-End Bound**	**L1 Bound**	**L2 Bound**	**L3 Bound**	**DRAM Bound**	**Store Bound**	**Store Latency**
RaceHorses QP = 32	12.9% of Pipeline Slots	5.2% of Clockticks	1.0% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	8.6% of Clockticks
RaceHorses QP = 27	13.7% of Pipeline Slots	5.9% of Clockticks	0.8% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.8% of Clockticks	8.5% of Clockticks
RaceHorses QP = 37	15.3% of Pipeline Slots	3.7% of Clockticks	1.2% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	1.2% of Clockticks	10.3% of Clockticks
RaceHorses QP = 22	8.0% of Pipeline Slots	7.3% of Clockticks	0.6% of Clockticks	0.0% of Clockticks	0.0% of Clockticks	0.6% of Clockticks	7.3% of Clockticks