NVIDIA VIDEO CODEC SDK APPLICATION NOTE – DECODER

NVDEC_Application_Note| Jan 2018

DOCUMENT CHANGE HISTORY

NVDEC_Application_Note

Version	Date	Authors	Description of Change	Highlight
01	June 10, 2016	SM	Updated for Video Codec SDK 7.0	VP8&VP9 decoding
02	Nov 15, 2016	SM	Updated for Video Codec SDK 7.1	
03	Feb 15, 2017	SM	Updated for Video Codec SDK 8.0	10&12-bit decoding
04	Jan 10, 2018	SM	Updated for Video Codec SDK 8.1	Sample applications based on re-usable classes

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NVIDIA HARDWARE VIDEO DECODER

1. INTRODUCTION

NVIDIA GPUs contain a hardware-based decoder (referred to as NVDEC in this document) which provides fully-accelerated hardware-based video decoding for several popular codecs. With complete decoding offloaded to NVDEC the graphics engine and the CPU are free for other operations.

NVDEC supports much faster than real-time decoding which makes it suitable to be used for transcoding scenarios, in addition to video playback.

The hardware capabilities available in NVDEC are exposed through APIs herein referred to as NVDECODE APIs in the document. This document provides information about the capabilities of the NVDEC engine and the features exposed through NVDECODE APIs. The current document highlights *only* the changes in the current video codec SDK package with respect to the previous SDK packages. To know about the features exposed in earlier SDKs please refer to the earlier SDK package(s).

2. NVDEC CAPABILITIES

At a high level, capabilities of the NVDEC engine exposed through NVDECODE APIs are summarized in Table 1 and the features exposed through NVDECODE APIs in SDK 8.0 and SDK 8.1 are summarized in Table 2 and Table 3 respectively.

Table 1. NVDEC Hardware Capabilities

Hardware Features	**Fermi GPUs**	**Kepler GPUs**	**1st Gen Maxwell GPUs**	**2nd Gen Maxwell GPUs**	**Pascal GPUs**	**Volta GPUs**
VC1 Simple, Main & Advanced profiles	✓	✓	✓	✓	✓	✓
MPEG4 Simple and Advanced Simple Profiles	✓	✓	✓	✓	✓	✓
MPEG2 Simple & Main profiles	✓	✓	✓	✓	✓	✓
H.264 Baseline, Main, High Profiles	✓	✓	✓	✓	✓	✓
VP8*	×	×	×	✓	✓	✓
HEVC Main Profile*	×	×	×	✓	✓	✓
VP9 Profile 0*	×	×	×	✓	✓	✓
8192x8192 Decoding support (HEVC&VP9 only) **	×	×	×	×	✓	✓

* : Present in Select Maxwell Second Generation GPUs, all Pascal and Volta GPUs

**: Present in Select Pascal GPUs and all Volta GPUs

3. WHAT'S NEW IN SDK 8.0 AND SDK 8.1

Table 2. What is new in SDK 8.0

Features	Description
HEVC 10 bit decoding	Decoding support for 10 bit HEVC bit streams.
HEVC 12 bit decoding	Decoding support for 12 bit HEVC bit streams.
VP9 10 bit decoding	Decoding support for 10 bit VP9 bit streams.
VP9 12 bit decoding	Decoding support for 12 bit VP9 bit streams.
Decoding capability API	NVDECODE API to query hardware capabilities.
Decode latency reduction	Enables user to kick off decoding if the user is ready with one frame data.
Memory optimization for I/IDR-frame only decoding	Enables user to achieve memory optimization if the use-case involves decoding of I/IDR frames only. This support is currently available for H.264, support for other codecs will be added in future drivers. It can be enabled through a flag exposed the NVDECODE API.

Table 3. What is new in SDK 8.1

Feature	Description
Sample applications developed on re-usable classes.	Older sample applications have been replaced with new sample applications built on classes which abstract the functionalities exposed thorough the NVDECODEAPI. The clients can re-use the classes to develop their own applications. Most of the programming of the decoder is done inside the base classes which makes NVDECODEAPI simple and easy to use.

4. NVDEC PERFORMANCE

NVDEC natively supports multiple hardware decoding contexts with negligible context-switching penalty. As a result, subject to the hardware performance limit and available memory, an application can decode multiple videos simultaneously.

The hardware and software maintain the context for each decoding session, allowing many simultaneous decoding sessions to run in parallel with minimal context switch penalty. Table 4 provides an indicative data of the decoding performance of NVDEC across Kepler, Maxwell and Pascal GPU architectures for HEVC, VP9 and H.264 encoded

bitstream (approximately at 20 Mbps), at resolution of 1920 × 1080 and decoded frames in YUV 4:2:0 8 and 10-bit format. The decoding performance on Volta GPUs scales up with the performance numbers on Pascal GPUs in proportion to the GPU core clocks. Note that performance numbers in Table 4 are measured on GeForce hardware with certain clocks and thermal characteristics. The performance varies across GPU classes (e.g. Quadro, Tesla), and scales (almost) linearly with the clock speeds for each hardware.

Table 4. NVDEC decoding performance (indicative)

GPU Architecture	Codec	Performance in frames/second
Kepler	H.264	161
First generation Maxwell	H.264	417
Second generation Maxwell	H.264	426
	VP9	396
	HEVC	464
	HEVC Main10	444
Pascal	H.264	633
	VP9	627
	VP9 10 bit	622
	HEVC	708
	HEVC Main10	701

5. PROGRAMMING NVDEC

Video Codec SDK 8.0 and Video Codec SDK 8.1 are supported on R378 and R390 drivers and above respectively. Please refer to the SDK release notes for information regarding the minimum driver version which adds the support for the SDK.

Various capabilities of NVDEC are exposed to the application software via the NVIDIA proprietary application programming interface (NVDECODE APIs). Please refer to the Video Decoder Programming guide and the Reference Manual for details on using these APIs.

For a complete list of GPUs supporting hardware accelerated decoding please refer to https://developer.nvidia.com/nvidia-video-codec-sdk.

6. FFMPEG AND LIBAV SUPPORT

FFmpeg and Libav are the most popular multimedia transcoding tools used extensively for video and audio transcoding.

The video hardware accelerators in NVIDIA GPUs can be effectively used with FFmpeg and Libav to significantly speed up the video decoding, encoding and end-to-end transcoding at very high performance.

Note that FFmpeg and Libav are open-source projects and their usage is governed by specific licenses and terms and conditions for each of these projects.

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