



NVIDIA VIDEO CODEC SDK

Read Me

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Chapter 1. Read Me

1.1. Release Notes

What's new in Video Codec SDK v13.0?

Encode Features:

1. H264 interlaced, 10-bit and 4:2:2 encoding support on Blackwell GPUs
2. HEVC 4:2:2 encoding support on Blackwell GPUs
3. MV-HEVC: Support MultiView coding in HEVC
4. AV1 LTR: Support Long-Term Reference frame in AV1
5. Support AV1 and HEVC Temporal Layer encoding
6. Support AV1 and HEVC MaxCLL, Mastering Display, and ITU-T T.35 SEI/Metadata

Decode Features:

1. 2x H264 throughput and maximum supported resolution 8192x8192 on Blackwell GPUs.
2. H264 High10/High422 Profile support (exclude MBAFF) on Blackwell GPUs
3. HEVC Main 4:2:2 10/12 profile support (exclude YUV400) on Blackwell GPUs
4. Dynamic decode surfaces allocation

Package Contents

This package contains the following:

1. Sample applications demonstrating various encoding/decoding/transcoding capabilities
 - ▶ [.\Samples\]
2. NVIDIA video encoder API header
 - ▶ [.\Interface\nvEncodeAPI.h]
3. NVIDIA video decoder API headers
 - ▶ [.\Interface\cuviddec.h]

编码功能：1. 在 Blackwell 系列 GPU 上，支持 H.264 隔行扫描、10 位色深及 4:2:2 采样格式编码；

2. 在 Blackwell 系列 GPU 上，支持 HEVC（高效视频编码，即 H.265）4:2:2 采样格式编码；

3. MV-HEVC（多视角高效视频编码）：支持 HEVC 中的多视角编码功能；

4. AV1 LTR（长参考帧）：支持 AV1 编码格式中的长参考帧功能；

5. 支持 AV1 和 HEVC 的时间层编码（Temporal Layer Encoding）；

6. 支持 AV1 和 HEVC 的 MaxCLL（最大内容光亮度）、主显示信息（Mastering Display）以及 ITU-T T.35 补充增强信息 / 元数据（SEI/Metadata）

解码功能

1. 在 Blackwell 系列 GPU 上，H.264 解码吞吐量提升 2 倍，支持的最大分辨率可达 8192x8192。

2. 在 Blackwell 系列 GPU 上，支持 H.264 High10（10 位色深）/High422（4:2:2 采样格式）profile（不包含 MBAFF，即宏块自适应帧场编码）。

3. 在 Blackwell 系列 GPU 上，支持 HEVC Main 4:2:2 10/12 位色深profile（不包含 YUV400，即 4:0:0 采样格式）。

4. 支持动态解码表面分配（Dynamic Decode Surfaces Allocation）。

演示各类编码 / 解码 / 转码功能的示例应用程序

- ▶ [.\Interface\nvcuvid.h]
- 4. NVIDIA video decoder and encoder stub libraries **NVIDIA 视频解码器和编码器库**
 - ▶ [.\Lib\linux\stubs\x86_64\libnvcuvid.so]
 - ▶ [.\Lib\linux\stubs\x86_64\libnvidia-encode.so]
 - ▶ [.\Lib\linux\stubs\armv8-a\libnvcuvid.so]
 - ▶ [.\Lib\linux\stubs\armv8-a\libnvidia-encode.so]
 - ▶ [.\Lib\Win32\nvcuvid.lib]
 - ▶ [.\Lib\Win32\nvencodeapi.lib]
 - ▶ [.\Lib\x64\nvcuvid.lib]
 - ▶ [.\Lib\x64\nvencodeapi.lib]

The sample applications provided in the package are for demonstration purposes only and may not be fully tuned for quality and performance. Hence the users are advised to do their independent evaluation for quality and/or performance.

1.2. System Requirements

- ▶ **NVIDIA Maxwell/Pascal/Volta/Turing/Ampere/Ada/Hopper/Blackwell GPU** with hardware video accelerators
 - ▶ Refer to the **NVIDIA Video Codec SDK GPU Support Matrix web** page (<https://developer.nvidia.com/video-encode-and-decode-gpu-support-matrix-new>) for GPUs which support video encoding and decoding acceleration.
- ▶ Video Codec SDK can be downloaded from <https://developer.nvidia.com/nvidia-video-codec-sdk>
- ▶ Video Codec SDK is available in GitLab at <https://gitlab.com/nvidia/video/video-codec-sdk>
- ▶ **Documents can be browsed online** at <https://docs.nvidia.com/video-technologies/video-codec-sdk/index.html>
- ▶ Windows: Driver version 570 and above
- ▶ Linux: Driver version 570 and above
- ▶ CUDA 11.0 or higher Toolkit
- ▶ Visual Studio Solution and Linux Makefiles can now be generated using CMake. CMake 3.9 or later is required for SDK 10.0 and higher. Self-extracting scripts or installers for CMake can be downloaded from <https://cmake.org/download/>.

可通过 CMake 生成 Visual Studio 解决方案和 Linux Makefile。SDK 10.0 及更高版本需使用 CMake 3.9 或更高版本。

Windows Configuration Requirements

1. Vulkan SDK 依赖

- ▶ The Vulkan SDK needs to be installed in order to build and run the AppMotionEstimationVkCuda sample application. **若要构建并运行 "AppMotionEstimationVkCuda" 示例应用程序，需先安装 Vulkan SDK。**

2. FFmpeg 依赖配置

- ▶ To build sample applications that require FFmpeg headers and libraries, user must :

- ▶ Get FFMPEG LGPL shared build (version 7.1) from [BtbN repository](#). The package name is ffmpeg-n7.1-latest-win64-lgpl-shared-7.1.zip which can be found under Latest Auto-Build section in the BtbN github repository.
- ▶ During cmake configuration phase ([Section 1.3](#)), set the FFMPEG_DIR cmake variable to point to the extracted FFMPEG directory containing the headers and libraries, i.e. the directory that contains bin, lib and include subdirectories.

- ▶ `cmake -G"Visual Studio 16 2019" -A"x64" -DCMAKE_BUILD_TYPE=Release -DFFMPEG_DIR=<Path to FFMPEG directory> -DCMAKE_INSTALL_PREFIX=. . .`

- ▶ If the user does not want to build any of the apps that depends on FFMPEG, then they can set cmake variable SKIP_FFMPEG_DEPENDENCY to TRUE during cmake configuration phase to skip setting up of FFMPEG libraries. This will exclude all the applications that depends on FFMPEG from the generated Visual Studio solution.

- ▶ `cmake -G"Visual Studio 16 2019" -A"x64" -DCMAKE_BUILD_TYPE=Release -DSKIP_FFMPEG_DEPENDENCY=TRUE -DCMAKE_INSTALL_PREFIX=. . .`

- ▶ If SKIP_FFMPEG_DEPENDENCY cmake variable is not set, then FFMPEG_DIR cmake variable must be set to point to the directory containing FFMPEG libraries and headers, else an error will be thrown during the cmake configuration phase.

- ▶ To build VideoCodecSDK applications that are dependent on freeglut and GLEW libraries, user must set the GLEW_DIR, GLUT_DIR and GLUT_INC cmake variables to point to appropriate directories containing binaries and headers for GLEW and freeglut libraries.

- ▶ To setup GLEW libraries and headers required for the build, user must :

- ▶ Get prebuilt GLEW binaries (version 2.1.0) from [GLEW repository](#)

- ▶ During cmake configuration phase ([Section 1.3](#)), set the GLEW_DIR cmake variable to point to the extracted GLEW directory containing the headers and libraries, i.e. the directory that contains bin, lib and include subdirectories.

- ▶ `cmake -G"Visual Studio 16 2019" -A"x64" -DCMAKE_BUILD_TYPE=Release -DGLEW_DIR=<Path to GLEW directory> -DCMAKE_INSTALL_PREFIX=. . .`

- ▶ If the user does not want to build any application that depends on GLEW library, then they can set cmake variable SKIP_GL_DEPENDENCY to TRUE during cmake configuration phase to skip setting up of GLEW libraries required for the build. This will exclude applications that depends on GLEW from the generated Visual Studio solution.

- ▶ `cmake -G"Visual Studio 16 2019" -A"x64" -DCMAKE_BUILD_TYPE=Release -DSKIP_GL_DEPENDENCY=TRUE -DCMAKE_INSTALL_PREFIX=. . .`

- ▶ If the SKIP_GL_DEPENDENCY cmake variable is not set, then GLEW_DIR cmake variable must be set to point to the directory containing GLEW libraries and headers, else an error will be thrown during the cmake configuration phase.

- ▶ To setup freeglut libraries and headers required for the build, user must :

3. freeglut 与 GLEW 库依赖配置

- ▶ Get freeglut source code (version 3.4.0) from [GLUT repository](#). The download link for version 3.4.0 can be found under Stable releases section.
- ▶ Since freeglut does not distribute prebuilt libraries, user need to build the libraries from the fetched source code. Detailed instructions to build libraries from the freeglut source can be found in the README.cmake file in the freeglut source directory. Make sure to build the Release and Debug versions of freeglut as both are required for building VideoCodecSDK apps. After a successful build the lib/Debug subdirectory in freeglut build directory will have freeglut_static.lib and freeglutd.lib files, and the lib/Release subdirectory in freeglut build directory will have freeglut.lib and freeglut_static.lib files.
- ▶ During cmake configuration phase ([Section 1.3](#)), set the GLUT_DIR cmake variable to point to the freeglut build directory containing the locally built libraries, i.e. the directory that contains bin and lib subdirectories.
- ▶ Set the GLUT_INC cmake variable to point to the include directory in freeglut source directory, i.e. the directory that contain GL subdirectory which has the freeglut headers.
 - ▶ `cmake -G"Visual Studio16 2019" -A"x64" -DCMAKE_BUILD_TYPE=Release -DGLUT_DIR=<Path to freeglut build directory> -DGLUT_INC=<Path to freeglut include directory> -DCMAKE_INSTALL_PREFIX=. . .`
- ▶ If the user does not want to build any application that depends on freeglut library, then they can set cmake variable SKIP_GL_DEPENDENCY to TRUE during cmake configuration phase to skip setting up of freeglut libraries required for the build. This will exclude applications that depends on freeglut from the generated Visual Studio solution.
 - ▶ `cmake -G"Visual Studio 16 2019" -A"x64" -DCMAKE_BUILD_TYPE=Release -DSKIP_GL_DEPENDENCY=TRUE -DCMAKE_INSTALL_PREFIX=. . .`
- ▶ If the SKIP_GL_DEPENDENCY cmake variable is not set, then GLUT_DIR and GLUT_INC cmake variables must be set, else an error will be thrown during the cmake configuration phase.

4. AppEncD3D12 示例应用程序配置

- ▶ In order to build and run AppEncD3D12 sample application, Windows 20H1 or later is required. Visual Studio 2017 and above should be used for building and running this application. This application also requires [Agility SDK](#). To configure Agility SDK :
 - ▶ Download Agility SDK (D3D12SDKVersion 606 or later) and set the following cmake variables while generating the projects
 - ▶ AGILITY_SDK_BIN : to point to the directory containing the D3D12Core.dll for the platform.
 - ▶ AGILITY_SDK_VER : D3D12SDKVersion of the Agility SDK version used.

AppEncD3D12 project will not be generated if the above cmake variables are not set.

- ▶ On building AppEncD3D12, D3D12 directory which contains the required dlls from Agility SDK is created along with AppEncD3D12.exe. Make sure to copy the D3D12 directory along with AppEncD3D12.exe if the executable is moved to some other location

5. 环境变量要求

- ▶ In Windows, the following environment variables must be set to build the sample applications included with the SDK 在 Windows 系统中，需设置以下环境变量才能构建 SDK 中包含的示例应用程序：

- ▶ DXSDK_DIR: pointing to the DirectX SDK root directory.
- ▶ VULKAN_SDK: pointing to Vulkan SDK install directory.
- ▶ The CUDA Toolkit and the related environment variables are optional to install if the client has Video Codec SDK 8.0. However, they are mandatory if client has Video Codec SDK 8.1 or above on his/her machine.

6. 补充说明

- ▶ Plus all the requirements under [System Requirements](#) and [Common to all OS platforms](#)

Linux Configuration Requirements

1. 依赖库要求

- ▶ X11 and OpenGL, GLUT, GLEW libraries for video playback and display

2. CUDA Toolkit 要求

- ▶ CUDA Toolkit is mandatory if client has Video Codec SDK 8.1 or above on his/her machine.

3. FFmpeg 依赖配置

- ▶ Libraries and headers from the FFmpeg project which can be downloaded and installed using the distribution's package manager or compiled from source.
 - ▶ The sample applications have been compiled and tested against the libraries and headers from FFmpeg- 7.1. While configuring FFmpeg on Linux, it is recommended not to use 'disable-decoders' option. This configuration is known to have a channel error (XID 31) while executing sample applications with certain clips and/or result in an unexpected behavior.
- ▶ To build/use sample applications that depend on FFmpeg, users may need to
 - ▶ Add the directory (/usr/local/lib/pkgconfig by default) to the PKG_CONFIG_PATH environment variable. This is required by the Makefile to determine the include paths for the FFmpeg headers.
 - ▶ Add the directory where the FFmpeg libraries are installed to the LD_LIBRARY_PATH environment variable. This is required for resolving runtime dependencies on FFmpeg libraries.

4. 库说明

- ▶ Stub libraries (libnvcuvid.so and libnvidia-encode.so) have been included as part of the SDK package, in order to aid development of applications on systems where the NVIDIA driver has not been installed. The sample applications in the SDK will link against these stub libraries as part of the build process. However, users need to ensure that the stub libraries are not referenced when running the sample applications. A driver compatible with this SDK needs to be installed in order for the sample applications to work correctly.
- ▶ The Vulkan SDK needs to be installed in order to build and run the AppMotionEstimationVkCuda sample application.
- ▶ Plus all the requirements under [System Requirements](#) and [Common to all OS platforms](#)

Windows Subsystem for Linux (WSL) Configuration Requirements

- ▶ CUDA Toolkit is mandatory to use Video Codec SDK 8.1 and higher".
- ▶ Add the directory /usr/lib/wsl/lib to PATH environment variable, if not added by default. This is required to include path for the WSL libraries.
- ▶ Libraries and headers from the FFmpeg project which can be downloaded and installed using the distribution's package manager or compiled from source.
 - ▶ The sample applications have been compiled and tested against the libraries and headers from FFmpeg- 7.1. While configuring FFmpeg on WSL, it is recommended not to use 'disable-decoders' option. This configuration is known to have a channel error (XID 31) while executing sample applications with certain clips and/or result in an unexpected behavior.
- ▶ To build/use sample applications that depend on FFmpeg, users may need to
 - ▶ Add the directory (/usr/local/lib/pkgconfig by default) to the PKG_CONFIG_PATH environment variable. This is required by the Makefile to determine the include paths for the FFmpeg headers.
 - ▶ Add the directory where the FFmpeg libraries are installed to the LD_LIBRARY_PATH environment variable. This is required for resolving runtime dependencies on FFmpeg libraries.
- ▶ Plus all the requirements under [System Requirements](#) and [Common to all OS platforms](#)

Common to all OS platforms

- ▶ CUDA toolkit can be downloaded from <http://developer.nvidia.com/cuda/cuda-toolkit>
- ▶ Vulkan SDK can be downloaded from <https://vulkan.lunarg.com/sdk/home>. Alternatively, it can be installed by using the distribution's package manager.
- ▶ **NVIDIA does not provide support for FFMPEG;** therefore, it is the responsibility of end users and developers, to stay informed about any vulnerabilities or quality bugs reported against FFMPEG. Users are encouraged to refer to the official FFMPEG website and community forums for the latest updates, patches, and support related to FFMPEG binaries and act as they deem necessary.

1.3. Building Samples

Video Codec SDK uses CMake for building the samples. To build the samples, follow these steps:

Video Codec SDK 使用 CMake 构建示例应用程序，具体步骤如下

Windows:

1. Install all dependencies for Windows, as specified in [Windows Configuration Requirements](#)
2. Extract the contents of the SDK into a folder.

3. Create a subfolder named "build" in Video_Codec_SDK_x.y.z/Samples
4. Open a command prompt in the "build" folder and run the following command, depending upon the version of Visual Studio on your computer.

- ▶ Visual Studio 2022: `cmake -G"Visual Studio 17 2022" -A"x64" -DCMAKE_BUILD_TYPE=Release -DCMAKE_INSTALL_PREFIX=. ..`
- ▶ Visual Studio 2019: `cmake -G"Visual Studio 16 2019" -A"x64" -DCMAKE_BUILD_TYPE=Release -DCMAKE_INSTALL_PREFIX=. ..`
- ▶ Visual Studio 2017: `cmake -G"Visual Studio 15 2017" -A"x64" -DCMAKE_BUILD_TYPE=Release -DCMAKE_INSTALL_PREFIX=. ..`

To build VideoCodecSDK applications having FFMPEG, freeglut or GLEW dependencies, make sure that required headers and libraries are setup as mentioned in [Windows Configuration Requirements](#).

For AppEncD3D12 project to be generated, cmake variables AGILITY_SDK_BIN and AGILITY_SDK_VER has to be set as mentioned in [Windows Configuration Requirements](#). Add the following options to the above commands to set this cmake variables.

- ▶ `-DAGILITY_SDK_BIN=<Path to Agility SDK folder containing D3D12Core.dll>`
`-DAGILITY_SDK_VER=<D3D12SDKVersion of Agility SDK>`

AppEncD3D12 project will not be generated if the above options are omitted.

This command will generate the necessary Visual Studio project files in the "build" folder. You can open `NvCodec.sln` file in Visual Studio and build. Alternatively, following command can be used to build the solution:

```
cmake --build . --target install --config Release
```

The application binaries will be available in `Samples/build`. Please note that the applications are validated only for x64 platform.

Linux:

1. Install all dependencies for Linux, as specified in [Linux Configuration Requirements](#).
2. Extract the contents of the SDK into a folder.
3. Create a subfolder named "build" in Video_Codec_SDK_x.y.z/Samples (`" x.y.z "` 代表 SDK 的具体版本号)
4. Use the following command to build samples in release mode.

- ▶ `cmake -DCMAKE_BUILD_TYPE=Release ..`
- ▶ `make`
- ▶ `make install`

This will build and install the binaries of the sample applications. The application binaries will be available in the folder `Samples/build`.

Windows Subsystem for Linux:

1. Install all dependencies for Windows Subsystem for Linux, as specified in [Windows Subsystem for Linux \(WSL\) Configuration Requirements](#).
2. Follow the build and installation steps provided above for Linux. Applications using OpenGL and Vulkan will not be built.



Note: Layout for several structures in NVENCODE API header have been changed in this SDK. Users are therefore recommended to populate the structures accordingly.

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