Daala Update
IETF 97 (서울시)
Progress Since Berlin

- Fixed-point PVQ version completed
- PVQ ported to AV1
- Daala entropy coder now the default in AV1
- Improvements in metrics tools
  - 10 bit support for all metrics
  - Found and fixed an overflow for FastSSIM
FastSSIM overflow

- Identified and fixed an integer overflow in FastSSIM
- Only affected video around 1080p and larger
  - That includes some videos in ntt-short-1
  - Still image sets were ~1 megapixel, so not affected
Previously Reported Fast MS-SSIM
January 2014 to April 2016

up and left is better

HQ YouTube
LQ Video
Conference
Jan
Jun
May
H.265

Rate (bit/pixel)
Corrected Fast MS-SSIM
January 2014 to April 2016

HQ YouTube
LQ Video Conference
H.265

up and left is better

Rate (bits/pixel)
objective-1-fast MS-SSIM
January 2014 to April 2016

H.265
up and left is better
HQ YouTube
LQ Video Conference
Daala Progress

Rate (bit/px)
objective-1-fast PSNR-HVS
January 2014 to April 2016

up and left is better

HQ YouTube

LQ Video Conference

H.265

← Daala Progress
Summary Since Berlin

- 60 commits
- 6-9% encoder speed improvements
- Aggregate BD-rate results

<table>
<thead>
<tr>
<th>Feature</th>
<th>Rate (%)</th>
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<tbody>
<tr>
<td>PSNR</td>
<td>-0.2433</td>
</tr>
<tr>
<td>PSNRHVS</td>
<td>-0.2610</td>
</tr>
<tr>
<td>SSIM</td>
<td>-0.2055</td>
</tr>
<tr>
<td>MSSSIM</td>
<td>-0.1850</td>
</tr>
<tr>
<td>CIEDE2000</td>
<td>-0.2087</td>
</tr>
</tbody>
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(objective-1-fast, default options)
Changes
Fixed-Point PVQ

- 27 of the 60 commits (45%)
- Overall BD-rate changes very small
- Encoder still uses doubles for search
  - Not critical for standardization (non-normative)
  - We may always use them on some platforms
    - E.g., x86 does not have integer SIMD reciprocal square root approximation (but ARM does), helpful for RDO
PVQ Encoder Speed Improvements

- Using approximate rate for making RDO decisions
  - 0.3% regression
- Order gain/theta candidates by K, start search for next candidate from result of previous
  - And skip the search entirely when K doesn’t change
  - Small (<0.1%) improvement
- Don’t consider gain/theta candidates that can’t possibly have lower distortion than “skip”
  - No metrics change
Deringing Filter Changes (AV1)

- Use shorter (5-tap) filters for chroma
  - Big improvements for the Minecraft sequence
  - Overall CIEDE change 0.01%
- Now works with 4:2:2 input
  - By disabling chroma deringing
- Simpler threshold calculation for the second filter
  - Based on total change made by first filter
  - No longer need the per-pixel change in the second pass
  - Small (0.05%...0.1%) regression
Deringing Speed-Ups (AV1)

- Landed SIMD code from Daala
- Greatly reduced the amount of copying and buffering
- Stop running at all when threshold == 0
- Decoder speed impact went from ~50% → 8.5%
  - 3.2% for the actual filter
  - 5.3% for buffering/copying/management
- Still room for improvement
  - Buffer copies are not SIMD
  - Could combine with deblocking to reduce cache misses
Q15 Entropy Coder Adaptation

• Wrote down what we described in Berlin in draft-terriberry-netvc-codingtools-01

• Showed it to some of our hardware partners
  – No one had any heartburn

• Still may change/improve going forward
Future Plans

• Enable activity masking, quantization matrices for PVQ
  – Including further tuning for visual quality
• Porting Chroma-from-Luma to AV1
• Porting Daala’s rate control to AV1
• Improved integration of Daala tools in AV1
Questions?