

# **TOSHIBA**

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## **JCTVC-A117**

# **Description of video coding technology proposal by TOSHIBA**

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# Summary

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- **Submission method**

- Several tools are added to H.264/AVC
  - QALF (Quadtree-based Adaptive Loop Filter)
  - HAIF (High Accuracy Interpolation Filter)
  - IBDI (Internal Bit Depth Increase)
  - SAQMS (Subjectively Adaptive Quantization Matrix Selection)
  - BIP (Bidirectional Intra Prediction)
  - DUT (Directional Unified Transform)
  - STDS (Spatio-Temporal Direct Selection)
  - Others

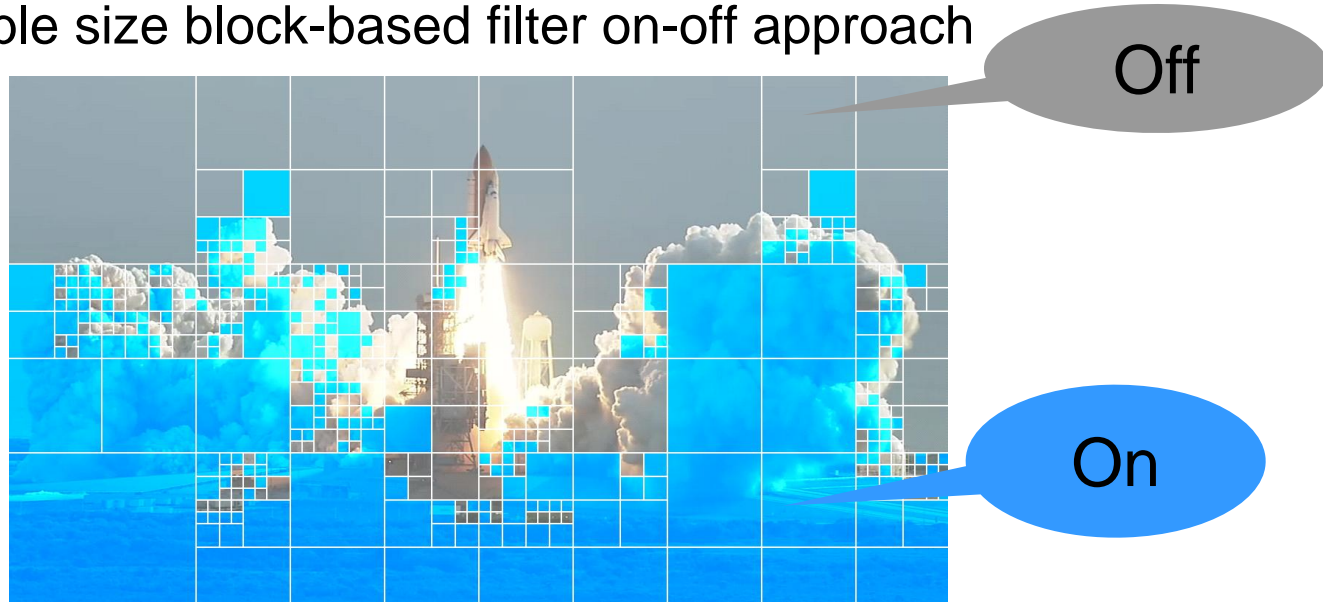
- **Results**

- On average, 28.66% (alpha), 25.88% (beta), 42.36% (gamma)
- Results of (Y, Cb, Cr) are balanced.

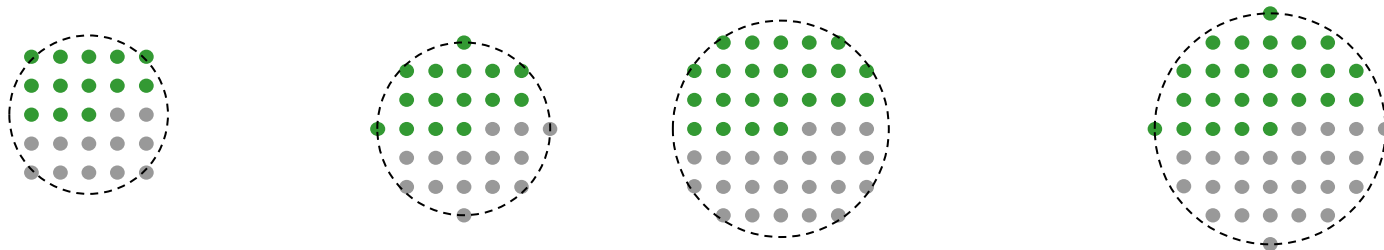
# QALF

- **Quadtree-based Adaptive Loop Filter (VCEG-AK22)**

- Loop filter based on Wiener filter
- Variable size block-based filter on-off approach



- Circular sharp filters

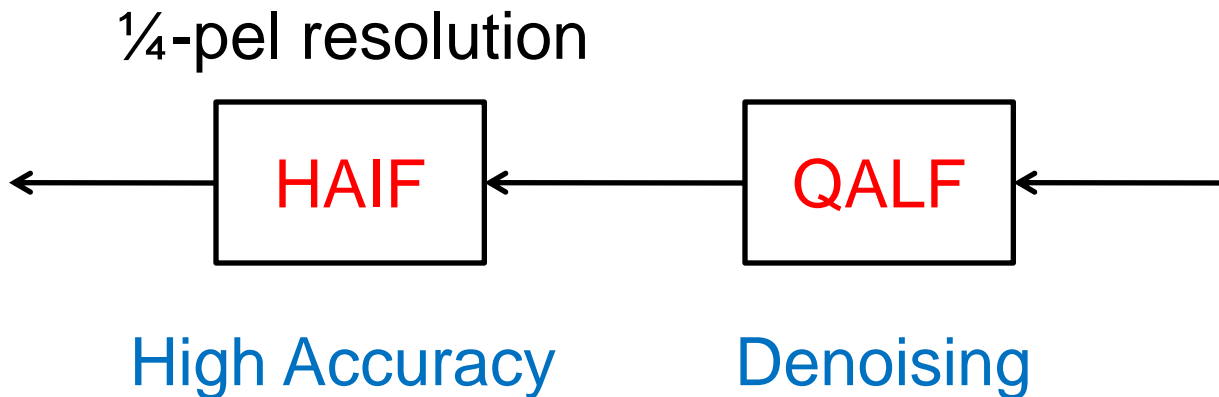


# HAIF

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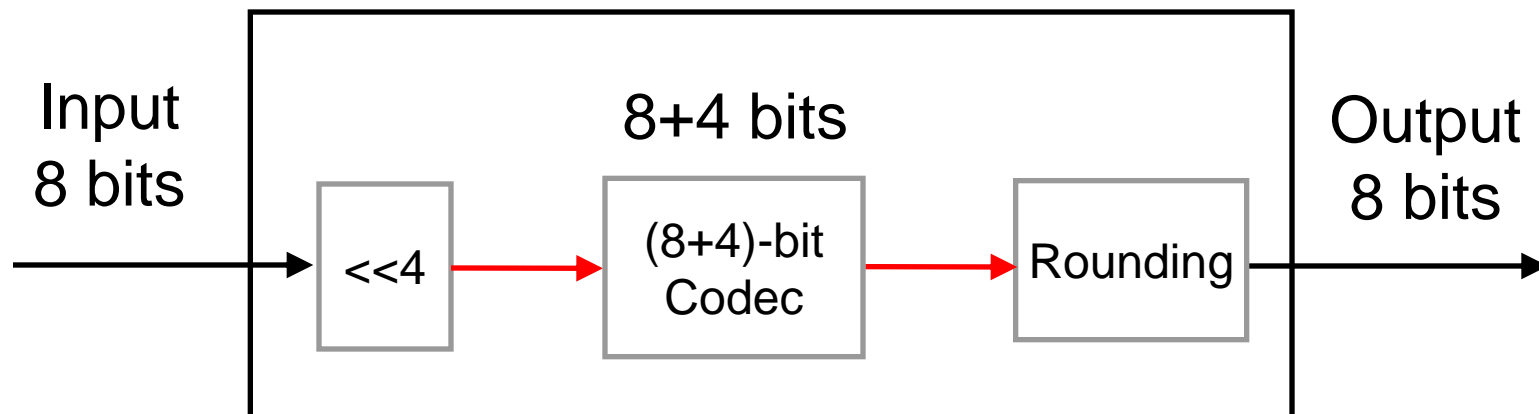
- **High Accuracy Interpolation Filter**

- QALF has already reduced noise.
- 8-tap filter for  $\frac{1}{4}$ -pel resolution
  - 1/4 pixel position:  $\{-3, 12, -37, 229, 71, -21, 6, -1\} // 256$
  - 1/2 pixel position:  $\{-3, 12, -39, 158, 158, -39, 12, -3\} // 256$
- QALF + HAIF produce a synergistic effect



- **Internal Bit Depth Increase (VCEG-AE13)**

- High Accuracy Internal processing



- Internal arithmetic error is decreased.
  - Interpolation filter, Deblocking filter, Weighted prediction, et al.

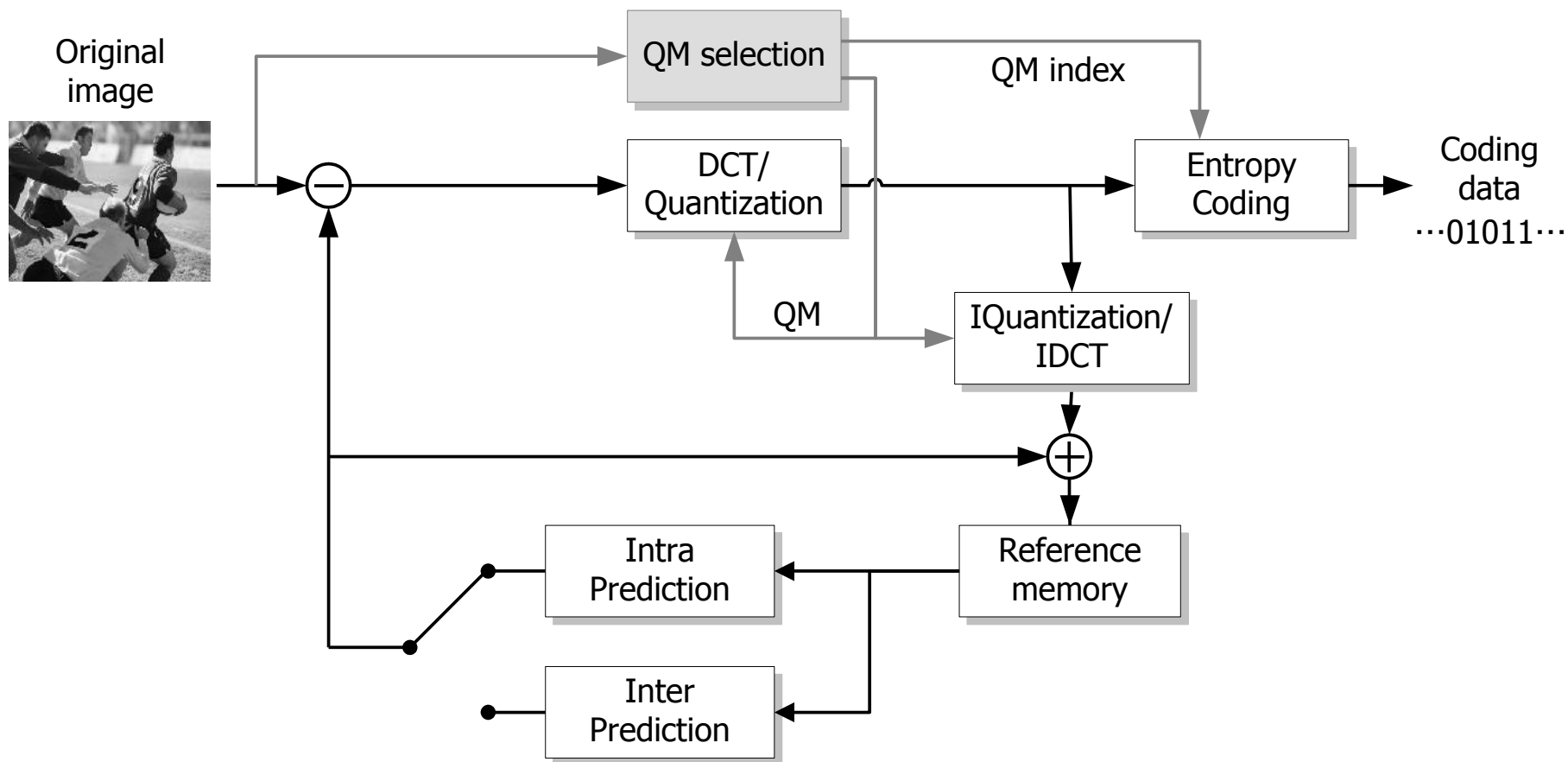
- **Decoded Picture Compression in DPB (VCEG-AF07)**

- Introduction of MB based adaptive rounding
- Memory bandwidth of DPB is kept 8-bit.

# SAQMS

- **Subjectively Adaptive Quantization Matrix Selection**

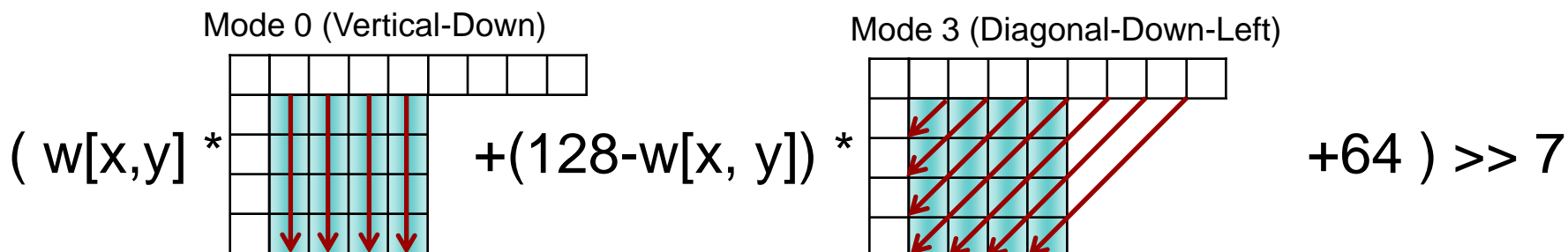
- Multiple kinds of Quantization Matrix is selected MB by MB subjectively.



- **Bidirectional Intra Prediction (VCEG-AG18)**

- Bidirectional spatial prediction

- Weighted average of two kinds of unidirectional prediction



- Changing sub-block coding order in macroblock

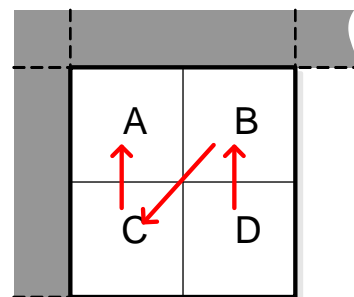
- Select sub-block coding order MB-by-MB

- Raster order or Reverse order

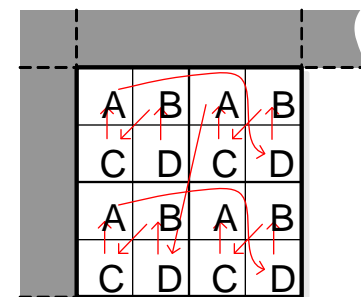
- Reverse order

- Intra\_8x8 : “D→B→C→A”

- Intra\_4x4 : “D→B→C→A→D→…”



(a) Sub-block size = 8x8

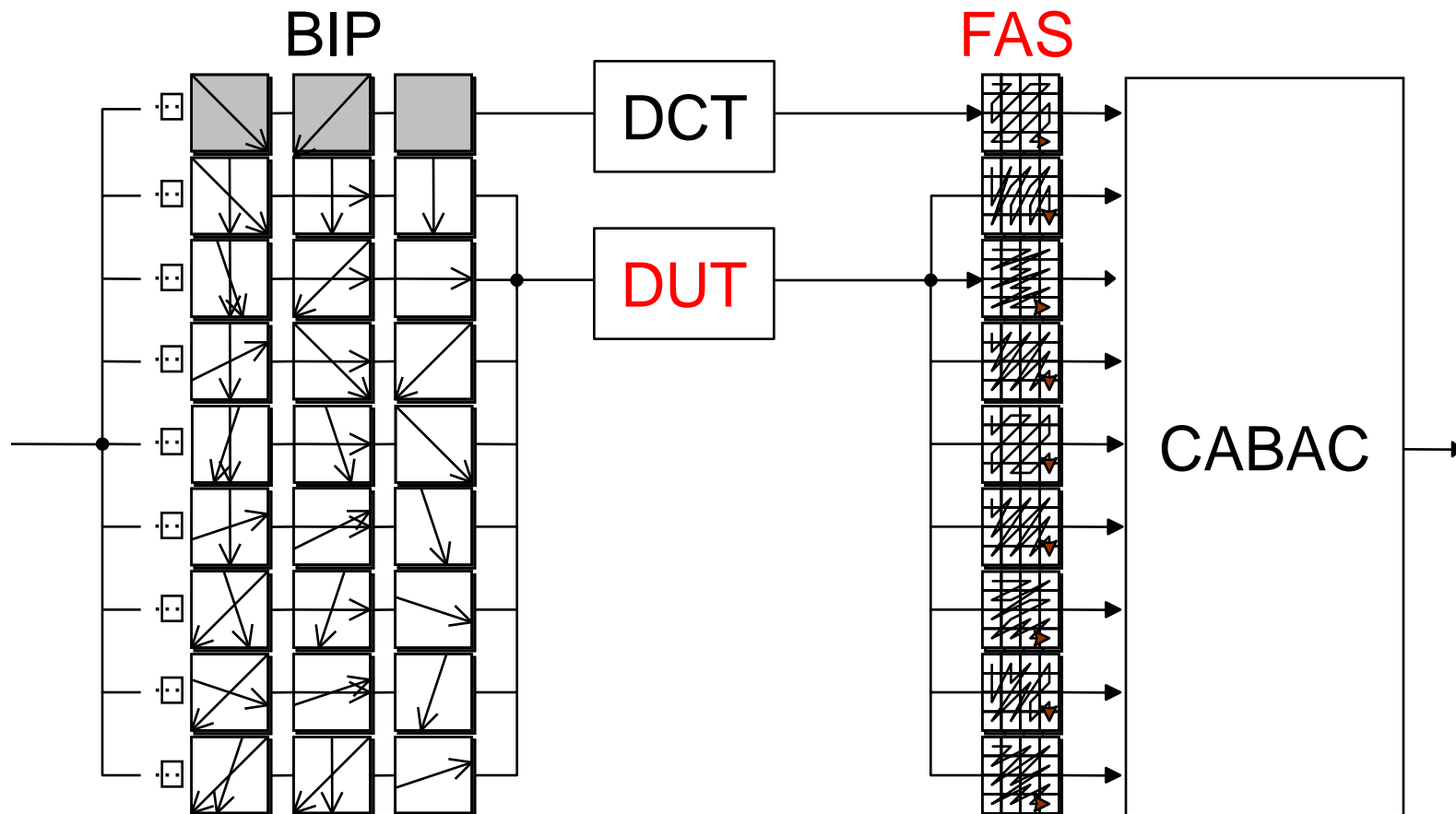


(b) Sub-block size = 4x4

# DUT

- **Directional Unified Transform (Intra)**

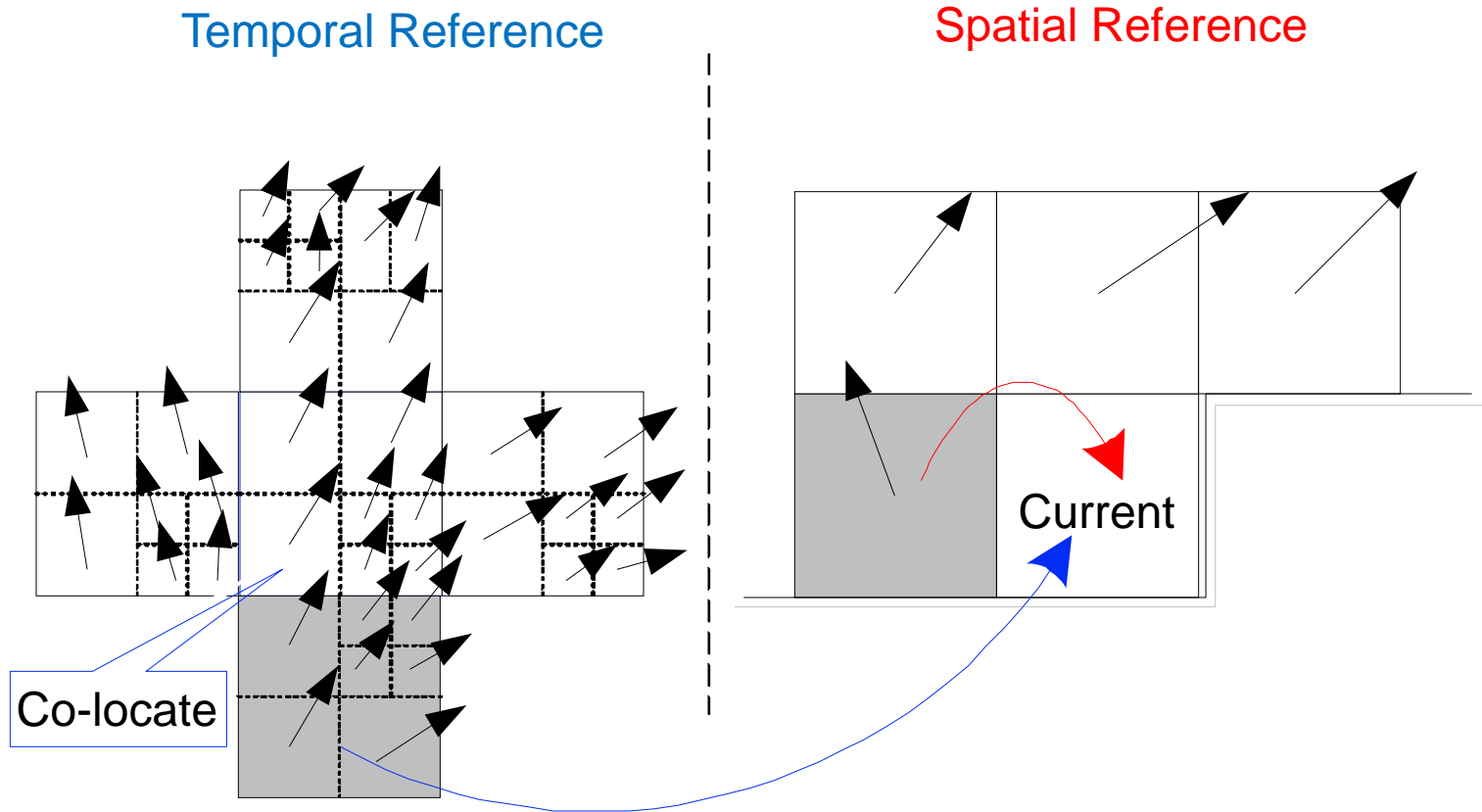
- 4/8/16-point Directional Unified Transform
- Fixed Alternative Scan





# STDS

- Spatio-Temporal Direct Selection



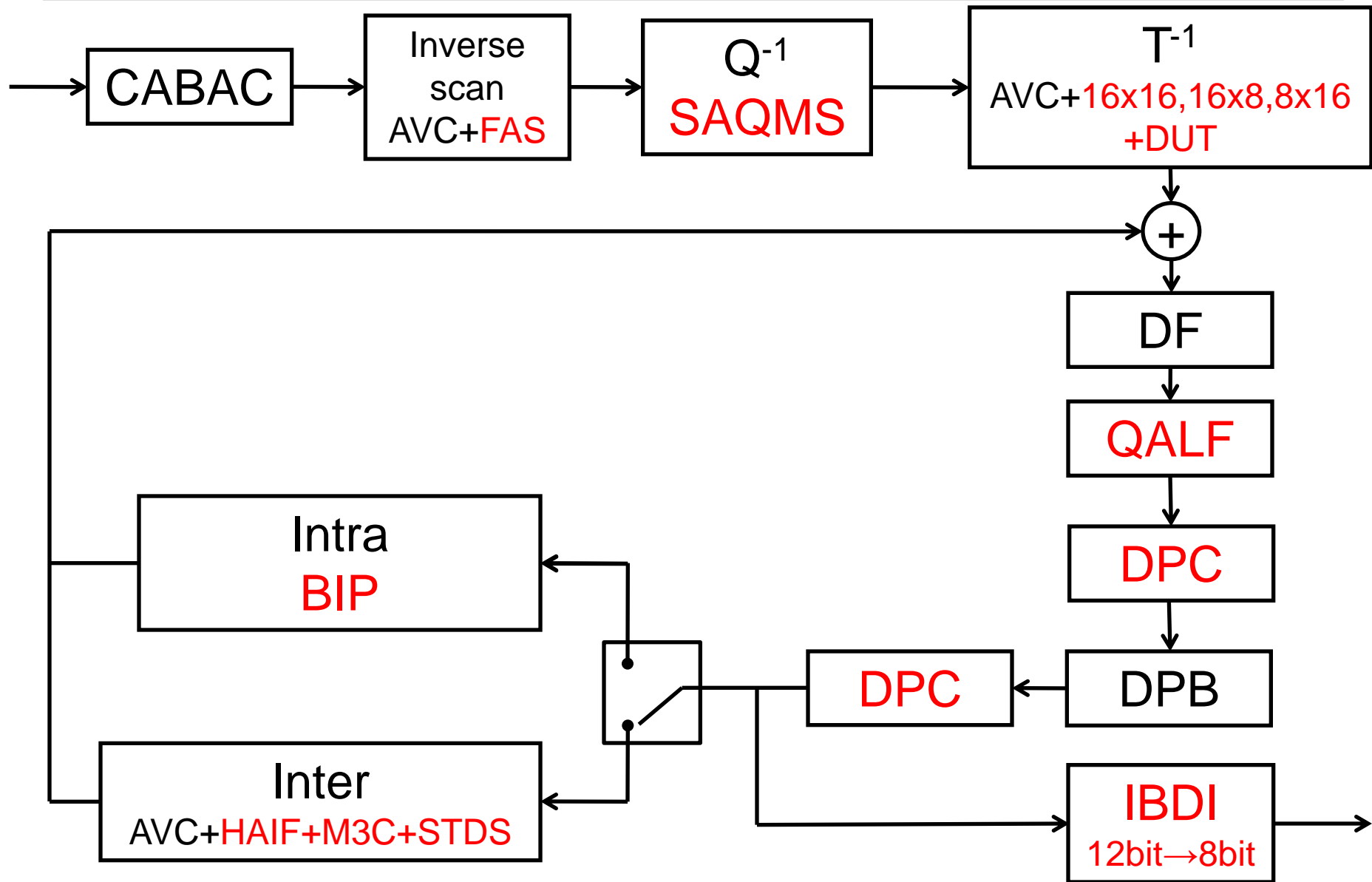
**Spatial reference block** and **temporal reference block** are selected adaptively

# Other

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- **M3C (Multiple Macroblock based Motion Compensation)**
  - Additional MC block size
    - 64x64, 64x32, 32x64, 32x32, 32x16, 16x32
- **Additional Transform size**
  - 16x16, 16x8, 8x16 DCT

# Overview



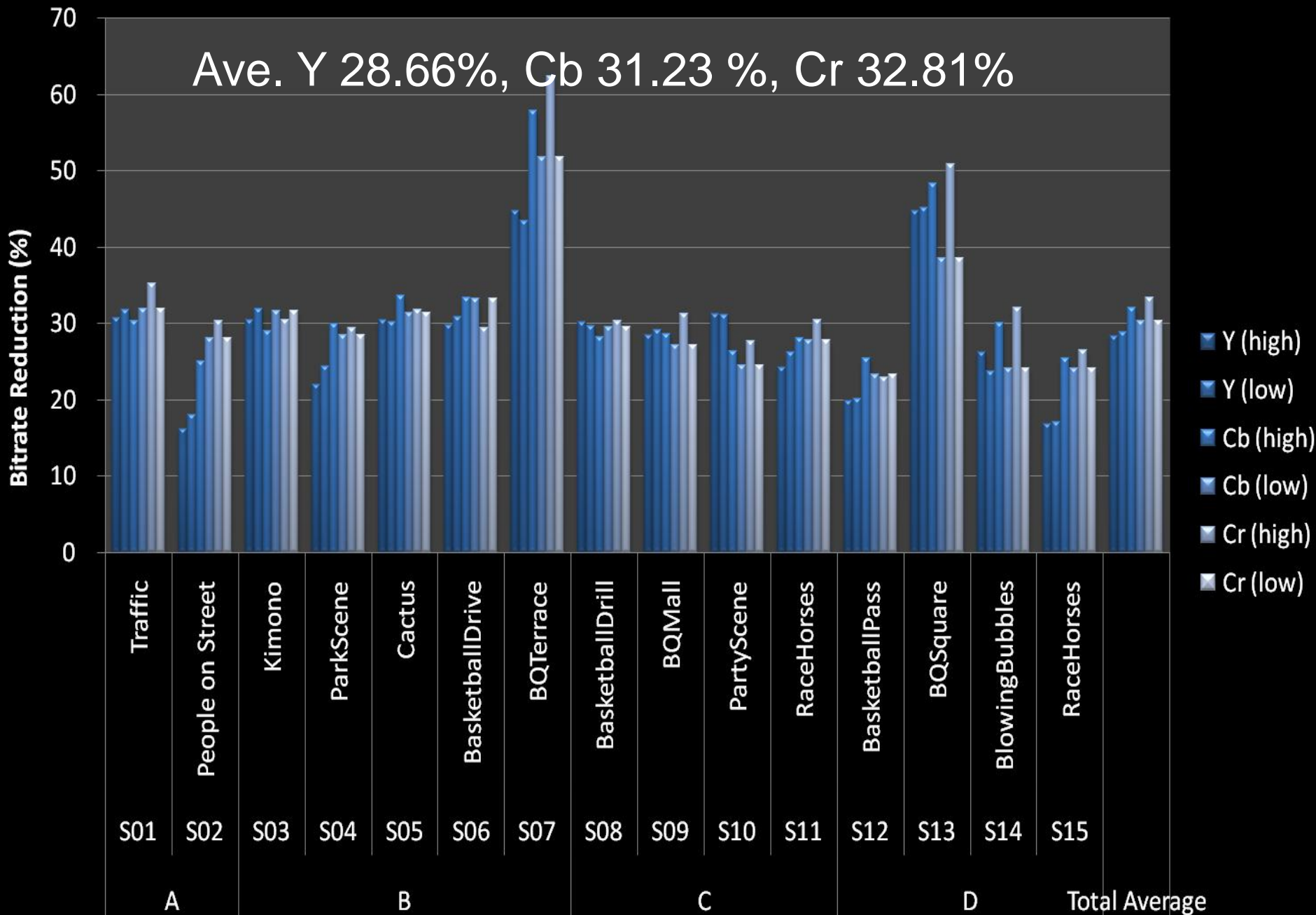
# Results

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- **The encoder configurations are as follows:**
  - Most of conditions based on alpha and beta anchor
    - Addition to one long-term reference for P-slice
- **All results of bitrate are less than -3 % of targets.**
- **Bitrate saving ( $\Delta$ Bitrate) are calculated based on BD-SNR (VCEG-M33) using BJM add-in supplied in VCEG-AE07.**
- **“high” means the higher 4 bitrate points and “low” means the lower 4 bitrate points.**

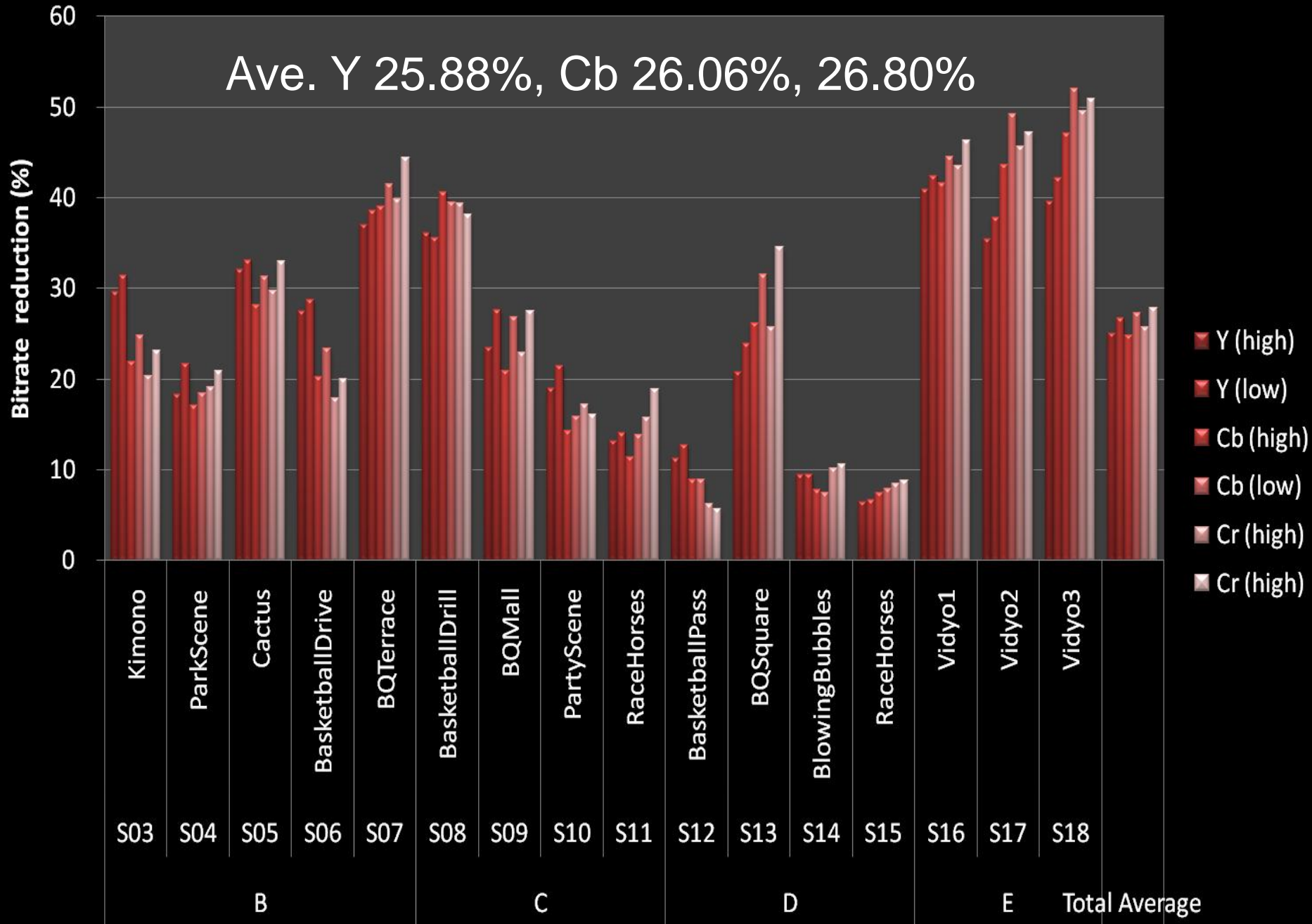
# Constraint set 1 (Alpha anchor)

Ave. Y 28.66%, Cb 31.23 %, Cr 32.81%



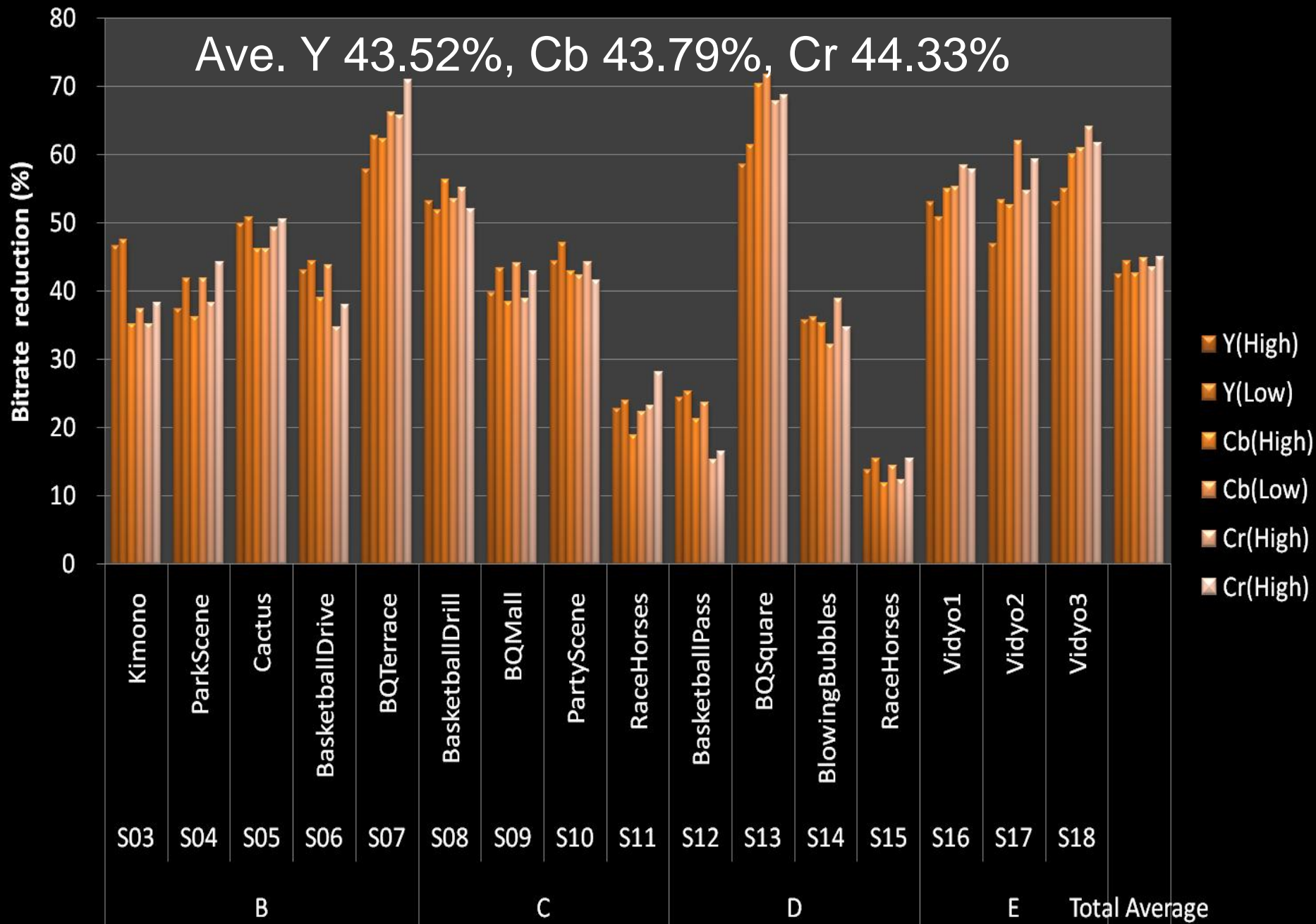
## Constraint set 2 (Beta anchor)

Ave. Y 25.88%, Cb 26.06%, 26.80%



## Constraint set 2 (Gamma anchor)

Ave. Y 43.52%, Cb 43.79%, Cr 44.33%



# Software and Complexity analysis

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- **Software**
  - Proprietary C++ software (Microsoft Visual Studio 2005)
- **Decoder complexity is a few times higher relative to H.264/AVC**
  - Filtering process: QALF and HAIF
  - Transform: Large size transforms and UDT
- **Encoder complexity is several times higher relative to H.264/AVC**
  - ME: M3C, HAIF
  - Mode decision: BIP, M3C, and large size transform
  - Filter design: QALF



# Conclusion

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- **Toshiba's submission method for CfP in JCT-VC is reported**
- **$\Delta$ Bitrate of (high, low) and (Y, Cb, Cr) are balanced**
- **Useful tools for core experiments and test model**
  - QALF (Quadtree-based Adaptive Loop Filter)
  - HAIF (High Accuracy Interpolation Filter)
  - IBDI (Internal Bit Depth Increase)
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