Agenda

• Introduction
• Intel® Media SDK
• Intel® OpenCL SDK
• Intel® Graphics Performance Analyzers
• Demo: Performance Tools in Action
• Q&A
Intel® Visual Computing Tools Family
Interoperability for Media Development

- **Intel® Media SDK**
  - Easy to use cross-platform media pipeline with easy access to stock HW codecs/filters
  - The best way to access HW decode/encode via a configurable media pipeline for stock functionality

- **Intel® OpenCL SDK**
  - An emerging low-level access, standard based, Platform Compute API
  - Unleash CPU performance
    - Utilization of the SIMD instruction
    - Multi-Core scalability
  - Use to develop custom media software

- **Intel® Graphics Performance Analyzers**
  - Full-Platform visualization tool covering Media SDK, OpenCL™, 3D graphics, and custom application code
  - Use to understand and resolve performance bottlenecks across the entire platform
Intel® Media SDK

Key Benefits

• **Performance:** Highly optimized to take advantage of Intel® Architecture and Intel® HD Graphics hardware acceleration

• **Efficiency:** One single API across hardware and software reducing code complexity. High level API to remove the complexity of DXVA2

• **Future Proof:** Supports today’s Intel HD Graphics and future hardware. Develop on today’s hardware in preparation to take advantage of the hardware of the future

Target Market Segments

• Consumer/Pro Media, Video Conversion, Video Editing, Video Conferencing, Stereoscopic 3D

• Content Creation

Availability

• Available Today (2.0 Gold, and 3.0 Beta): [www.intel.com/software/mediasdk](http://www.intel.com/software/mediasdk)
Intel® Media SDK

- **Intel® Media SDK** - access hardware acceleration for video codecs with optimized media libraries for **Intel® Processor, Intel® Quick Sync Video, Intel® HD Graphics & Future Intel® Architecture** – accessible through a single API.

**Intel® Media SDK API**
(encode, decode, video processing)

**ISV Media Application**

**Software Library**
- Intel® Processor
  - Optimized Media Library

**Hardware Libraries**
- Intel® GMA 4500HD
  - Optimized Media Library**
- Intel® HD Graphics
  - Optimized Media Library
- 2nd Gen Intel® Core™ Processor
  - Optimized Media Library
- Future Intel® Architecture
  - Optimized Media Library

**Intel® Processor Optimized Media Library**

**Intel® GMA 4500HD Optimized Media Library**

**Intel® HD Graphics Optimized Media Library**

**2nd Gen Intel® Core™ Processor Optimized Media Library**

**Future Intel® Architecture Optimized Media Library**

**Intel® Media SDK 1.0 and 1.5 only**
High Level Architecture

- **Sample Applications** (Source code) (Encoders, decoders, transcoder)
- **Sample Media Framework Plug-ins** (Source code for video encode, decode)
- **Windows* Explorer or Window Media Player**
- **ISV Applications**
- **Production MFTs**
- **ISV Plug-Ins**

**Intel® Media SDK API**
Media Library Dispatcher (encode, decode, video processing)

- **Intel® Processor**
  - Optimized Media Software Library
- **Intel® GMA 4500HD**
  - Optimized Media Hardware Library**
- **Intel® HD Graphics**
  - Optimized Media Hardware Library
- **2nd Gen Intel® Core™ processor**
  - Optimized Media Hardware Library
- **Future Intel® Architecture**
  - Optimized Media Hardware Library

**DXVA / DDI Extensions**
- **Graphics Drivers**

**Intel® Media SDK**
**Driver Package**
**3rd party**

**Intel Media SDK 1.0 and 1.5 only**
Building Blocks

• API building blocks
  – DECODE: Decode elementary video streams
  – VPP: Pre/Post-Process uncompressed video frames
  – ENCODE: Encode to elementary video streams
  – USER: Integrate application specific algorithms with plugin callbacks

Usage model examples

– Playback
  ![Playback Diagram]

– Transcode
  ![Transcode Diagram]

– Mixed transcode
  ![Mixed Transcode Diagram]

– Custom Processing
  ![Custom Processing Diagram]
Asynchronous Pipeline

• Asynchronous operation by design
  – Requires explicit synchronization to obtain results

• Performance considerations (recommended)
  – Form asynchronous pipeline
    • SDK checks dependencies on I/O parameters
  – Multiple data flow and delayed synchronizations
Transcoding Data Flow

- Parallelizing DECODE, VPP, and ENCODE execution to unleash Intel® Quick Sync Video performance
  - Insert queues into the transcoding pipeline
  - Continue feeding DECODE after ENCODE
  - Delay synchronization until absolutely necessary

*Parallelize execution to increase performance*
What’s new with Intel® Media SDK 3.0

• Transcode Enhancements
  – Increased Performance
  – Enhanced Quality
  – Easier to use with Opaque Memory

• MVC Encode and Decode
  – Stereoscopic 3D

• Video Conferencing Extensions
  – Dynamic Bitrate Control
  – Robustness (Error Resilience)
  – Error Detection and Reporting
  – Low Latency: Improved Responsiveness

• OpenCL Sample

*Highly optimized for the next generation Intel® Core™ Processor*
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Intel® OpenCL SDK

Key Benefits
- Open standard
- Low-level
- Heterogeneous
- Augments Intel’s developer choice of APIs and libraries
- CPU Accessibility: SIMD instruction, Multi-Core scalability
- Forward Scalability: Generation and devices

Target Market Segments
- Consumer Media, Video Editing/Transcoding Apps.
- Highly Parallel Compute mainly in domains of Image Processing and Digital Content Creation

Availability
- Available Today:
  - Intel® OpenCL SDK 1.1 for CPU
  - Unique Implicit CPU Vectorization Module
  - Publicly available free of charge at: intel.com/go/openc1
- Future: scale to next generation of Intel® architecture
Intel® and OpenCL

- Intel is a leading participant in the OpenCL standard efforts
  - Engaged with OpenCL since its beginning early 2008.
  - Significant impact on the OpenCL feature set.
  - Intel OpenCL for CPU and related tools available today.

Who is behind OpenCL

* Apple initiated the standard and continues to be active

Developer Choices for Parallelism

- Intel delivers **developer choice** of high-performance parallel programming tools and technologies
  - **Intel® Parallel Building Blocks (Intel® PBB)** adds parallelism for the vast majority of applications
  - **OpenCL** addresses the needs of customers in specific segments, and provides developers an additional choice to maximize their applications performance
The OpenCL Technology

- Host-device programming model
- Unified programming model for CPU, GPU, and Accelerators
- Dynamic compilation model (Just In Time - JIT)
- Data parallel model
  - A kernel defines the logic of handing one element.
  - The runtime executes multiple kernel instances, one per element, "work-item"
- Low-level APIs for data transfer and asynchronous kernel execution
  - Multiple command queues, event dependencies
  - Query device capabilities
- A C-based kernel programming language
  - C99 with restrictions (IEEE-754 compliant)
  - Vector data types (float4, char16, etc.)
  - 100’s of Built-in functions
- Wide support for visual computing usages
  - Inter-operability with DirectX*, and OpenGL*
  - 2D & 3D Images, Samplers
Writing OpenCL for the CPU

• Motivation
  – Utilize all resources on your system
  – Unleash CPU performance
    • Multi-core
    • Vector units

• OpenCL on CPU Advantages
  – Low-level abstraction without the need for ISA specific code
  – Cross-architecture functional portability
    • Cross vendor uArch, Cross devices (CPUs/GPUs/Co-processors)
  – Kernel performance close to hand tuned
    • For usages that fits OpenCL programming models with current generation OpenCL C compiler and getting better all the time!
  – Maintainable, Readable, “Debuggable” code

OpenCL Challenge Ahead
Performance portability across devices and generations
Intel® OpenCL Implicit Vectorization Module

- Compiler module that better utilizes SIMD architecture
- Runs by default when compiling to CPU
- What it does
  - Packs together work items

Main advantages: **Performance Portability**

- Developer writes code according to the problem domain
- Compiler scales code to the SIMD vector width
- Developer’s need for HW specific considerations is reduced
Optimize using Intel® OpenCL SDK Tools

Create

Profile

Tune

Offline compilation and analysis of OpenCL Kernels

Profile OpenCL app Execution

Tune OpenCL C Kernels

Intel® OpenCL SDK Offline Compiler

Intel® Performance Tools

Minimal tuning can bring significant speedup

Use Intel® GPA to understand and resolve performance bottlenecks
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Intel® Graphics Performance Analyzers

Key Benefits
- Profiler with cross-platform hardware support (Intel, Nvidia, AMD)
- Designed for Games, Media, OpenCL, and Rich Web (Accelerated Browsers)
- Provides platform-wide insight into heterogeneous workflows
- Supports full breadth of Intel silicon from Core processors to Atom
- Rated #1 profiling tool by developers in 2011 Evans Data Survey

Target Market Segments
- Games & Graphics
- Media Developers
- Rich Web Developers (HTML5, WebGL)

Availability
- Available Today:
  - Intel® GPA 4.1
  - Publicly available free of charge at: www.intel.com/software/gpa
- Future: scale to next generation of Intel® architecture

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**System Analyzer HUD** *(Heads Up Display)*
Real-time graphs and state overrides including analysis metrics for graphics and media

**Frame Analyzer**
Deep frame performance analysis down to the draw call level, including shaders, textures, D3D states, pixel history, textures, etc.

**Platform Analyzer**
Full System analysis of CPU metrics and workloads across multiple threads and cores, including OpenCL profiling plus simultaneous GPU metrics
Media Performance Analysis

Real-time Processor Graphics Monitoring
- GPU Execution Units (EU)
- GPU Multi-Format Codec Engine (MFX)

Trace Capture for Detailed Analysis
- Drill down on GPU decode, video processing and encoding execution
- Intel® Media SDK and DXVA2 interface calls
- Track media tasks from submission to execution

Performance Problem:
GPU is idle because all queues are empty
OpenCL Profiling

• Drill-down on OpenCL commands (kernels and memory operations) being scheduled across all system’s software threads
• Resolve host application bottlenecks in conjunction with the OpenCL commands

Key problems in a glance:
- Performance is bounded by the host application thread
- OpenCL kernels are distributed on only 4 CPU HW threads
- At least 4 unused threads occupies the other HW threads (oversubscribing)

Solution: Tune your application, use Intel® OpenCL SDK optimization guide.
Here’s how to use Intel® GPA

Use Real-time HUD

If CPU bound, use Platform Analyzer or VTune Amplifier

Or

Media Analyzer

If GPU bound, use Frame Analyzer
Middleware Pre-Instrumented for GPA

“To earn our customers’ trust we’ve always had to focus on performance. The integration of our run-time component with the Intel GPA tool provides critical performance data right out of the box. Seeing not only the performance characteristics of SpeedTree, but how it interacts with other middleware packages, is just a fantastic step forward.”

CHRIS KING
CEO, IDV INC.

“The visualization provided by Intel’s GPA allows us to clearly understand the temporal relation of tasks. This can be really powerful when seeking performance optimizations. The dependencies and utilization patterns of Enlighten tasks are clear, as are their interactions with other tasks such as rendering or game logic.”

CHRIS DORAN
COO

“Using Substance smart textures has tremendous benefit for real-time texture map generation, but one always has to look toward optimizing performance. The integration work we did with the Intel GPA tool and the Substance run-time is certainly going to aid game developers when they do their performance tuning. Now with holistic, integrated performance, data developers can confidently deliver fast, beautifully textured content generated at runtime.”

SÉBASTIEN DEGUY
CEO

“The first time we used the GPA Platform Analyzer, we saw that our AMP instrumentation was lacking in some code parts and was giving too much information in others. The ability to visualize the events within each game frame is surprisingly effective in pointing you in the right code-optimizing direction.”

ALEXIS MANTZARIS
PRINCIPAL ENGINEER

“Now with Umbra 3 being instrumented for Intel’s GPA, when developers profile their culling code, they will see, in detail, the various culling tasks that the Umbra runtime is responsible for. Furthermore, this integration enables developers to visualize the clear flow of these culling tasks, whether they come from multiple cameras, AI or other entities.”

TEPPO SOININEN
COO

“GPA is outstanding as a profiler, showing the data the way you would expect it. We use it for pretty much all the GPU optimizations we work on, on every piece of hardware we target.”

WOLFGANG ENGEL
FOUNDER

“Intel GPA is the best GPU performance tool on PC.”

ARAS PRANCKEVICIUS
LEAD GRAPHICS PROGRAMMER

INTEL* GPA ALSO SUPPORTED IN:
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Demo: Intel® Media Tools Family in Action

- Decode using the Intel® Media SDK
- Use post processing filters utilizing the advantages of OpenCL on the CPU.
- Rendering using DirectX
- Profile performance using the Intel® GPA
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Download, Integrate, Accelerate

• Download the Intel® tools today!
• Free of charge for Visual Adrenaline members. Joining the developer program is also free
• Be prepared for next generation platforms seamlessly

Start to develop today and be prepared for future Intel architectures automatically
Summary

• Download the tools today and start your development

• Intel® Media SDK

• Intel® OpenCL SDK

• Intel® Graphics Performance Analyzers
Q&A

Please turn in your evaluation forms
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Backup