COMPARING AV1, V9, HEVC, AND H.264

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Agenda

• Who are the competitors?
• Setting the ground rules
• Results
• Conclusions
What I tested

- Codecs
  - x264 as baseline
  - Main Concept HEVC
  - x265
  - VP9 (Google)
  - AV1 (more later)

- Focus
  - VOD
  - 720p, 1080p, 4K
    - Six data rates each
  - Seven short video files
Boat
Food Market
Liquor Store
Pier
Ritual Dance
File Creation Process

- Downloaded raw file
- Inserted time code
- Output 4K (300 Mbps), 1080p (100 Mbps), and 720 (50 Mbps) versions
- Files to MainConcept, MulticoreWare, and AV1 vendor
- Verified encoding params
- Ran tests with MSU tool
Building the Perfect Codec Comparison

1. Agree on clips/parameters/tests • Done
2. Encode • Done
3. Score encodes (VMAF) • Done
4. Subjectively confirm scores • Not done
5. Compute Bjontegaard metrics • Not done
Status of AV1

• Bitstream schedule to freeze by 12/31
• Expected to be at least 20% higher quality than HEVC upon release (or won’t be released)
Big Issue – AV1 Encodes

• Came back worse than previous encodes
  • “We believe there must be a bug somewhere in the way we are using the encoder currently.
  • Probably some settings got changed or some settings are missing, etc.
  • The files we provided can't be right as the quality back some months was already better and there where multiple improvements along the road”

• Oops – so, AV1 included in some comparisons, but definitely not representative
  • Will hope to include and recompute in the next 30 days or so
What’s Going to Happen

- Confirm subjective
- Compute BD
- Get updated AV1
- Republish results on Streaming Learning Center (maybe Streaming Media)
- These results preliminary
## Basic Encoding Parameters

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Choosing the Quality Setting

• X265
  • Tried to find reasonable setting where MC/x265 performed similarly
  • Tested on Intel Core i7 7700K, which is a 4-core/8-threads machine
  • Slow preset for x265
  • Setting of 28 for MainConcept
  • Both vendors encoded their own files and supplied command scripts to me to confirm

• AV1 comparisons
  • Both HEVC encoders encoded at highest quality to compare with AV1 – didn’t use because AV1 quality was hosed

• VP9/H.265 – encoded with highest quality “reasonable” preset (very slow/4/1)
Measured Quality with VMAF

- Video Multimethod Assessment Fusion (VMAF)
  - Objective metric used by Netflix in their per-title optimization workflow
  - Replaced PSNR
  - Open source
  - Meld of four basic benchmarks
  - Scales from 0 – 100
    - Higher scores better
    - Differential of 6 is JND

- Used Moscow State University VQMT tool to compute
Results

• 720p
• 1080p
• 4K
Boat Clip - 720p

VMAF Score vs. Data Rate for different codecs:
- H.264
- x265
- MainConcept
- VP9
- AV1
Liquor Store Clip - 720p

Graph showing VMAF score against data rate for different codecs: H.264, x265, MainConcept, VP9.
Boat Clip - 1080p

VMAF Score vs. Data Rate for different codecs:
- H.264
- X265
- MainConcept
- VP9
- AV1
Forklift Clip - 1080p

![Graph showing VMAF vs Data Rate for different codecs: H.264, X265, MainConcept, VP9, AV1.](image)

- **VMAF** values for different data rates for various video codecs.
- The chart compares the performance of H.264, X265, MainConcept, VP9, and AV1 coders.
- The data rate is shown on the x-axis, and the VMAF values are on the y-axis.
Pier Clip - 1080p

VMAF Score vs Data Rate

- H.264
- x265
- MainConcept
- VP9
- AV1
4K Food Market

![Graph showing VMAF score against data rate for different video codecs: H.264, x265, MainConcept, and VP9. The graph illustrates the performance comparison between these codecs.]
4K Liquor Store

Graph showing VMAF score against data rate for H.264, x265, MainConcept, and VP9.
4K Ritual Dance

![Graph showing VMAF scores for different data rates with lines for H.264, x265, MainConcept, and VP9.]
Conclusions

• The qualitative difference between Main Concept and x265 was minimal, particularly with VMAF
• VP9 appears to be falling behind a bit
• Need to redo AV1 encodes
• Comments from MainConcept/MulticoreWare