

# How Innovations in ASIC architectures and novel design approaches power tomorrow's video networks

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# Scenarios/Goals

- Live Encoding at scale
- Lower Latency
- 50% or higher improvement over H.264

# Issues/Criteria

- Complexity of newer codecs (AV1/VVC)
- Scale of deployment
- Software-like adaptability

# AV1 Coding Tools

## BLOCKS

128x128  
BLOCKS

64x64  
TRANSFORMS

RECTANGULAR  
PARTITIONS

ALL  
TRANSFORM  
TYPES

## INTRA

DELTA ANGLES

CFL

PALETTE

INTRA BLOCK  
COPY (IBC)

INTRA FILTER

SMOOTH MODES

## INTER

COMPOUND  
MODES

OBMC

WARPED  
MOTION

GLOBAL MOTION

SUPER  
RESOLUTION

## FILTERING

LOOP FILTER

CDEF FILTER

RESTORATION  
FILTER

# Encoding Algorithms

## PARTITIONING

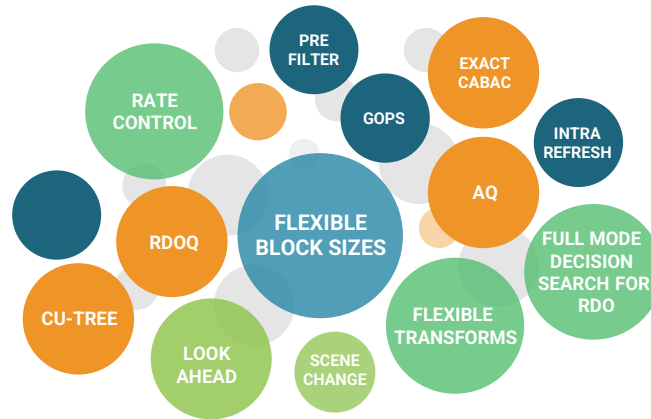
64x64 down to 4x4

## TRANSFORMS

64x64 down to 4x4

## PRE-ENCODING

Pre-filtering, Lookahead  
Scene Change



## RATE CONTROL

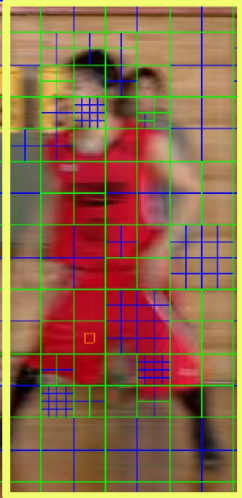
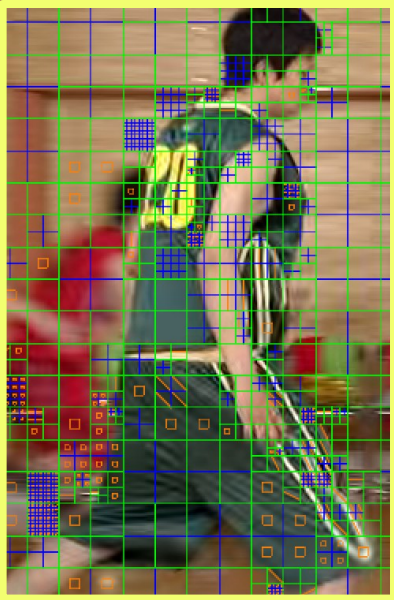
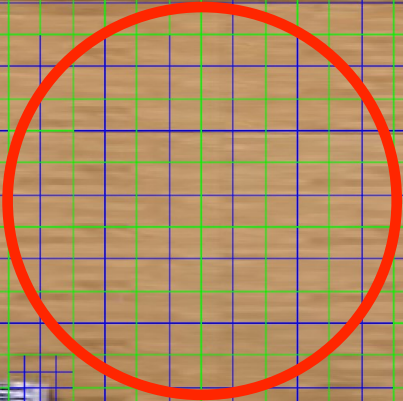
### AQ

RDOQ  
CU-Tree

## FULL RDO

# Encoder Decisions

- Block Partitioning
- Coding Mode
- Prediction Parameters
- Bits distribution



**Larger Partitions  
& Transforms**

**Smaller Partitions &  
Transforms capture  
details**



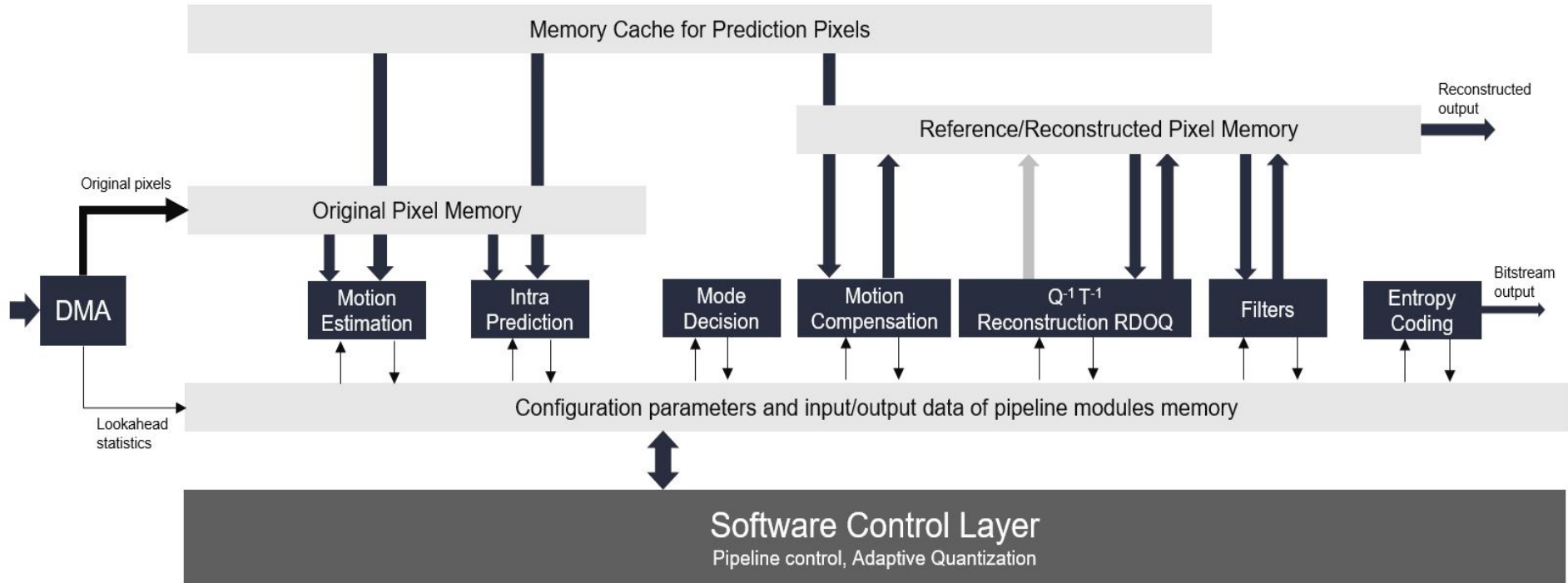
# AQ

- Spatial & Temporal
- CU-Tree
- RDOQ

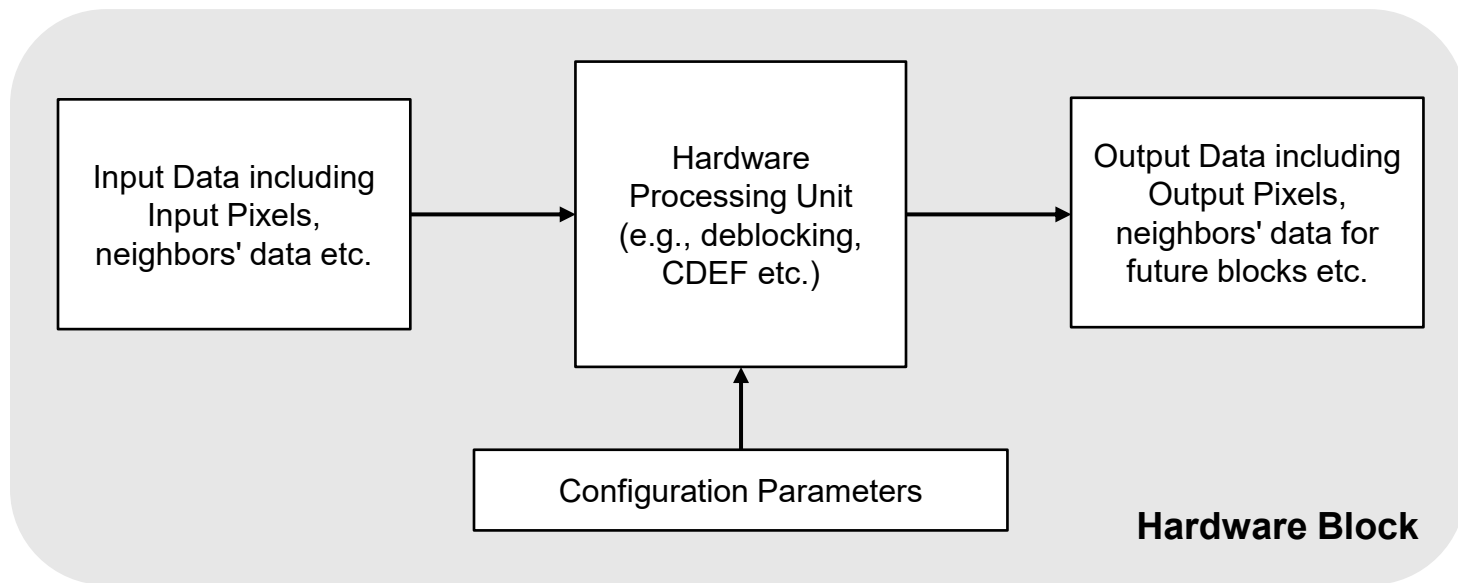




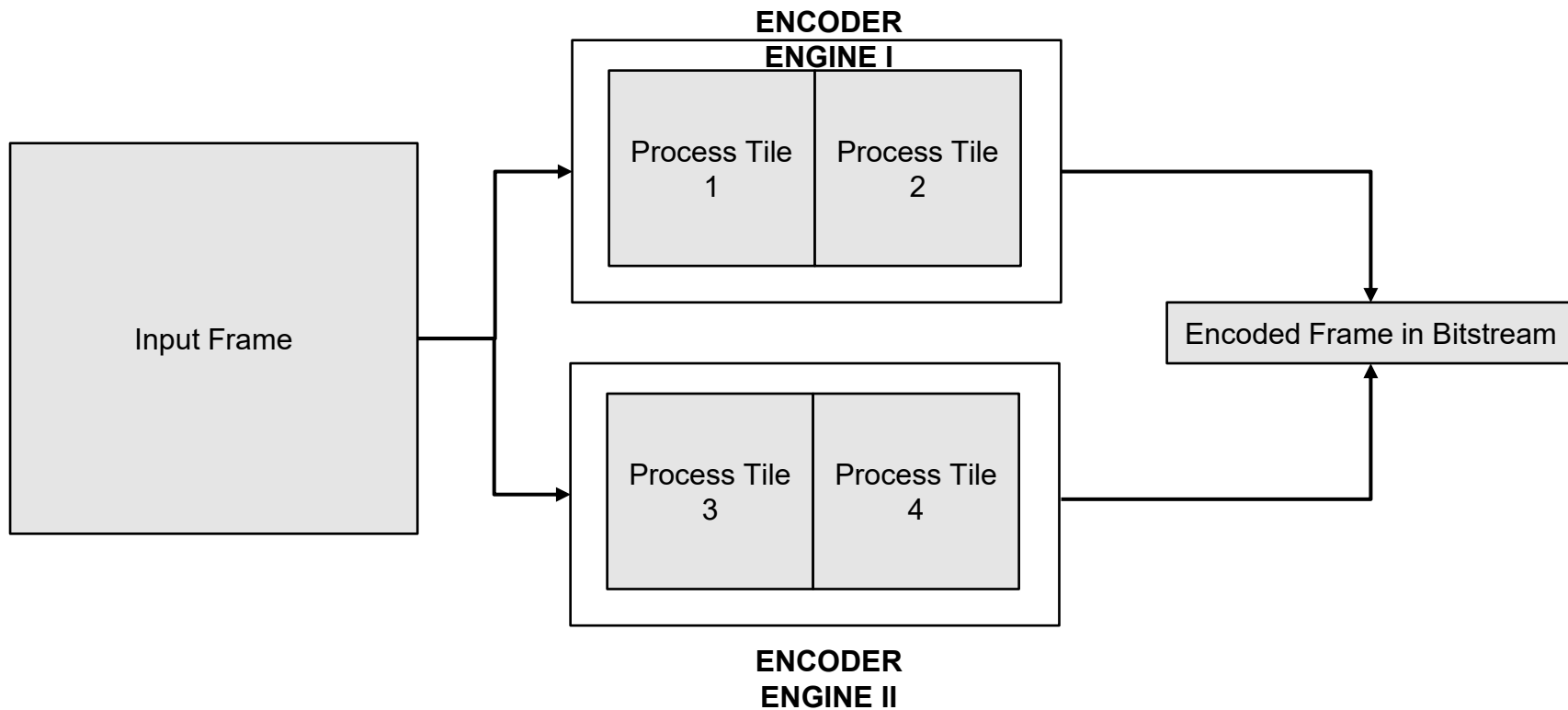
# AV1 Hardware Encoder



# Computational Block



# Tiles



# Implementation

- Blocks Pipeline
- Frame/block-level programmability
- Tiles

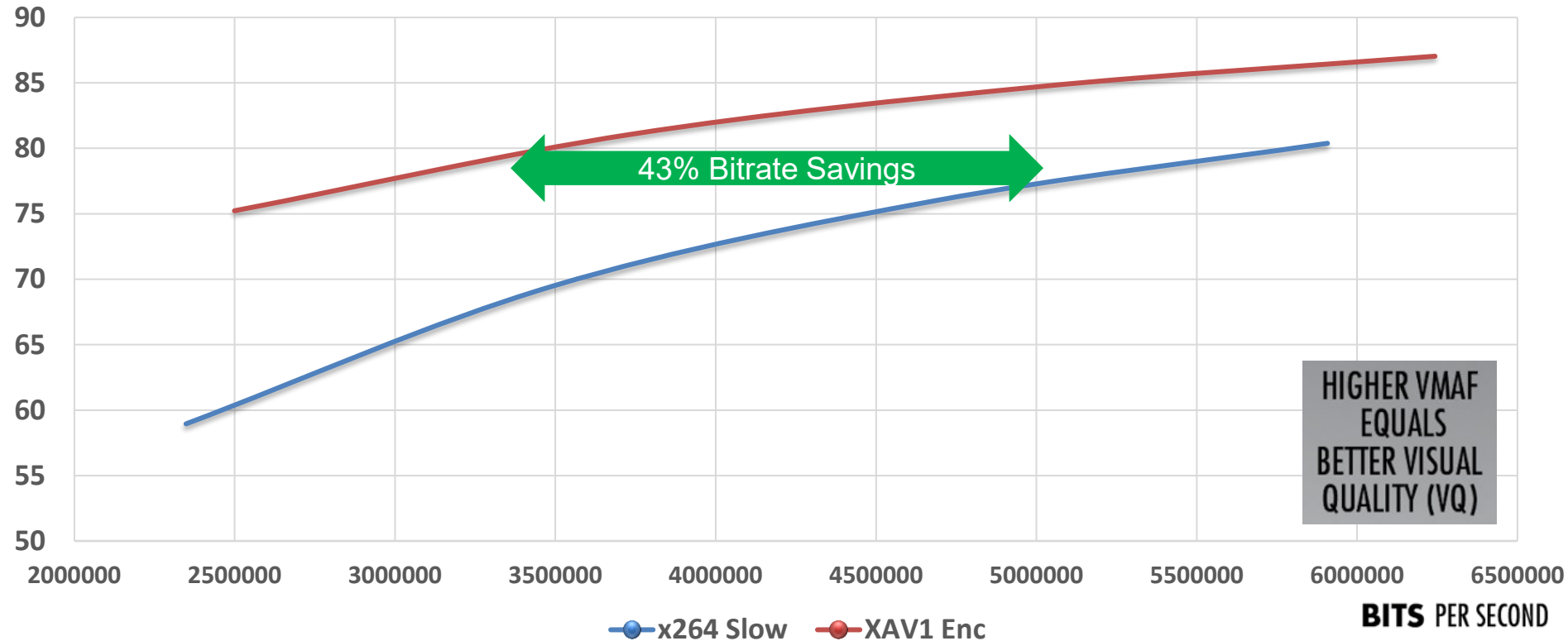
# Latency

- Blocks Pipeline & Tiles
- Frame Types (Intra/Inter)
- Lookahead (Reduce/None)
- Intra Refresh

# VQ Comparison - VMAF

**VMAF**

EuroTruck Clip CBR BD Rates



# Thank You!

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