



# NVIDIA VIDEO CODEC SDK SAMPLES GUIDE

**SDK Samples Guide**



## REVISION HISTORY

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1.0	Nov 14, 2014	YG	Initial release.
2.0	Nov 25, 2015	EY	Update to NVIDIA Video Codec SDK 6.0 Added NVCUVID decode samples
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# NVIDIA VIDEO CODEC SDK SAMPLES GUIDE

## INTRODUCTION

NVIDIA Video Codec SDK contains the following samples. The sample applications provided in the package are for demonstration purposes only and may not be fully tuned for Quality and/or Performance. Hence the users are advised to do their independent evaluation for Quality and/or performance.

### **NvEncoder**

This sample demonstrates the usage of basic encoding functionality.

### **NvEncoderCudaInterop**

This sample demonstrates the usage of encoding with CUDA surfaces.

### **NvEncoderD3DInterop**

This sample demonstrates the usage of encoding with D3D9 surfaces.

### **NvEncoderLowLatency**

This sample demonstrates the usage of low latency features such as Intra Refresh and Reference Picture Invalidations.

### **NvEncoderPerf**

This sample demonstrates the maximum achieved encoding performance.

### **NvTranscoder**

This sample demonstrates the transcoding capabilities of NVENC.

### **NvDecodeD3D9**

This sample demonstrates video decode with D3D9 visualization.

### **NvDecodeD3D11**

This sample demonstrates video decode with D3D11 visualization.

## NvDecodeGL

This sample demonstrates video decode and OpenGL visualization.

# 1. BUILDING SAMPLES

## Windows

The Windows SDK samples are built using the Visual Studio IDE. Solution files (\*.sln) are provided for Visual Studio 2010 and 2013.

Complete samples solution files exist at:

```
SDK7.0\Samples\
```

Each individual sample has its own set of solution files at:

```
SDK7.0\Samples\\
```

To build/examine all the samples at once, the complete solution files should be used. To build/examine a single sample, the individual sample solution files should be used

## Linux

The Linux samples are built using makefiles. To use the makefiles, change the current directory to the sample directory you wish to build, and run make:

```
$ cd <sample_dir>  
$ make
```

## 2. SAMPLES REFERENCE

### 2.1 NvEncoder

The NvEncoder application demonstrates the code for doing a basic encoding using NVENC. It supports both H.264 and HEVC encoding with different presets. The application allows to configure bitrate, frame rate, number of B frames and allows the user to select from the given Rate Control Modes.

The following are the options that may be specified for NvEncoder Application.

```
-i <string> : Specifies the input YUV File that has to be encoded
-o <string> : Specifies the output bitstream file
-size <integer integer> : Specifies the input resolution width and height

-codec <integer>: Specifies the codec (0) - H264 and (1) - HEVC
-preset <string> :  hq - High Quality Preset
                   hp - High Performance Preset
                   lowLatencyHP - Low Latency High Performance Preset
                   lowLatencyHQ - Low Latency High Quality Preset
-startf <integer> : Specifies the starting frame Index for encoding.
Default value is zero
-endf <integer> : Specifies the end frame Index for encoding. Default
value is zero
-fps <integer> : Specifies the encoding frame rate
-gopLength <integer> : Specifies the GOP (Group of Pictures) Length
-numB <integer> : Specifies the number of B frames
-bitrate <integer> : Specifies the encoding average bitrate
-vbvMaxBitrate <integer> : Specifies the VBV Maximum Bitrate
-vbvSize <integer> : Specifies the Encoding VBV/HRD Buffer Size
-rcmode <integer> : Specifies the Rate Control Mode.
                   0 : Constant QP
                   1 : Single Pass VBR
                   2 : Single Pass CBR
                   4 : Single Pass VBR with Minimum QP
                   8 : Two Pass Frame Quality
                   16 : Two Pass Frame Size Cap
                   32 : Two Pass VBR

-qp <integer> : Specifies the qp value for Constant QP Rate Control Mode
-deviceType <integer> : 0 - DX9 Device Type
                       1 - DX10 Device Type
                       2 - DX11 Device Type
                       3 - CUDA Device Type
-inputFormat <integer> : Specify the input format
                       0: YUV 420
```

- 1: YUV 444
- 2: YUV 420 10-bit
- 3: YUV 444 10-bit

**-help** : Prints Help Information

## 2.2 NvEncoderCudaInterop

The NvEncoderCudaInterop application demonstrates the interoperability of the NVENC hardware encoder with CUDA surfaces.

The following are the options that may be specified for NvEncoderCudaInterop Application.

- i** <string> : Specifies the input YUV File that has to be encoded
- o** <string> : Specifies the output bitstream file
- size** <integer integer> : Specifies the input resolution width and height
- startf** <integer> : Specifies the starting frame Index for encoding.  
Default value is zero
- endf** <integer> : Specifies the end frame Index for encoding. Default value is zero
- codec** <integer>: Specifies the codec (0) - H264 and (1) - HEVC
- preset** <string> : hq - High Quality Preset  
hp - High Performance Preset  
lowLatencyHP - Low Latency High Performance Preset  
lowLatencyHQ - Low Latency High Quality Preset
- fps** <integer> : Specifies the encoding frame rate
- gopLength** <integer> : Specifies the GOP (Group of Pictures) Length
- numB** <integer> : Specifies the number of B frames
- bitrate** <integer> : Specifies the encoding average bitrate
- vbvMaxBitrate** <integer> : Specifies the VBV Maximum Bitrate
- vbvSize** <integer> : Specifies the Encoding VBV/HRD Buffer Size
- rcmode** <integer> : Specifies the Rate Control Mode.
  - 0 : Constant QP
  - 1 : Single Pass VBR
  - 2 : Single Pass CBR
  - 4 : Single Pass VBR with Minimum QP
  - 8 : Two Pass Frame Quality
  - 16 : Two Pass Frame Size Cap
  - 32 : Two Pass VBR
- qp** <integer> : Specifies the qp value for Constant QP Rate Control Mode
- deviceID** <integer> : Specifies the GPU Device on which encoding will take place
- help** : Prints Help Information

## 2.3 NvEncoderD3DInterop

The NvEncoderD3DInterop application shows the interoperability with DX Surfaces. This application takes a directory of BMP files as an input and generates the output encoded file.

The following are the options that may be specified for NvEncoderD3DInterop Application.

```
-bmpfilePath <string> : Specifies the input RGB BMP file path
-o <string> : Specifies the output bitstream file

-size <integer integer> : Specifies the input resolution width and height
-codec <integer>: Specifies the codec (0) - H264 and (1) - HEVC

-preset <string> : hq - High Quality Preset
                    hp - High Performance Preset
                    lowLatencyHP - Low Latency High Performance Preset
                    lowLatencyHQ - Low Latency High Quality Preset

-fps <integer> : Specifies the encoding frame rate
-gopLength <integer> : Specifies the GOP (Group of Pictures) Length
-numB <integer> : Specifies the number of B frames
-bitrate <integer> : Specifies the encoding average bitrate
-vbvMaxBitrate <integer> : Specifies the VBV Maximum Bitrate
-vbvSize <integer> : Specifies the Encoding VBV/HRD Buffer Size
-rcmode <integer> : Specifies the Rate Control Mode.
                    0 : Constant QP
                    1 : Single Pass VBR
                    2 : Single Pass CBR
                    4 : Single Pass VBR with Minimum QP
                    8 : Two Pass Frame Quality
                    16 : Two Pass Frame Size Cap
                    32 : Two Pass VBR

-qp <integer> : Specifies the qp value for Constant QP Rate Control Mode
-help : Prints Help Information
```

## 2.4 NvEncoderLowLatency

The NvEncoderLowLatency application demonstrates the encoding for low latency streaming. The application shows the usage of features such as Intra Refresh and Reference Picture Invalidation, Dynamic Resolution Change and Dynamic Bitrate Change that are extremely useful in error prone streaming environments.



The following are the options that may be specified for NvEncoderLowLatency Application.

**-i** <string> : Specifies the input YUV File that has to be encoded  
**-o** <string> : Specifies the output bitstream file  
**-size** <integer integer> : Specifies the input resolution width and height  
**-codec** <integer>: Specifies the codec (0) - H264 and (1) - HEVC  
**-preset** <string> : hq - High Quality Preset  
hp - High Performance Preset  
lowLatencyHP - Low Latency High Performance Preset  
lowLatencyHQ - Low Latency High Quality Preset  
**-startf** <integer> : Specifies the starting frame Index for encoding.  
Default value is zero  
**-endf** <integer> : Specifies the end frame Index for encoding. Default  
value is zero  
**-fps** <integer> : Specifies the encoding frame rate  
**-bitrate** <integer> : Specifies the encoding average bitrate  
**-vbvSize** <integer> : Specifies the Encoding VBV/HRD Buffer Size  
**-rcmode** <integer> : Specifies the Rate Control Mode.  
0 : Constant QP  
1 : Single Pass VBR  
2 : Single Pass CBR  
4 : Single Pass VBR with Minimum QP  
8 : Two Pass Frame Quality  
16 : Two Pass Frame Size Cap  
32 : Two Pass VBR  
**-encCmdFile** <string> : Specifies the name of the encode command file. The  
commands can be given in the following format.  
<encode command> <frame number> <param0> < param1>...<param15>  
The following commands can be given in the encode command file:  
0 : Dynamic Resolution Command <param0 = new Width> <param1 = new Height>  
1 : Dynamic Bitrate Change <param0 = new bitrate> <param1 = new vbv size>  
2 : Force IDR Frame  
3 : Force Intra Refresh <param0 = intra refresh duration>  
4. Invalidate Reference Frame <param 0 = ref frame 0> <param1 = ref frame  
1>..  
<param15 = ref frame 15>  
**-intraRefresh** <boolean> : Specifies if Intra Refresh is used during  
Encoding  
**-intraRefreshPeriod** <integer> : Specifies the period for cyclic Intra  
Refresh  
**-intraRefreshDuration** <boolean> : Specifies the number of frames over which  
intra refresh takes place  
**-deviceID** <integer> : Specifies the GPU Device on which encoding will take  
place  
**-help** : Prints Help Information

## 2.5 NvEncoderPerf

The NvEncoderPerf application demonstrates the maximum encoding performance that may be achieved using NVENC. The application buffers a large number of input frames to prevent Disk I/O from being a bottleneck. The execution may be constrained by the Video Memory available on a system. The MAX\_FRAMES\_TO\_PRELOAD compile time variable determines the number of frames that are buffered and may be reduced on systems with constrained Video Memory. The performance numbers give an indication of the Encode Compute Power available on NVENC. Applications need to be pipelined/multi-threaded in order to achieve maximum encode performance in practice.

The following are the options that may be specified for NvEncoderPerf Application.

```
-i <string> : Specifies the input YUV File that has to be encoded
-o <string> : Specifies the output bitstream file
-size <integer integer> : Specifies the input resolution width and height
-codec <integer>: Specifies the codec (0) - H264 and (1) - HEVC
-preset <string> :  hq - High Quality Preset
                   hp - High Performance Preset
                   lowLatencyHP - Low Latency High Performance Preset
                   lowLatencyHQ - Low Latency High Quality Preset
-startf <integer> : Specifies the starting frame Index for encoding.
Default value is zero
-endf < integer> : Specifies the end frame Index for encoding. Default
value is zero
-fps <integer> : Specifies the encoding frame rate
-gopLength <integer> : Specifies the GOP (Group of Pictures) Length
-numB <integer> : Specifies the number of B frames
-bitrate <integer> : Specifies the encoding average bitrate
-vbvMaxBitrate <integer> : Specifies the VBV Maximum Bitrate
-rcmode <integer> : Specifies the Rate Control Mode.
                   0 : Constant QP
                   1 : Single Pass VBR
                   2 : Single Pass CBR
                   4 : Single Pass VBR with Minimum QP
                   8 : Two Pass Frame Quality
                   16 : Two Pass Frame Size Cap
                   32 : Two Pass VBR
-qp <integer> : Specifies the qp value for Constant QP Rate Control Mode
-devicetype <integer> : 0 - DX9 Device Type
                       1 - DX10 Device Type
                       2 - DX11 Device Type
                       3 - CUDA Device Type
-inputFormat <integer> : Specify the input format
                        0: YUV 420
                        1: YUV 444
                        2: YUV 420 10-bit
```

3: YUV 444 10-bit

**-help** : Prints Help Information

## 2.6 NvTranscoder

The NvTranscoder application demonstrates transcoding using NVENC. The transcoder application supports 8-bit depth H.264 encoded files for input that may be transcoded to H.264 or HEVC files.

The following are the options that may be specified for NvTranscoder Application.

**-i** <string> : Specifies the input file that has to be transcoded  
**-o** <string> : Specifies the output bitstream file  
**-size** <integer integer> : Specifies the input resolution width and height for encoding. If not specified, it will use the width and height of the input file.  
**-codec** <integer>: Specifies the codec (0) - H264 and (1) - HEVC  
**-preset** <string> : hq - High Quality Preset  
hp - High Performance Preset  
lowLatencyHP - Low Latency High Performance Preset  
lowLatencyHQ - Low Latency High Quality Preset  
**-fps** <integer> : Specifies the encoding frame rate. If not specified, it will use the fps of the input file.  
**-gopLength** <integer> : Specifies the GOP (Group of Pictures) Length  
**-numB** <integer> : Specifies the number of B frames  
**-bitrate** <integer> : Specifies the encoding average bitrate  
**-vbvMaxBitrate** <integer> : Specifies the VBV Maximum Bitrate  
**-vbvSize** <integer> : Specifies the Encoding VBV/HRD Buffer Size  
**-rcmode** <integer> : Specifies the Rate Control Mode.  
0 : Constant QP  
1 : Single Pass VBR  
2 : Single Pass CBR  
4 : Single Pass VBR with Minimum QP  
8 : Two Pass Frame Quality  
16 : Two Pass Frame Size Cap  
32 : Two Pass VBR  
**-qp** <integer> : Specifies the qp value for Constant QP Rate Control Mode  
**-deviceID** <integer> : Specifies the GPU Device on which encoding will take place  
**-help** : Prints Help Information

## 2.7 NvDecodeD3D9

The NvDecodeD3D9 application demonstrates the code for handling video decode of MPEG-2, VC-1, H.264, HEVC, VP8 and VP9 with NVDEC. The application takes a video file as input and renders the result to D3D9 window for display. The sample will use an included MPEG-2 file if no video file is provided.

The following are the options that may be specified for NvDecodeD3D9 Application.

NVDecodeD3D9 [parameters]

```
-i=source          - Input file for decoding
-o=output.yuv     - Output YUV file
-decodecuda       - Use CUDA for MJPEG (Available with 64+ CUDA cores)
-decodedxva       - Use NVDEC for decode.
-decodecuvid      - Use NVDEC for decode (optimized)
-vsync            - Enable vertical sync.
-novsync          - Disable vertical sync.
-repeatframe      - Enable frame repeats.
-updateall        - always update CSC matrices.
-displayvideo     - display video frames on the window
-nointerop        - create the CUDA context w/o using graphics interop
-readback         - enable readback of frames to system memory
-device=n         - choose a specific GPU device to decode video with
-nframestart=n   - set the start frame number
-nframeend=n     - set the end frame number
```

## 2.8 NvDecodeD3D11

The NvDecodeD3D9 application demonstrates the code for handling video decode of MPEG-2, VC-1, H.264, HEVC, VP8 and VP9 with NVDEC. The application takes a video file as input and renders the result to D3D11 window for display. The sample will use an included MPEG-2 file if no video file is provided.

The following are the options that may be specified for NvDecodeD3D11 Application.

NVDecodeD3D9 [parameters]

```
-i=source          - Input file for decoding
-o=output.yuv     - Output YUV file
-decodecuda       - Use CUDA for MJPEG (Available with 64+ CUDA cores)
-decodedxva       - Use NVDEC for decode.
-decodecuvid      - Use NVDEC for decode (optimized)
-vsync            - Enable vertical sync.
-novsync          - Disable vertical sync.
-repeatframe      - Enable frame repeats.
-updateall        - always update CSC matrices.
-displayvideo     - display video frames on the window
-nointerop        - create the CUDA context w/o using graphics interop
-readback         - enable readback of frames to system memory
-device=n         - choose a specific GPU device to decode video with
-nframestart=n   - set the start frame number
-nframeend=n     - set the end frame number
```

## 2.9 NvDecodeGL

The NvDecodeGL application demonstrates the code for handling video decode of MPEG-2, VC-1, H.264, HEVC, VP8 and VP9 with NVDEC. The application takes a video file as input and renders the result to an OpenGL window for display. The sample will use an included MPEG-2 file if no video file is provided.

The following are the options that may be specified for NvDecodeGL Application.

```
NVDecodeGL [parameters]
```

```
-i=source      - Input file for decoding
-o=output.yuv  - Output YUV file
-decodecuda    - Use CUDA for MJPEG (Available with 64+ CUDA cores)
-decodecuvid   - Use NVDEC for decode (optimized)
-vsync         - Enable vertical sync.
-novsync       - Disable vertical sync.
-repeatframe   - Enable frame repeats.
-updateall     - always update CSC matrices.
-displayvideo  - display video frames on the window
-nointerop    - create the CUDA context w/o using graphics interop
-readback      - enable readback of frames to system memory
-device=n      - choose a specific GPU device to decode video with
-nframestart=n - set the start frame number
-nframeend=n   - set the end frame number
```

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