# Interoperability with Intel® Media SDK

Sample User's Guide

Intel® SDK for OpenCL\* Applications - Samples

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# About the Interoperability with Intel® Media SDK

The sample for Interoperability with Intel® Media SDK demonstrates how to use Intel® Media SDK and Intel® SDK for OpenCL\* Applications together for efficient video decoding and fast post-processing.

### Introduction

Intel Media SDK provides fast decoding of h264 and mpeg2 video streams, while Intel SDK for OpenCL Applications is good for pixel processing of video frames (for example OpenCL enables to easy implement pixel parallel algorithm). See Intel Media SDK website at http://software.intel.com/enus/articles/media/. The Intel Media SDK Interoperability sample shows how to combine Intel Media SDK and Intel SDK for OpenCL Applications to perform fast/smooth video playback with additional post processing effects. Both SDK products are optimized for seamless interoperability. It is optimized for running on Processor Graphics device, which allows efficient data transfers from the Intel Media SDK surface to OpenCL memory object.

#### **Motivation**

The sample demonstrates an Intel Media SDK pipeline combined with simple (yet optimized) post-processing filters in OpenCL, showing how to:

- Integrate processing with Intel SDK for OpenCL Applications into Intel Media SDK pipeline and get benefit from hardware-accelerated (if available) video decoding with Intel Media SDK pipeline.
- Organize efficient sharing between MediaSDK frames and OpenCL images via cl\_khr\_dx9\_media\_sharing extension.
- Implement simple video effects in OpenCL.

# **Algorithm**

The algorithm consists of the following stages:

- 1. Read the frame data from file.
- 2. Feed the data to the Intel Media SDK Decoder and get decoded video frame back in NV12 (which is a specific layout for YUV) format.
- 3. Execute the OpenCL kernel which processes the decoded video frame.
- 4. Draw image on the screen.

# Implementation Details

The Intel Media SDK Interoperability sample demonstrates implementation of basic media processing pipeline. The pipeline consists of two main modules:

- The **Decoder** module which leverages Intel Media SDK for hardware -assisted decoding mpeg2 and h264 formats.
- The Post-Processing module which relies on Intel SDK for OpenCL Applications for efficient implementation of the video effects. This module actually serves as a plug-in for Intel Media SDK pipeline.

You should follow these requirements to be able to share dx9/DirectX Video Acceleration\* surfaces with OpenCL:

- 1. Use the Direct3D9Ex object but not the Direct3D9.
- 2. Create the dx9 surfaces as DXVA2\_VideoProcessorRenderTarget.

# OpenCL\* Implementation

The Post-processing module introduced above is actually a plug-in for Intel Media SDK. The plug-in initializes Intel SDK for OpenCL\* Applications and generates a list of filters scanning current folder and detecting all files with \*.cl extension. Each file is a separate filter implementation.

Each file has at least one kernel which processes pixels. For example ProcessUV processes the 2x2 pixel at once that contains two color components and four intensities components processing. The sample contains the following c1 filters:

- \_color\_control.cl simple control of intensity and color characteristics inside circle controlled by mouse
- \_wave.cl simulates wave propagation and distorts image according to simulated waves.
- Files contain following kernels:
- Processuv processes U and V component of four pixels of input frame
- Mouse executes once for each frame to indicate where the mouse pointer is right now

When Intel Media SDK calls Intel SDK for OpenCL Applications plug-in to execute filter for given frame, clEnqueueTask and clEnqueueNDRangeKernel functions execute kernels from \*.cl files. The host program keeps a sync event returned by these functions to check (by use of clGetEventInfo) whether the post-processing module is done with a frame.

For each frame the Post-Processing module creates OpenCL memory object wrapping the DirectX Video Acceleration surface. Use the cl\_khr\_dx9\_media\_sharing extension to avoid extra memory copying from the Intel Media SDK frame into Intel SDK for OpenCL Applications memory object.

# **Work-Group Size Considerations**

You can specify any size of workgroup for this kernel aligned with vertical and horizontal sizes of input image in the range 1 to imagewidth and 1 to imageHeight. Current version use 8x8 local size that is ok with FullHD resolution video and Intel SDK for OpenCL Applications - Optimization Guide

# **Project Structure**

The Intel Media SDK Interoperability sample project has the following structure:

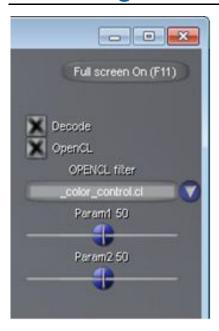
- src folder contain main code, with Intel SDK for OpenCL Applications and Intel Media SDK initialization and processing functions
  - o  $\mbox{main.cpp}$  file initializes window and GUI controlled and draws the resulting frame to window using DXUT
  - o OCLStruct.cpp file contains OpenCL initialization code
  - o pipeline\_decode.cpp file contains code which constructs processing pipeline for video decoding and post processing
  - o sample\_opencl\_plugin.cpp file contains code of Intel Media SDK plug-in for post processing video frames using Intel SDK for OpenCL Applications
- src\_MediaSDK folder contains memory management files of Intel Media SDK samples
  - o base\_alllocator.cpp base memory allocators
  - o d3d\_allocator.cpp specific memory allocators which allocate buffers and frames using dx9 surface
  - o sample\_defs.h some macros and defines used from Intel Media SDK APIs.

# **APIs Used**

The Intel Media SDK Interoperability sample uses the following APIs [3]:

- clGetDeviceIDs
- clCreateContext
- clReleaseContext
- clCreateCommandQueue
- clReleaseCommandQueue
- clGetDeviceInfo
- clCreateProgramWithSource
- clBuildProgram
- clReleaseProgram
- clGetProgramBuildInfo
- clKreateKernel
- clReleaseKernel
- clReleaseMemObject
- clSetKernelArg
- clEnqueueTask
- clEnqueueNDRangeKernel
- clReleaseEvent
- clFlush
- clGetDeviceIDsFromDX9MediaAdapterKHR
- clCreateFromDX9MediaSurfaceKHR
- clEnqueueAcquireDX9MediaSurfacesKHR
- clEnqueueReleaseDX9MediaSurfacesKHR

# Controlling the Sample



- Decode check box switches Intel Media SDK Decoder on/off
- OpenCL check box switches OpenCL post processing effect on/off
- OPENCL filer combo box enables you to choose current OpenCL program
- Param1 and Param2 sliders enable you to change parameters passed to OpenCL kernels
- Press F11 key to switch on/off full screen mode
- Press F2 key to show/hide currently executed OpenCL source code.

# References

- http://software.intel.com/en-us/articles/media/
- http://software.intel.com/en-us/vcsource/tools/media-sdk
- http://www.khronos.org/registry/cl/specs/opencl-1.2.pdf
- http://www.khronos.org/registry/cl