技术开启新“视”界
Technology Bring New Vision

LiveVideoStackCon 2018音视频技术大会

2018.10.19-20 北京丽亭华苑酒店

LiveVideoStack 音视频技术社区

CSDN

ACCELERATED GROWTH OF THE VISUAL CLOUD THROUGH OPEN SOURCING SVT-HEVC & SVT-AV1

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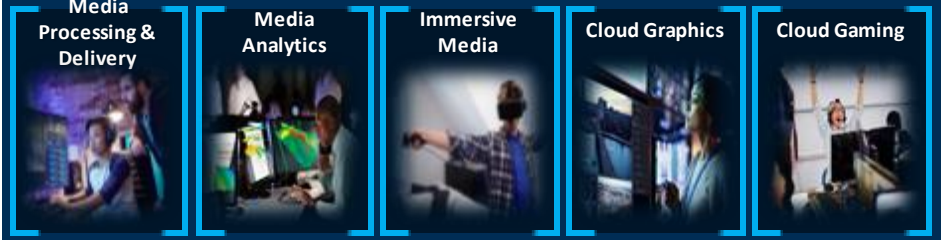
DIRECTOR OF ARCHITECTURE AND ENGINEERING
INTEL CORPORATION

VISUAL CLOUD

Visual Cloud Workloads



DECODE

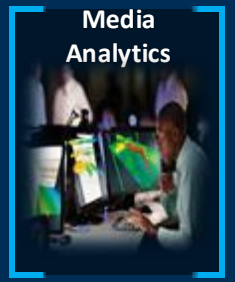
RENDER

INFERENCE

ENCODE

Four building blocks – Five Key Workloads – Multiple Use Cases

Visual Cloud Pipeline



DECODE → INFERENCING → ENCODE

VISUAL CLOUD: GROWTH STRATEGY

Software First

- Optimize the SW architecture & algorithms (e.g., SVT) for current Intel® Xeon™ processors
- Increase the CPU performance and HW support for visual workloads of future-generation Intel® Xeon™ processors

Open Source

- Launch new open source visual workload projects (e.g., SVT-HEVC, Open Vino),
- Lead in the development of future open source visual workload projects (e.g., SVT-AV1)

Fast Productization & Deployment

- Develop one pipeline for many visual workloads
- Adopt a permissive license with explicit patent rights*

Benefits

High scalability, high performance and excellent visual quality with optimized algorithms & software

Continuous optimizations and use-case customizations by ecosystem partners & customers

Reduced TTM/TCO for customers

→ ***Growth of the Visual Cloud***

*https://opensource.org/licenses/BSDplusPatent

VISUAL CLOUD: GROWTH STRATEGY

Visual cloud reference pipeline, IA-platform optimized, open source

Decode | Inference | Render | Encode

Optimized and integrated within Industry Frameworks

ffmpeg

gstreamer

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Fostering innovation with high-quality encoders and new permissive licensing

COLLABORATION SUITE FOR WEBRTC

SVT-AV1

Q4'2018

Q2'2019

Open Source Intel Frameworks & Libraries

MEDIA SERVER STUDIO

Intel® Rendering framework

SVT-HEVC

Deep learning deployment Toolkit

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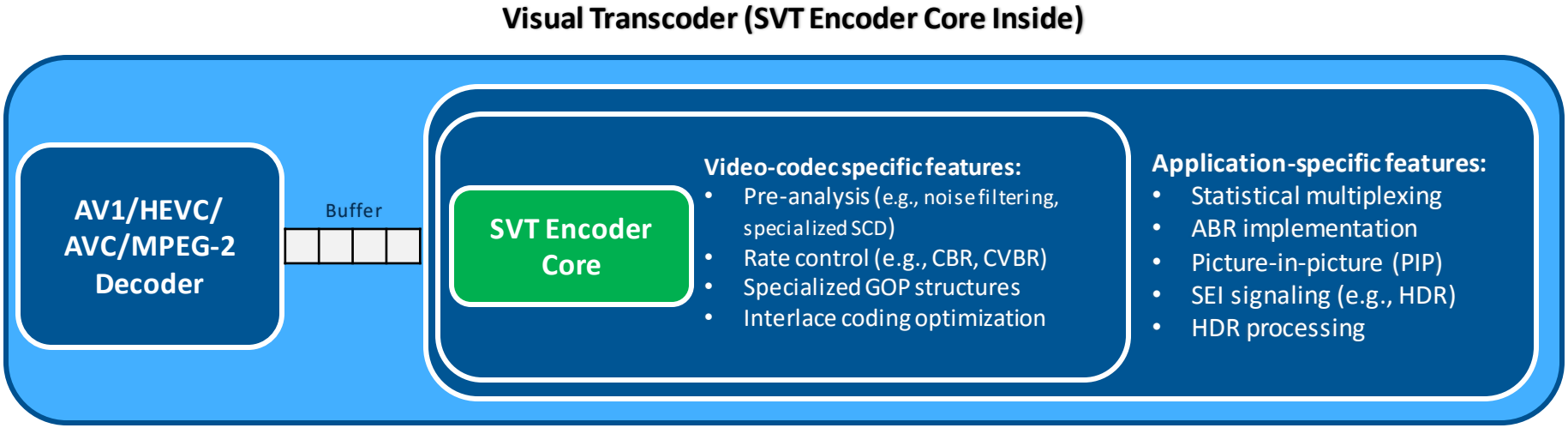
SCALABLE VIDEO TECHNOLOGY (SVT)

- Standard-agnostic architecture that divides a ***core encoder*** (e.g., HEVC, AV1, VP9, AVC, AVS2, AVS3) into:
  - Analysis (e.g., Inter/Intra search, mean, variance, edge detection),
  - Mode Decision (e.g., Partitioning, mode decision),
  - Encode-Decode (e.g., Encode, decode, filtering), and
  - Entropy Coding processes.

- Standard-Agnostic Algorithms & Features:
  - Segment-based parallelism
  - HVS-optimized classification:
    - Data-efficient processing
    - Computation-efficient depth/mode decision
    - Better tradeoffs between rate and visual quality
  - Resource-adaptive scalability

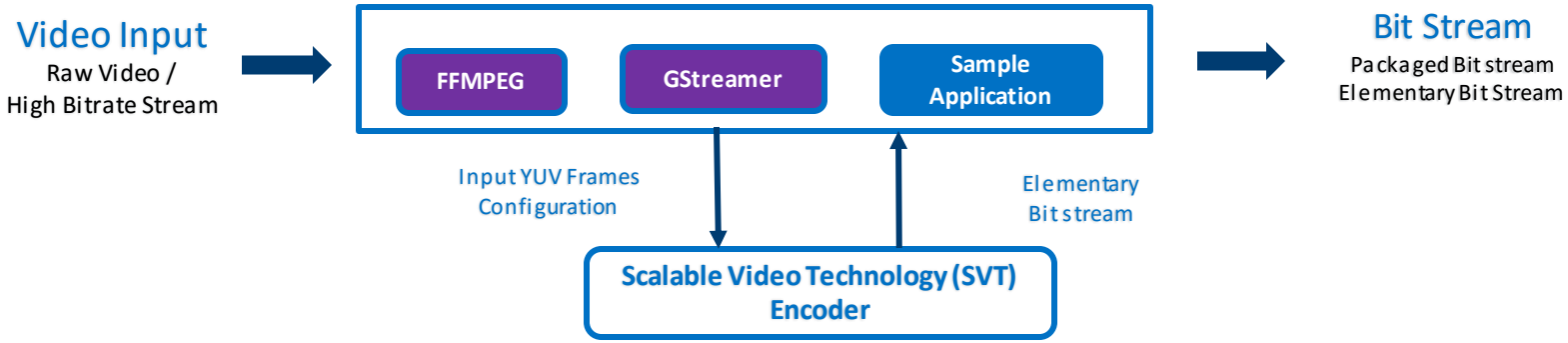
SVT CORE ENCODER



SVT Encoder core (developed and open-sourced by Intel)

Components developed by partner codec ISVs and/or customers for a complete visual transcoder

SVT ENCODER INTERFACE

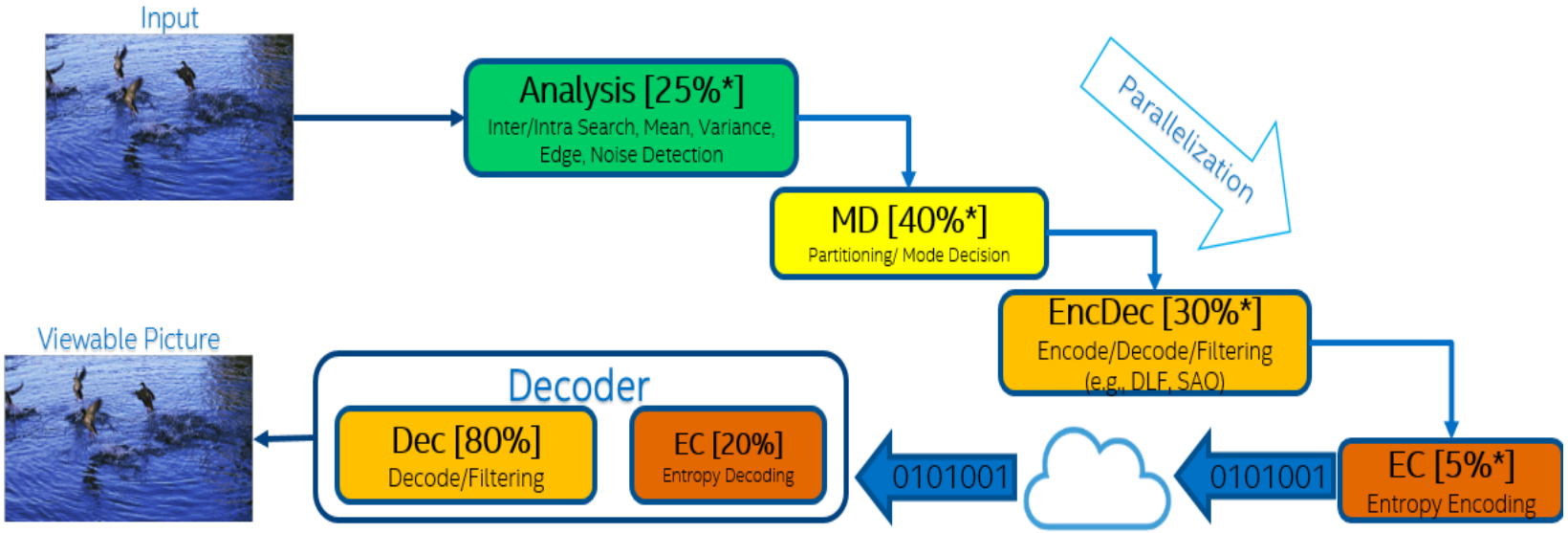


- Available with September 28th SVT-HEVC Release
- Expected Completion in Q4'2018

Interface Features

- Up to thirteen encoding presets: M0-M12
- VBR-like rate control & speed control
- Support for the following prediction structures:
  - 2-6 hierarchical-layer RA structures
  - 1-3 hierarchical-layer LDB structures

SVT ARCHITECTURE

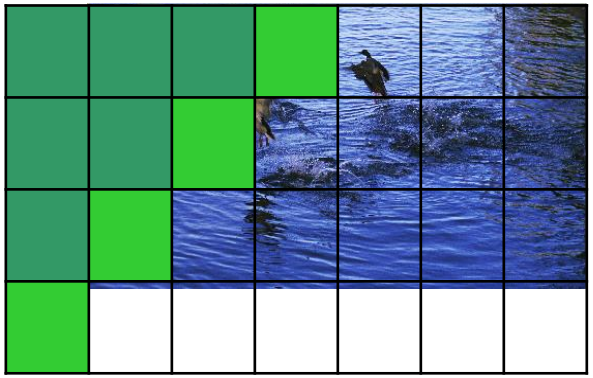


* CPU load estimates based on real-time encoding (preset M11) of 4Kp60/10-bit/HDR video content

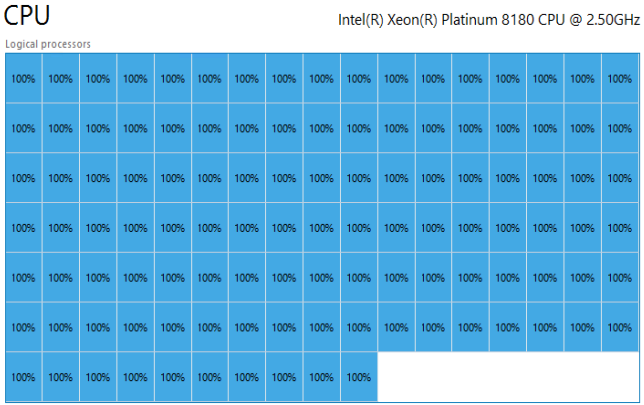
SVT FEATURES: SEGMENT-BASED PARALLELISM

Scalable Architecture

Segment Based Parallelism

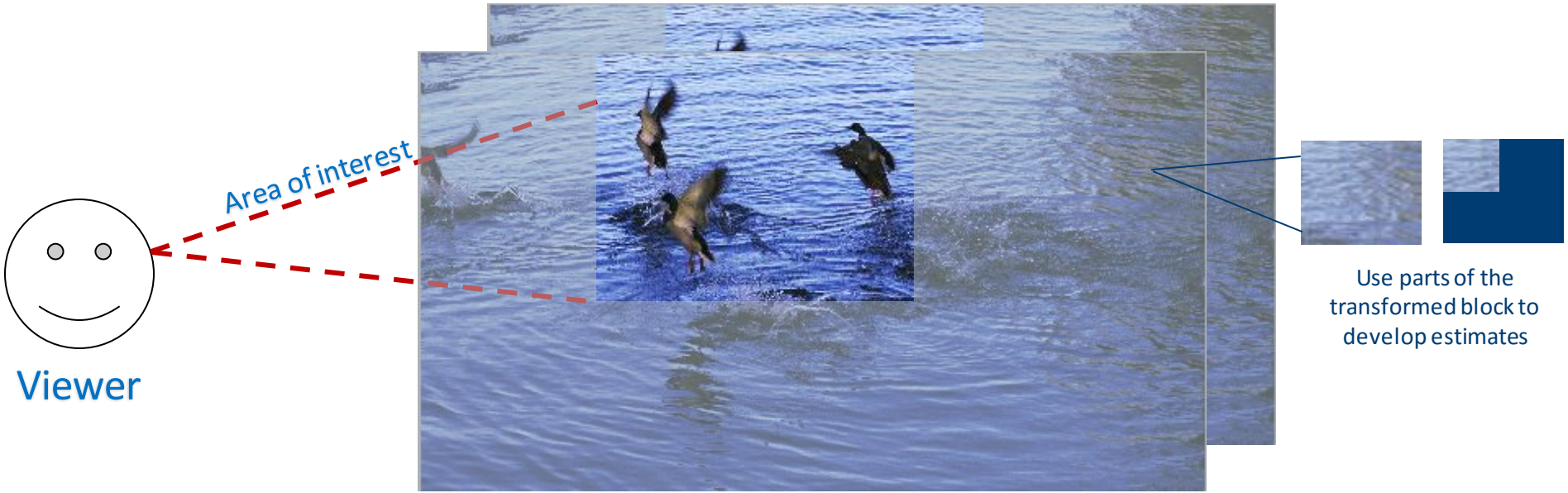


Scales over many CPU Cores



- Picture split into multiple segments:
  - Each segment processed on a separate core in parallel while complying with inter-dependencies
  - *No loss in video quality* (i.e. same output bit stream)

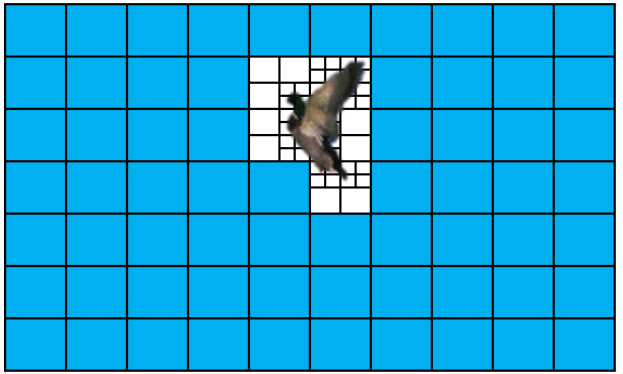
SVT FEATURES: DATA-EFFICIENT PROCESSING



- **Analyze and Detect:** Spatiotemporal analysis results used through an HVS-optimized ***classifier*** to detect areas of interest to the viewer
- **Preserve or Estimate:** Most important areas preserved while estimates (e.g., PF) used to approximate the other areas

SVT FEATURES: COMPUTATION-EFFICIENT DEPTH/MODE DECISIONS

Spatiotemporal data used through *classifier* to minimize the average number of tested depth/mode combinations



Content Adaptive Depth & Mode Decision: Spatiotemporal characteristics employed through the same HVS-optimized ***classifier*** to minimize (through prediction) the average number of tested depth/mode combinations.

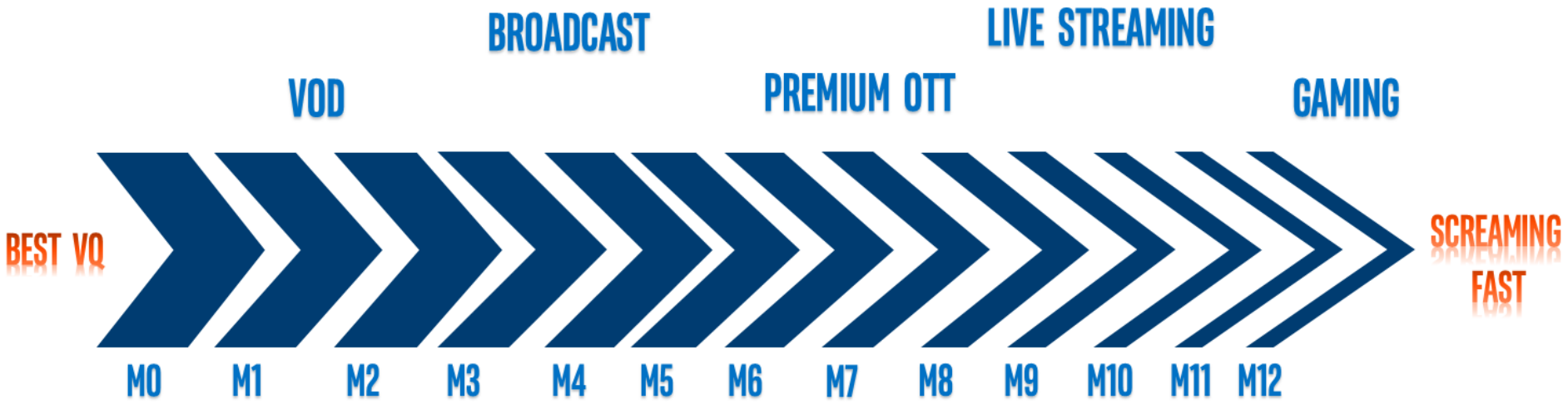
SVT FEATURES: BETTER RATE-VQ TRADEOFFS

Employ the same HVS-optimized ***classifier*** to avoid the coding of areas where the artifacts would unlikely be detected by the human eye
→ Substantially lower bit rate while maintaining same visual quality

HVS-targeted (through ***classifier***) optimizations →**15-25%** bit rate savings for 4kp60/10-bit video content

SVT FEATURES: RESOURCE ADAPTIVE SCALABILITY

Picture- and segment-based parallelism + multi-precision-level features + high optimization for Intel® SkyLake® Xeon-SP™ and Xeon-D™ processors → For a given number of CPU cores, SVT encoder achieves *multiple excellent tradeoffs* between performance, latency and visual quality.



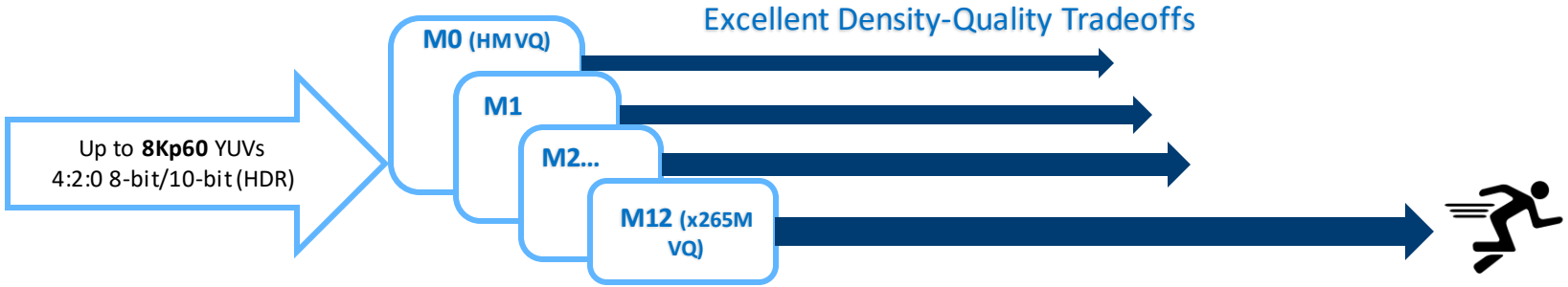
WHY SVT?

- Enables up to 13 presets corresponding to excellent tradeoffs between speed, latency and visual quality → Can be applied to VOD, broadcast, streaming, surveillance, cloud graphics, video conferencing, etc.

- Available through the open-source community: Optimizations and customizations by partners & customers

→ **Enables reduced TTM/TCO for our partners and customers**

EXAMPLE: SVT-HEVC ENCODER CORE



Supports the following:

1. HEVC Main and Main10 profiles, up to Level 5.1
2. Video input resolutions up to **8Kp60**, 4:2:0, 8-bit and 10-bit (HDR)
3. Two modes: Objective-quality and subjective-quality modes
4. Up to ***thirteen*** presets: M0-M12, providing fine granularity in the selection of the quality versus density tradeoffs

EXAMPLE: SVT-HEVC ENCODER PRESETS

Supported
Currently Not Supported

Speed

Video Quality

Preset	4k Target Speed on 1x8180 (fps)	Subjective Quality Mode [SQ] (-tune 0)					Objective Quality Mode [OQ] (-tune 1)				
		480p Resolution Class	720p Resolution Class	1080p Resolution Class	4k Resolution Class	8k Resolution Class	480p Resolution Class	720p Resolution Class	1080p Resolution Class	4k Resolution Class	8k Resolution Class
M0	3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M1	5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M2	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M3	15	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M4	25	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M5	40	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M6	60	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M7	75	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M8	90	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M9	120	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
M10	150	x	x	✓	✓	✓	x	x	✓	✓	✓
M11	165	x	x	x	✓	✓	x	x	x	x	x
M12	180	x	x	x	✓	✓	x	x	x	x	x

SVT-HEVC: REAL-TIME PERFORMANCE ON INTEL® XEON® PROCESSORS

Dual Intel® Xeon® Platinum 8180 Processor / RU

- One 8Kp60 10-bit HDR encode stream (M11)
- Up up to 2 x 8Kp50 10-bit HDR encode streams (M12)
- Up to 6 x 4Kp60 10-bit HDR encode streams (M12)

Specific System Configuration and Workload Details: 2x Intel® Xeon® Platinum processor 8180, 2.5GHz, 28 cores, turbo and HT on, 192GB total memory, 12 slots / 16GB / 2666 MT/s / DDR4 LRDIMM, 1 x 800GB, Intel SSD SC2BA800G4 / OS: Ubuntu Server 18.04, ucode 0x200004d.
8k60: 7680x4320 @ 60 fps encoding @ 20Mbps
4k60: 3840x2160 @ 60 fps encoding @10Mbps

Compact 1U form factor

Dual Intel® Xeon® Gold 6148 Processor / RU

- Up to 4 x 4kp60 10-bit HDR encode streams (M12)
- Up to 10 x 1080p60 10-bit HDR encode streams (M10)

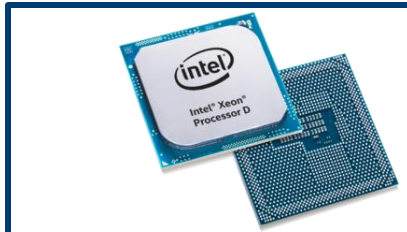
Specific System Configuration and Workload Details: 2x Intel® Xeon® Gold processor 6148, 2.4GHz, 20 cores, turbo and HT on, 192GB total memory, 12 slots / 16GB / 2666 MT/s / DDR4 LRDIMM, 1 x 800GB, Intel SSD SC2BA800G4 / OS: Ubuntu Server 16.04 Linux 4.4.0-87-generic, ucode 0x200004d.

4k60: 3840x2160 @ 60 fps encoding @10Mbps
1080p60: 1920x1080 @ 60 fps encoding @7Mbps

SVT-HEVC: REAL-TIME PERFORMANCE ON INTEL® XEON® PROCESSORS

ABR Profile

1 x 4kp60/10-bit Stream
1 x 1080p60/10-bit Stream
1 x 720p60/8-bit Stream
1 x 480p60/8-bit Stream
1 x 360p60/8-bit Stream



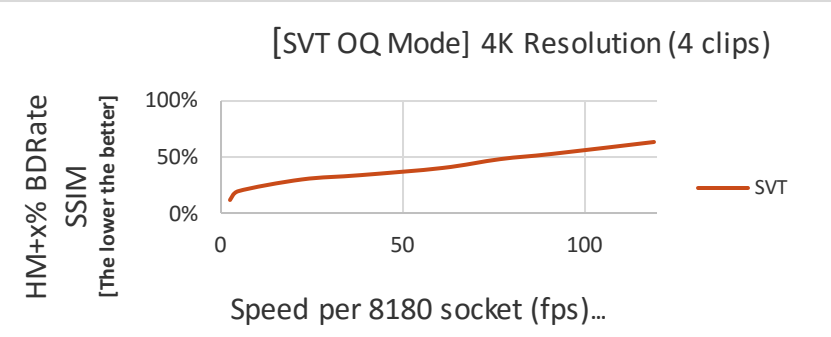
Single INTEL® XEON® D-2191 Processor
Good Video Quality (M11)

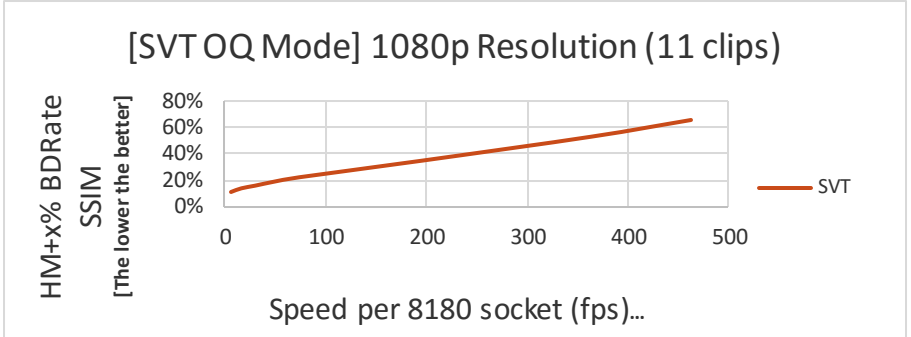
Four Processors →
Four ABR Encode Profiles

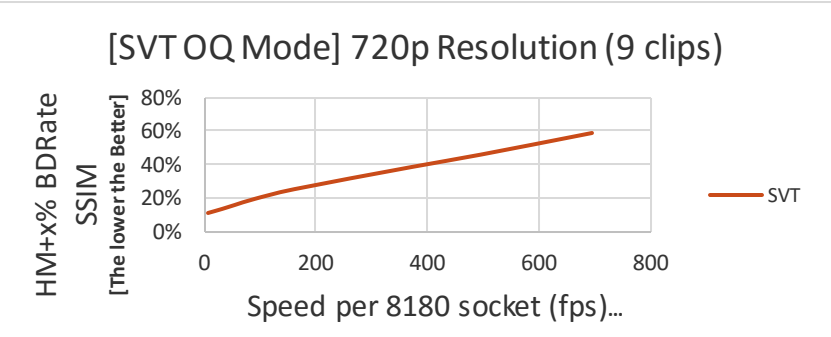
Compact 1U form factor

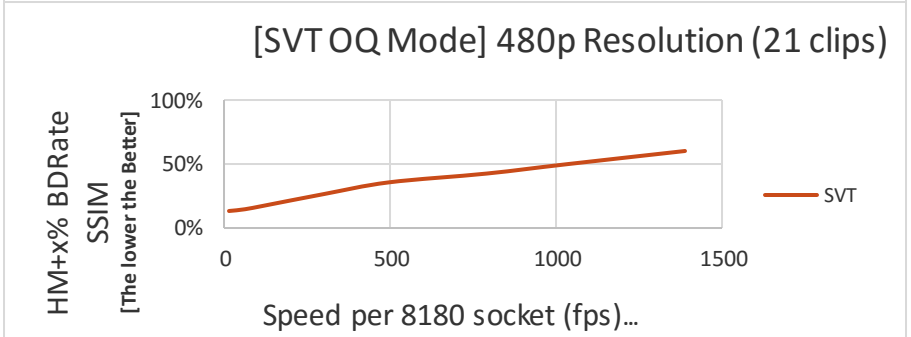
Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more information go to www.intel.com/benchmarks. Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Learn more at intel.com, or from the OEM or retailer.
Performance results are based on testing as of Sept, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure
Specific System Configuration per System: 1x Intel® Xeon®D-2191 processor, 1.6GHz, 18 cores, turbo and HT on, 128GB total memory, / OS: Fedora 27, ucode 0x200004d.
Resolution and Bitrate Details : 4k: 3840x2160 @ 10Mbps / 1920x1080 @ 6Mbps / 1280x720 @ 3Mbps / 640x480 @ 1Mbps / 480x360 @ 700Kbps

SVT-HEVC: EXCELLENT DENSITY-QUALITY TRADEOFFS









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1x Intel® Xeon® Platinum processor 8180, 2.5GHz, 28 cores, turbo and HT on, 192GB total memory, 12 slots / 16GB / 2666 MT/s / DDR4 LRDIMM, 1 x 800GB, Intel SSD / OS: Windows Server 2012 sdt R2
Config: Encoders: SVT-HEVC: version 1.1 / x265 version 2.7 CQP mode for both.
Performance results are based on testing as of Sept, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure

SVT-HEVC: EXCELLENT DENSITY-QUALITY TRADEOFFS

Similar 4K Visual Quality [SVT SQ Mode] to HM → ~70:1 Speed Advantage

SVT-HEVC SQ M0 vs HM 16 (4Kp60 Content)	
Average DMOS VQ Score	Speed up factor SVT vs HM
0.1	~70

Testing conditions based on ITU-T P.913, with a pool of **3** viewers on **15** 4k test clips.
Encoder versions: SVT-HEVC v 1.2.0 M0 vs HM 16

Specific System Configuration and Workload Details:
1x Intel® Xeon® Platinum processor 8180, 2.5GHz, 28 cores, turbo and HT on,
192GB total memory, 12 slots / 16GB / 2666 MT/s / DDR4 LRDIMM,
1 x 800GB, Intel SSD SC2BA800G4 / OS: Windows Server 2016, ucode 0x200004d.

Similar 4K Visual Quality [SVT SQ Mode] to x265 (VBR) → ~178:1 Speed Advantage

SVT-HEVC SQ M11 vs x265 veryslow (out of the box*) (*4Kp60 Content*)	
Average DMOS VQ Score	Speed up factor SVT vs x265
-0.2	~178

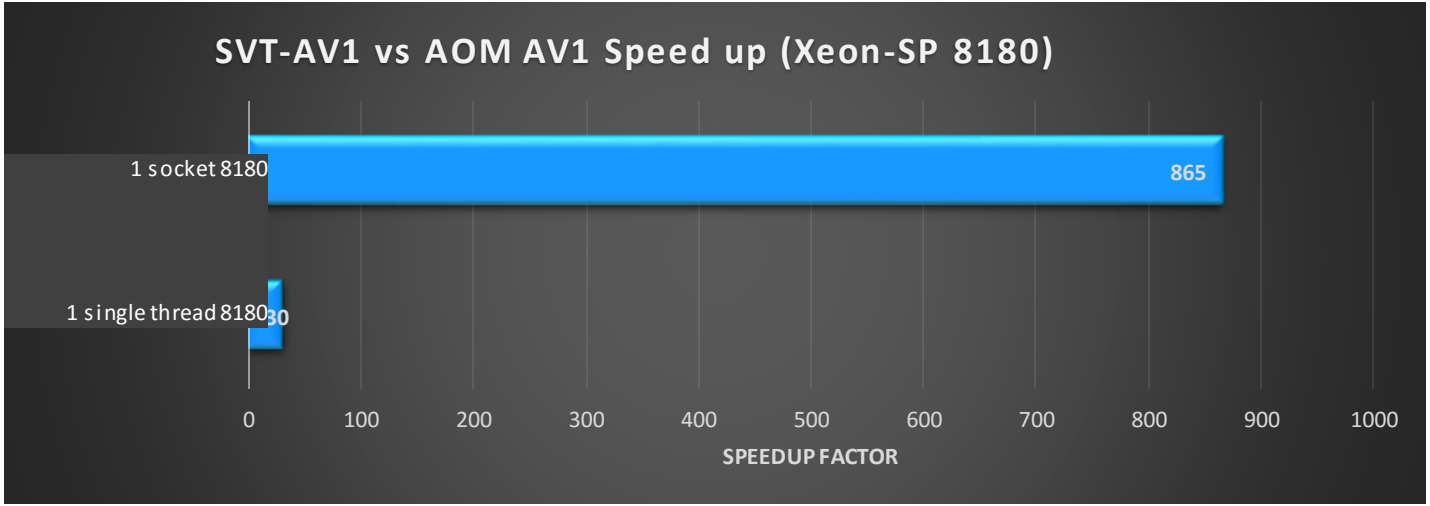
Video quality tests performed by Intel using subjective visual MOS comparison of the output of both encoders using VBR at iso bitrate. Testing conditions based on ITU-T P.913, with a pool of 21 viewers on 12 4k test clips. Encoder versions: SVT-HEVC 1.2.0M11 / x265 HEVC encoder version 2.9 [veryslow]

Specific System Configuration and Workload Details:
2x Intel® Xeon® Platinum processor 8180, 2.5GHz, 28 cores, turbo and HT on, 192GB total memory, 12 slots / 16GB / 2666 MT/s / DDR4 LRDIMM, 1 x 800GB, Intel SSD SC2BA800G4 / OS: Windows Server 2016, ucode 0x200004d.

Comparison done using 12 public 4k clips, SVT-HEVC running **four** concurrent encodings at an average of **83fps** each and x265 p8 running **four** concurrent encodings at an average of **0.43fps** each. Bitrates tested: 7, 10 and 12 Mbps depending on the test clip.

Above comparison employed "out of box" versions of the two encoders; The results also apply to 4Kp60 content only. SVT-HEVC's advantage expected to decrease for lower resolutions and/or optimized versions of the x265 encoder

SVT-AV1: EXCELLENT DENSITY-QUALITY TRADEOFFS



Similar Visual Quality, Much Faster !!

Config: 1x Intel® Xeon® Platinum processor 8180, 2.5GHz, 28 cores, turbo and HT on, 192GB total memory, 12 slots / 16GB / 2666 MT/s / DDR4 LRDIMM, 1 x 800GB, Intel SSD / OS: Windows Server 2016, ucode 0x200004d.

SUMMARY & NEXT STEPS

CODEC AGNOSTIC TECHNOLOGY

1. Highly flexible architecture
2. Segment-based parallelism
3. HVS-optimized classification
4. Resource-adaptive scalability

Highly optimized for Intel® SkyLake® Xeon-SP™ and Xeon-D™ processors

Widely available through the open-source community

Faster TTM and lower TCO for our partners and customers

Growth of Visual Cloud!

SVT-HEVC

- **SVT-HEVC** available to be downloaded at: https://github.com/intel/SVT-HEVC.
- We welcome your ***feedback*** using the "issues" tab: https://github.com/intel/SVT-HEVC/issues
- Submit your ***contributions*** using the pull request functionality: https://github.com/intel/SVT-HEVC/pulls

SVT-AV1

- We welcome contributions to the Open Source **SVT-AV1** project.
- Please subscribe to our mailing list at: https://lists.01.org/mailman/listinfo/svt-av1

FUTURE SVT SUPPORT FOR *SVT-VP9, SVT-AVC…*

NOTICES AND DISCLAIMERS

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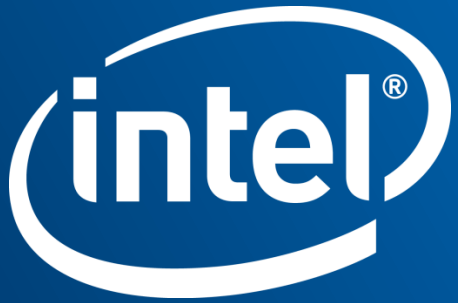
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Thank you

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