Complexity & Power Analysis

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Automation: Python
Report generation: Latex
Power Analysis: Intel® SoC Watch
Complexity Analysis: Intel® VTune™ Profiler

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Contents

1 Analysis Summary

1.1 Encoding Summary

Table 1: Encoding Combinations

Combination No.	Seq Name	Codec Name	Config Name	QP
1	Kimono_1920x1080_24	modified-config	encoder_intra_vtm_modified	32
2	Kimono_1920x1080_24	modified-source	encoder_intra_vtm	32
3	Kimono_1920x1080_24	original	encoder_intra_vtm	32

Table 2: Encoding Results

Combination No.	Bitrate	Y-PSNR	CPU Time	Average Power (mW)	Total Energy (mJ)
1	637.7520	40.6350	258.644s	4206.97	1077896.06
2	636.0240	40.6085	67.950s	4168.71	281815.86
3	630.7200	40.6363	291.377s	4178.56	1197477.54

1.2 Decoding Summary

Table 3: Decoding Combinations

Combination No.	Seq	Codec	Cfg
1	Kimono_1920x1080_24_QP_32	modified-config	encoder_intra_vtm_modified.cfg
2	Kimono_1920x1080_24_QP_32	modified-source	encoder_intra_vtm.cfg
3	Kimono_1920x1080_24_QP_32	original	encoder_intra_vtm.cfg

Table 4: Decoding Results

Combination No.	Bitrate (kbps)	CPU Time	Average Power (mW)	Total Energy (mJ)
1	637.7520	0.390s	4443.49	1777.65
2	636.0240	0.390s	4705.51	1854.49
3	630.7200	0.390s	4551.25	1750.18

2 Complexity Analysis - (Codec Name: MODIFIED-CONFIG)

2.1 MODIFIED-CONFIG ENCODER's Complexity

modified-config - (CLASS_A)
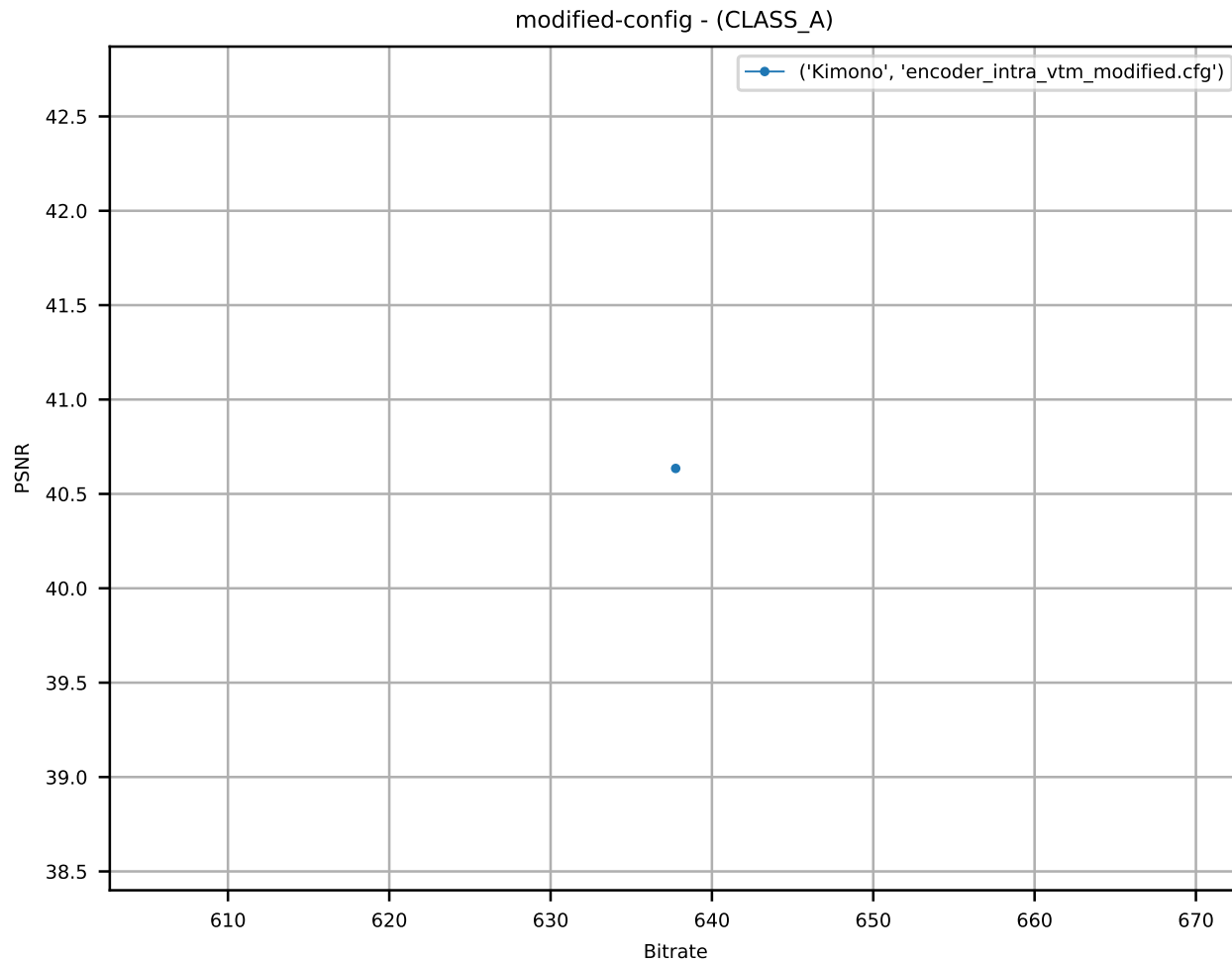
2.1.1   Config Name: encoder_intra_vtm_modified.cfg, Class Name: CLASS_A

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

Class	CPU Time (%)
IntraPrediction	10.816
CDTrace	9.802
DQIntern	9.736
TrQuant	9.442
CodingStructure	8.071
std	7.966
IntraSearch	5.355
CABACWriter	4.708
EncAdaptiveLoopFilter	3.842
RdCost	2.889
CtxStore<BinProbModel_Std>	2.29
__GI_	2.26
__memmove_avx_unaligned_erms	2.203
fastForwardDCT2_B16	0.96
__memset_avx2_unaligned_erms	0.955
CU	0.807
EncCu	0.784
AreaBuf<short>	0.755
TBitEstimator<BinProbModel_Std>	0.73
fastForwardDCT2_B32	0.697

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

Function	CPU Time
CDTrace::dtrace<(bool)0>	21.729995
IntraPrediction::xPredIntraAng	18.052285
std::_Rb_tree<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>», std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>» const, int>, std::_Select1st<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>» const, int>», std::less<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>»>, std::allocator<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>» const, int>»>::_M_copy<std::_Rb_tree<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>», std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>» const, int>, std::_Select1st<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>» const, int>», std::less<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>»>, std::allocator<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char>» const, int>»>::_Alloc_node>	14.131854
EncAdaptiveLoopFilter::getBlkStats	9.064008
IntraSearch::estIntraPredLumaQT	7.709975
TrQuant::transformNxN	6.379879
CtxStore<BinProbModel_Std>::getFracBitsArray	5.923819
__GI_	5.845308
__memmove_avx_unaligned_erms	5.697859
DQIntern::DepQuant::xDecide	5.464008
TrQuant::invLfnstNxN	5.393964

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

Function	CPU Time
std::_Rb_tree<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char», std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int>, std::_Select1st<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int», std::less<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char»>, std::allocator<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int»>::_M_erase	5.108048
CABACWriter::residual_coding_subblock	4.867874
DQIntern::DepQuant::quant	4.543997
CodingStructure::getCU	3.832083
TrQuant::invTransformNxN	3.773901
IntraPrediction::predIntraAng	3.467926
DQIntern::State::updateState<(unsigned char)5>	3.216170
DQIntern::DepQuant::xDecideAndUpdate	3.211986
RdCost::xGetHADs_SIMD<(X86_VEXT)4>	2.852147

Table 7: Memory Access Analysis
Config Name: encoder_intra_vtm_modified.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 = 32	261.693s	5.0% of Clockticks	0.8% of Clockticks	1.8% of Clockticks	0.7% of Clockticks	0.8% of Clockticks	26,401,848	9

2.2   MODIFIED-CONFIG DECODER's Complexity

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

Function
_intra_vtm_modified.cfg,
A

Class,CPU Time (%)
CDTrace,16.405
LoopFilter,9.223
SampleAdaptiveOffset,8.205
std,8.203
DecLib,6.155
TrQuant,6.155
IntraPrediction,6.151
CodingStructure,5.132
___memset_avx2_unaligned_erms,5.128
CABACReader,4.101
___memset_avx2_erms,4.1
AreaBuf<short>,3.082
simdFilter7x7Blk<(X86_VEXT)4>,3.079
CU,3.077
TBinDecoder<BinProbModel_Std>,3.076
_GLOBAL__sub_I_Rom.cpp,2.571
dtrace_frame_blockwise<short const>,2.054
reco_SSE<(X86_VEXT)4, (int)8>,2.053
simdDeriveClassificationBlk<(X86_VEXT)4>,2.049

Table 9: Memory Access Analysis
Config Name: encoder_intra_vtm_modified.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 = 32	0.423s	4.1% of Clockticks	0.2% of Clockticks	1.3% of Clockticks	2.3% of Clockticks	3.5% of Clockticks	120,000	11

3 Complexity Analysis - (Codec Name: MODIFIED-SOURCE)

3.1 MODIFIED-SOURCE ENCODER's Complexity

modified-source - (CLASS_A)
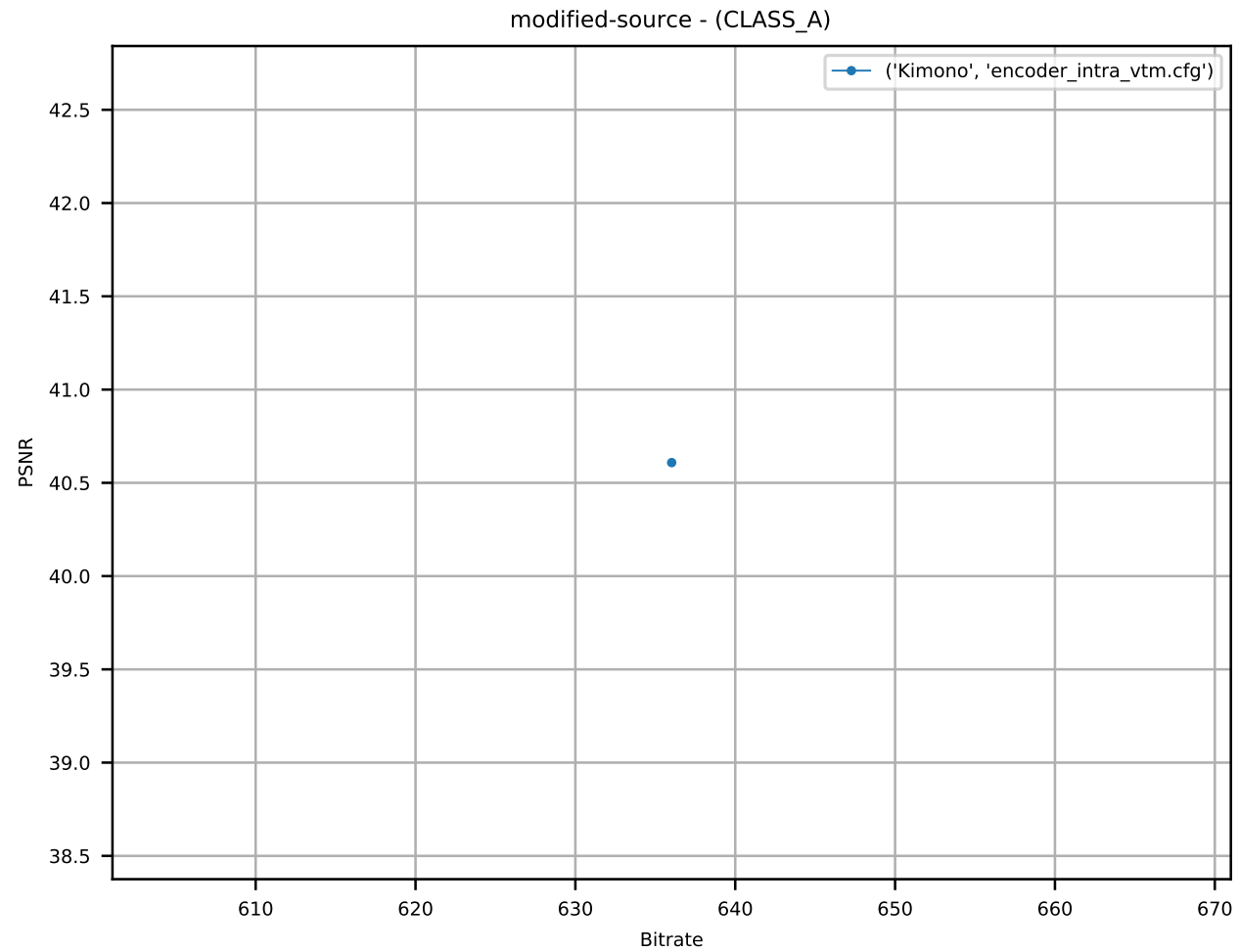
3.1.1   Config Name: encoder_intra_vtm.cfg, Class Name: CLASS_A

Table 10: Hotpots By Class (Kimono, QP =32)

Class	CPU Time (%)
EncAdaptiveLoopFilter	14.628
CDTrace	11.244
DQIntern	10.231
IntraPrediction	8.335
TrQuant	6.846
CodingStructure	4.751
CABACWriter	4.344
std	3.969
RdCost	3.473
IntraSearch	2.914
AlfCovariance	2.561
IbcHashMap	2.464
fastForwardDCT2_B32	2.252
MatrixIntraPrediction	2.231
__GI_	1.618
__memmove_avx_unaligned_erms	1.548
CtxStore<BinProbModel_Std>	1.254
fastInverseDCT2_B32	1.03
fastInverseDCT2_B64	0.971
fastInverseDST7_B32	0.777

Table 11: Hotspots By Function
Config Name: encoder_intra_vtm.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	CPU Time
EncAdaptiveLoopFilter::getBlkStats	9.115985
CDTrace::dtrace<(bool)0>	7.163993
IntraPrediction::xPredIntraAng	3.715962
DQIntern::DepQuant::xDecide	1.739944
TrQuant::transformNxN	1.684002
CABACWriter::residual_coding_subblock	1.608030
fastForwardDCT2_B32	1.530029
std::_Rb_tree<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char», std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int>, std::_Select1st<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int», std::less<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char»>, std::allocator<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int»>::_M_copy<std::_Rb_tree<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char», std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int>, std::_Select1st<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int», std::less<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char»>, std::allocator<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int»>::_Alloc_node>	1.435993
DQIntern::DepQuant::xDecideAndUpdate	1.240003
CodingStructure::getCU	1.163973
__GI_	1.099673

Table 11: Hotspots By Function
Config Name: encoder_intra_vtm.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	CPU Time
___memmove_avx_unaligned_erms	1.051965
IntraSearch::estIntraPredLumaQT	1.004073
DQIntern::DepQuant::quant	0.947942
CtxStore<BinProbModel_Std>::getFracBitsArray	0.852070
TrQuant::invTransformNxN	0.827998
AlfCovariance::gnsCholeskyDec	0.799990
MatrixIntraPrediction::predictionUpsampling1D	0.775945
DQIntern::State::updateState<(unsigned char)5>	0.727996
IbcHashMap::xxBuildPicHashMap<(ChromaFormat)1>	0.715970

Table 12: Memory Access Analysis
Config Name: encoder_intra_vtm.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 = 32	68.312s	4.3% of Clockticks	0.7% of Clockticks	1.4% of Clockticks	2.0% of Clockticks	0.5% of Clockticks	24,001,680	9

3.2 MODIFIED-SOURCE DECODER's Complexity

3.2.1 Config Name: encoder_intra_vtm.cfg, Class Name: CLASS_A

Table 13: Hotpots By Class (Kimono, QP =32)

Class	CPU Time (%)
CDTrace	14.361
DecLib	10.256
LoopFilter	10.256
IntraPrediction	10.252
TBinDecoder<BinProbModel_Std>	6.159
CodingStructure	6.156
_GLOBAL__sub_I_Rom.cpp	5.132
SampleAdaptiveOffset	5.129
fastInverseDST7_B32	5.128
__memset_avx2_erms	4.101
simdDeriveClassificationBlk<(X86_VEXT)4>	3.079
func@0x11350	3.078
[Outside any known module]	2.564
AreaBuf<short>	2.051
fastInverseDCT2_B64	2.05
MatrixIntraPrediction	2.05
CU	2.05
BinDecoderBase	2.049
simdFilter7x7Blk<(X86_VEXT)4>	2.049
std	2.049

Table 14: Hotspots By Function
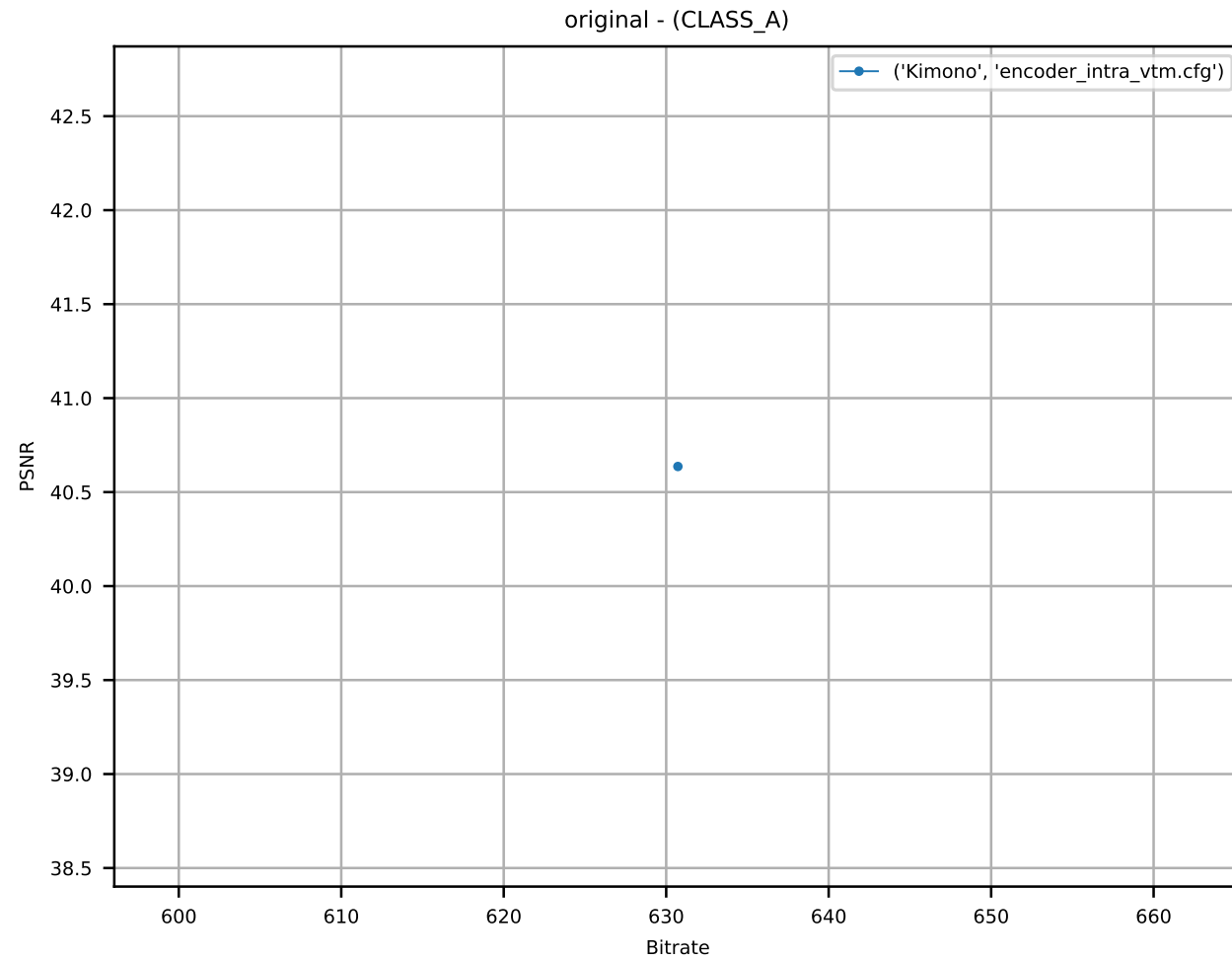Config Name: encoder_intra_vtm.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	CPU Time
CDTrace::dtrace<(bool)0>	0.044001
DecLib::DecLib	0.040000
TBinDecoder<BinProbModel_Std>::decodeBin	0.024019
__GLOBAL__sub_I_Rom.cpp	0.020014
fastInverseDST7_B32	0.019999
__memset_avx2_erms	0.015995
SampleAdaptiveOffset::offsetBlock	0.012010
LoopFilter::xDeblockCU	0.012008
simdDeriveClassificationBlk<(X86_VEXT)4>	0.012007
CodingStructure::getPU	0.012007
CDTrace::dtrace<(bool)1>	0.012006
func@0x11350	0.012003
IntraPrediction::xPredIntraPlanar	0.012003
IntraPrediction::xFillReferenceSamples	0.012001
CodingStructure::addCU	0.012001
LoopFilter::xEdgeFilterChroma	0.012001
[Outside any known module]	0.010000
AreaBuf<short>::rspSignal	0.007998
fastInverseDCT2_B64	0.007996
MatrixIntraPrediction::predictionUpsampling1D	0.007995

Table 15: Memory Access Analysis
Config Name: encoder_intra_vtm.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 = 32	0.416s	5.2% of Clockticks	0.0% of Clockticks	1.0% of Clockticks	2.5% of Clockticks	2.9% of Clockticks	120,000	10

4 Complexity Analysis - (Codec Name: ORIGINAL)

4.1 ORIGINAL ENCODER's Complexity

original - (CLASS_A)

4.1.1   Config Name: encoder_intra_vtm.cfg, Class Name: CLASS_A

Table 16: Hotpots By Class (Kimono, QP =32)

Class	CPU Time (%)
IntraPrediction	10.332
DQIntern	9.944
CDTrace	9.804
TrQuant	8.868
CodingStructure	8.758
std	6.425
IntraSearch	5.092
CABACWriter	4.742
EncAdaptiveLoopFilter	3.404
RdCost	3.246
MatrixIntraPrediction	2.985
___memmove_avx_unaligned_erms	2.067
CtxStore<BinProbModel_Std>	1.938
___GI_	1.702
fastForwardDCT2_B16	1.017
TBitEstimator<BinProbModel_Std>	0.968
CU	0.89
fastForwardDCT2_B32	0.874
___memset_avx2_unaligned_erms	0.822
EncCu	0.688

Table 17: Hotspots By Function
Config Name: encoder_intra_vtm.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	CPU Time
CDTrace::dtrace<(bool)0>	24.782150
IntraPrediction::xPredIntraAng	17.319818
std::_Rb_tree<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char», std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int>, std::_Select1st<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int», std::less<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char»>, std::allocator<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int»>::_M_copy<std::_Rb_tree<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char», std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int>, std::_Select1st<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int», std::less<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char»>, std::allocator<std::pair<std::___cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int»>::_Alloc_node>	12.858297
EncAdaptiveLoopFilter::getBlkStats	9.011817
TrQuant::transformNxN	8.199733
IntraSearch::estIntraPredLumaQT	8.099912
CodingStructure::getCU	7.309880
DQIntern::DepQuant::xDecide	6.463917
___memmove_avx_unaligned_erms	6.023870
CABACWriter::residual_coding_subblock	5.661899
CtxStore<BinProbModel_Std>::getFracBitsArray	5.648019

Table 17: Hotspots By Function
Config Name: encoder_intra_vtm.cfg,
Class Name: CLASS_A
(Kimono, QP =32)

Function	CPU Time
___GI__	4.957910
TrQuant::invLfnstNxN	4.891779
DQIntern::DepQuant::quant	4.639936
std::_Rb_tree<std::__cxx11::basic_string<char, std::char_traits<char>, std::allocator<char», std::pair<std::__cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int>, std::_Select1st<std::pair<std::__cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int», std::less<std::__cxx11::basic_string<char, std::char_traits<char>, std::allocator<char»>, std::allocator<std::pair<std::__cxx11::basic_string<char, std::char_traits<char>, std::allocator<char» const, int»>::_M_erase	4.599957
MatrixIntraPrediction::computeReducedPred	4.193850
TrQuant::invTransformNxN	3.992025
RdCost::xGetHADs_SIMD<(X86_VEXT)4>	3.803936
DQIntern::State::updateState<(unsigned char)5>	3.707888
DQIntern::DepQuant::xDecideAndUpdate	3.587803

Table 18: Memory Access Analysis
Config Name: encoder_intra_vtm.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 = 32	290.252s	4.9% of Clockticks	0.8% of Clockticks	1.3% of Clockticks	0.6% of Clockticks	0.7% of Clockticks	26,401,848	9

4.2   ORIGINAL DECODER's Complexity

4.2.1   Config Name: encoder_intra_vtm.cfg, Class Name: CLASS_A

Function
_intra_vtm.cfg,
A

Class,CPU Time (%)
LoopFilter,12.307
CDTrace,11.279
IntraPrediction,9.234
DecLib,9.227
___memmove_avx_unaligned_erms,8.205
TBinDecoder<BinProbModel_Std>,8.203
___memset_avx2_erms,6.153
MatrixIntraPrediction,5.128
TrQuant,5.127
CodingStructure,4.102
___memset_avx2_unaligned_erms,3.081
operator new,3.078
TU,3.075
simdDeriveClassificationBlk<(X86_VEXT)4>,2.842
_GLOBAL__sub_I_Rom.cpp,2.57
[Outside any known module],2.286
simdFilter7x7Blk<(X86_VEXT)4>,2.053
std,2.05

Table 20: Memory Access Analysis
Config Name: encoder_intra_vtm.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 = 32	0.430s	4.2% of Clockticks	0.2% of Clockticks	1.3% of Clockticks	2.0% of Clockticks	2.9% of Clockticks	240,000	12