TEGRA X1/TEGRA LINUX DRIVER PACKAGE MULTIMEDIA USER GUIDE

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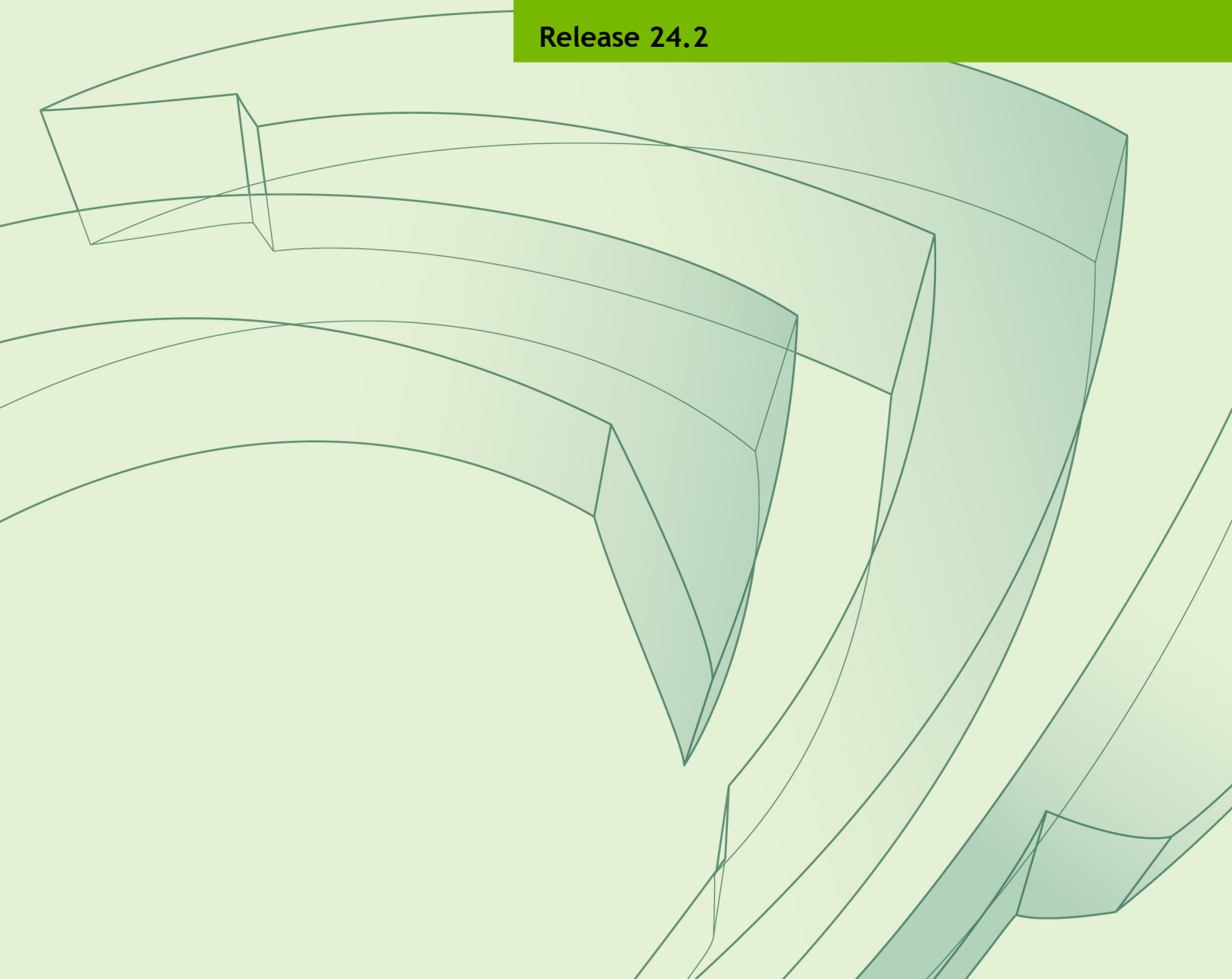
Advance Information | Subject to Change

Release 24.2



DOCUMENT CHANGE HISTORY

DA_07303

Version	Date	Authors	Description of Change
v1.0	01 May 2015	mzensius	Initial release.
v1.1	30 Jun 2015	mzensius	Added rotation and scaling commands, other new content.
v1.2	03 Nov 2015	emilyh	Changes for 23.1
v1.3	19 Nov 2015	mzensius	Added note for display export.
v1.4	17 Dec 2015	hlang	Updated gst-nvivafilter sample pipelines. Updated steps to build gstreamer manually.
v1.5	8 Jan 2016	kstone	Added nvvidconv interpolation method.
v1.5	29 Jan 2016	hlang	Additional syntax changes for 23.2 release
v2.0	11 May 2016	mzensius	Minor change to nvgstcapture options.
v3.0	12 Sep 2016	mzensius	Versioned for 24.2 release. Gstreamer-0.10 content removed. Also Adds Video Cropping example, interpolation methods for video scaling, EGLStream producer example, and an EGL Image transform example.

TABLE OF CONTENTS

TEGRA X1/TEGRA LINUX DRIVER PACKAGE MULTIMEDIA USER GUIDE

This document is a user guide for the Gstreamer version 1.0 based accelerated solution included in NVIDIA® Tegra® Linux Driver Package for Ubuntu Linux 16.04 on platforms including Tegra X1 devices.

This document contains the following sections:

GSTREAMER-1.0 INSTALLATION AND SETUP

This section describes how to install and configure Gstreamer.

To install Gstreamer-1.0

- Install Gstreamer-1.0 on the platform with the following command:

```
sudo apt-get install gstreamer1.0-tools gstreamer1.0-alsa gstreamer1.0-plugins-base gstreamer1.0-plugins-good gstreamer1.0-plugins-bad gstreamer1.0-plugins-ugly gstreamer1.0-libav
```

To check the Gstreamer-1.0 version

- Check the Gstreamer-1.0 version with the following command:

```
gst-inspect-1.0 --version
```

Gstreamer version 1.0 includes the following gst-omx video decoders:

Video Decoder	Description
omxh265dec	OpenMAX IL H.265 Video Decoder
omxh264dec	OpenMAX IL H.264 Video Decoder
omxmpeg4videodec	OpenMAX IL MPEG4 Video Decoder
omxvp8dec	OpenMAX IL VP8 Video Decoder
omxvp9dec	OpenMAX IL VP9 video decoder

Gstreamer version 1.0 includes the following gst-omx video encoders:

Video Encoders	Description
omxh264enc	OpenMAX IL H.264/AVC video encoder
omxh265enc	OpenMAX IL H.265/AVC video encoder
omxvp8enc	OpenMAX IL VP8 video encoder

Gstreamer version 1.0 includes the following gst-omx video sinks:

Video Sink	Description
nvoverlaysink	OpenMAX IL videosink element
nvhdmioverlaysink (deprecated)	OpenMAX IL HDMI videosink element

Gstreamer version 1.0 includes the following egl image video sinks:

Video Sink	Description
nveglglessink	EGL/GLES videosink element

Gstreamer version 1.0 includes the following proprietary NVIDIA plugins:

Video Sink	Description

nvvidconv	Video format conversion & scaling
nveglstreamsrc	Acts as Gstreamer Source Component, accepts EGLStream from EGLStream producer
nvvideosink	Video Sink Component. Accepts YUV-I420 format and produces EGLStream (RGBA)
nvegltransform	Video transform element for NVMM to EGLimage (supported with nveglglessink only)

Gstreamer version 1.0 includes the following libjpeg based JPEG image video encode/decode plugins:

Video Sink	Description
nvjpegenc	JPEG encoder element
nvjpegdec	JPEG decoder element

Note: Execute the following command on the target before starting the video decode pipeline using gst-launch or nvgstplayer.

export DISPLAY=:0

Start the X server with xinit &, if it is not already running.

DECODE EXAMPLES

The examples in this section show how you can perform audio and video decode with Gstreamer.

Note: Gstreamer version 0.10 support is deprecated in Linux for Tegra (L4T) Release 24.2. Use of Gstreamer version 1.0 is recommended for development.

Audio Decode Examples Using gst-launch-1.0

The following examples show how you can perform audio decode using Gstreamer-1.0.

AAC Decode (OSS software decode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.audio_0 ! queue ! avdec_aac ! audioconvert ! alsasink -e
```

AMR-WB Decode (OSS software decode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.audio_0 ! queue ! avdec_amrwb ! audioconvert ! alsasink -e
```

AMR-NB Decode (OSS software decode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.audio_0 ! queue ! avdec_amrnb ! audioconvert ! alsasink -e
```

MP3 Decode (OSS software decode)

```
gst-launch-1.0 filesrc location=<filename.mp3> ! mpegaudioparse !
avdec_mp3 ! audioconvert ! alsasink -e
```

Note: To route audio over HDMI, set the alsasink property `device` to the following:

`hw:Tegra,3`

Video Decode Examples Using gst-launch-1.0

The following examples show how you can perform video decode on Gstreamer-1.0.

H.264 Decode (NVIDIA accelerated decode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! h264parse ! omxh264dec ! nveglglessink -e
```

H.265 Decode (NVIDIA accelerated decode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! h265parse ! omxh265dec ! nvoverlaysink -e
```

Note: Decoding H.265 streams requires gstreamer version 1.4.x or later, including support for h265parse and qtdemux. See Gstreamer Build Instructions in this guide for details.

VP8 Decode (NVIDIA accelerated decode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! omxvp8dec ! nvoverlaysink -e
```

Note: When you do not use the primary display to render video, use the `display-id` property of `nvoverlaysink`. For example, refer to the pipeline below.

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! omxvp8dec ! nvoverlaysink display-id=1 -e
```

MPEG-4 Decode (NVIDIA accelerated decode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! mpeg4videoparse ! omxmpeg4videodec !
nveglglessink -e
```

Image Decode

```
gst-launch-1.0 filesrc location=<filename.jpg> ! nvjpegdec !
imagefreeze ! xvimagesink -e
```

ENCODE EXAMPLES

The examples in this section show how you can perform audio and video encode with Gstreamer.

Audio Encode Examples Using gst-launch-1.0

The following examples show how you can perform audio encode on Gstreamer-1.0.

AAC Encode (OSS software encode)

```
gst-launch-1.0 audiotestsrc ! 'audio/x-raw, format=(string)S16LE,
layout=(string)interleaved, rate=(int)44100, channels=(int)2' !
voaacenc ! qtmux ! filesink location=test.mp4 -e
```

AMR-WB Encode (OSS software encode)

```
gst-launch-1.0 audiotestsrc ! 'audio/x-raw, format=(string)S16LE,
layout=(string)interleaved, rate=(int)16000, channels=(int)1' !
voamrwbenc ! qtmux ! filesink location=test.mp4 -e
```

Video Encode Examples Using gst-launch-1.0

The following examples show how you can perform video encode with Gstreamer-1.0.

H.264 Encode (NVIDIA accelerated encode)

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)I420,
width=(int)640, height=(int)480' ! omxh264enc ! 'video/x-h264, stream-
format=(string)byte-stream' ! h264parse ! qtmux ! filesink
location=test.mp4 -e
```

H.265 Encode (NVIDIA accelerated encode)

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)I420,
width=(int)640, height=(int)480' ! omxh265enc ! filesink
location=test.h265 -e
```

VP8 Encode (NVIDIA accelerated encode)

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)I420,
width=(int)640, height=(int)480' ! omxvp8enc ! qtmux ! filesink
location=test.mp4 -e
```

MPEG-4 Encode (OSS software encode)

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)I420,
width=(int)640, height=(int)480' ! avenc_mpeg4 ! qtmux ! filesink
location=test.mp4 -e
```

H.263 Encode (OSS software encode)

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)I420,
width=(int)704, height=(int)576' ! avenc_h263 ! qtmux ! filesink
location=test.mp4 -e
```

Image Encode

```
gst-launch-1.0 videotestsrc num-buffers=1 ! 'video/x-raw,
width=(int)640, height=(int)480, format=(string)I420' ! nvjpegenc !
filesink location=test.jpg -e
```

Supported H.264 Encoder Features with Gstreamer-1.0

This section describes example gst-launch-1.0 usage for features supported by the NVIDIA accelerated H.264 encoder.

Note: Display detailed information on omxh264enc encoder properties with the `gst-inspect-1.0 omxh264enc` command.

Set I-frame interval

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
iframeinterval=100 ! qtmux ! filesink location=test.mp4 -e
```

Set temporal-tradeoff (the rate the encoder should drop frames)

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
temporal-tradeoff=1 ! qtmux ! filesink location=test.mp4 -e
```

Set rate control mode

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
control-rate=1 ! qtmux ! filesink location=test.mp4 -e
```

Set quantization range for I,P and B frame

The format for the range is the following:

```
”<I_range>:<P_range>:<B_range>”
```

Where `<I_range>`, `<P_range>` and `<B_range>` are each expressed as hyphenated values, as shown in the following example:

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc qp-
range="10,30:10,35:10:35" ! qtmux ! filesink location=test.mp4 -e
```

Set quality level

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
quality-level=0 ! qtmux ! filesink location=test.mp4 -e
```

Set profile

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
profile=8 ! qtmux ! filesink location=test.mp4 -e
```

Set **Set number of B frames beween two reference frame**

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
num-B-Frames=2 ! qtmux ! filesink location=test.mp4 –e
```

Insert SPS PPS at IDR

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
insert-sps-pps=1 ! qtmux ! filesink location=test.mp4 -e
```

Enable two pass cbr

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
EnableTwopassCBR=1 control-rate=2 ! qtmux ! filesink location=test.mp4
-e
```

Set virtual buffer size

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
vbv-size=10 ! qtmux ! filesink location=test.mp4 -e
```

Slice-header-spacing with spacing in terms of MB

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
slice-header-spacing=200 bit-packetization=0 ! qtmux ! filesink
location=test.mp4 -e
```

Slice header spacing with spacing in terms of number of bits

```
gst-launch-1.0 videotestsrc num-buffers=200 ! 'video/x-raw,
width=(int)1280, height=(int)720, format=(string)I420' ! omxh264enc
slice-header-spacing=1024 bit-packetization=1 ! qtmux ! filesink
location=test1.mp4 -e
```

CAMERA CAPTURE WITH GSTREAMER-1.0

For `nvgstcapture-1.0` usage information enter the following command:

```
nvgstcapture-1.0 --help
```

The `nvgstcapture-1.0` application uses the `v4l2src` plugin to capture still images and video.

The following table shows USB camera support.

USB Camera Support	Feature

YUV	Preview display
	Image capture (VGA, 640 x 480)
	Video capture (480p, 720p, H.264/VP8 encode)

raw-yuv Capture (I420 format) and preview display with xvimagesink

```
gst-launch-1.0 v4l2src device="/dev/video0" ! "video/x-raw, width=640,
height=480, format=(string)I420" ! xvimagesink -e
```

VIDEO PLAYBACK WITH GSTREAMER-1.0

For nvgstplayer-1.0 usage information enter the following command:

```
nvgstplayer-1.0 --help
```

Video can be output to HD displays using the HDMI connector on the platform. The Gstreamer-1.0 application supports currently the following video sinks:

Overlay Sink (Video playback on overlay in full-screen mode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux !
h264parse ! omxh264dec ! nvoverlaysink –e
```

nveglglessink (Windowed video playback, NVIDIA EGL/GLES videosink)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux !
h264parse ! omxh264dec ! nveglglessink –e
```

This nvgstplayer-1.0 application supports specific window position and dimensions for windowed playback:

```
nvgstplayer-1.0 –i <filename> --window-x=300 –window-y=300 –window-
width=500 –window-height=500
```

VIDEO FORMAT CONVERSION WITH GSTREAMER-1.0

The NVIDIA proprietary `nvvidconv` Gstreamer-1.0 plug-in allows conversion between OSS (raw) video formats and NVIDIA video formats. The `nvvidconv` plug-in currently supports the format conversions described in this section

raw-yuv Input Formats

Currently `nvvidconv` supports the I420, UYVY, and NV12 raw-yuv input formats.

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)UYVY,
width=(int)1280, height=(int)720' ! nvvidconv !
'video/x-raw(memory:NVMM), format=(string)I420’ ! omxh264enc !
'video/x-h264,
stream-format=(string)byte-stream' ! h264parse ! qtmux ! filesink
location=test.mp4 -e
```

raw-gray Input Formats

Currently `nvvidconv` supports the GRAY8 raw-gray input format.

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)GRAY8,
width=(int)1280, height=(int)720’ ! nvvidconv !
'video/x-raw(memory:NVMM), format=(string)I420’ ! omxh264enc !
'video/x-h264,
stream-format=(string)byte-stream' ! h264parse ! qtmux ! filesink
location=test.mp4 –e
```

raw-yuv Output Formats

Currently `nvvidconv` supports the I420 and UYVY the raw-yuv output formats.

```
gst-launch-1.0 filesrc location=640x480_30p.mp4 ! qtdemux ! queue !
h264parse ! omxh264dec ! nvvidconv ! 'video/x-raw, format=(string)UYVY'
! xvimagesink –e
```

raw-gray Output Formats

Currently `nvvidconv` supports the GRAY8 raw-gray output format.

```
gst-launch-1.0 filesrc location=640x480_30p.mp4 ! qtdemux ! queue !
h264parse ! omxh264dec ! nvvidconv ! 'video/x-raw,
format=(string)GRAY8' ! videoconvert ! xvimagesink –e
```

VIDEO SCALING WITH GSTREAMER-1.0

The NVIDIA proprietary `nvvidconv` Gstreamer-1.0 plug-in also allows you to perform video scaling. The `nvvidconv` plug-in currently supports scaling with the format conversions described in this section.

raw-yuv Input Formats

Currently `nvvidconv` supports the I420, UYVY, and NV12 raw-yuv input formats for scaling.

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)I420,
width=(int)1280, height=(int)720' ! nvvidconv !
'video/x-raw(memory:NVMM), width=(int)640, height=(int)480,
format=(string)I420' ! omxh264enc ! 'video/x-h264, stream-
format=(string)byte-stream' ! h264parse ! qtmux ! filesink
location=test.mp4 -e
```

raw-gray Input Formats

Currently `nvvidconv` supports the GRAY8 raw-gray input format for scaling.

```
gst-launch-1.0 videotestsrc ! 'video/x-raw, format=(string)GRAY8,
width=(int)1280, height=(int)720’! nvvidconv !
'video/x-raw(memory:NVMM), width=(int)640, height=(int)480,
format=(string)I420' !  omxh264enc ! 'video/x-h264, stream-
format=(string)byte-stream' ! h264parse ! qtmux ! filesink
location=test.mp4 -e
```

raw-yuv Output Formats

Currently `nvvidconv` supports the I420 and UYVY raw-yuv output formats for scaling.

```
gst-launch-1.0 filesrc location=1280x720_30p.mp4 ! qtdemux ! queue !
h264parse ! omxh264dec ! nvvidconv ! 'video/x-raw, format=(string)I420,
width=640, height=480' ! xvimagesink -e
```

raw-gray Output Formats

Currently `nvvidconv` supports the GRAY8 raw-gray output format for scaling.

```
gst-launch-1.0 filesrc location=1280x720_30p.mp4 ! qtdemux ! queue !
h264parse ! omxh264dec ! nvvidconv ! 'video/x-raw,
```

```
format=(string)GRAY8, width=640, height=480' ! videoconvert !
xvimagesink -e
```

NVIDIA Input and Output Formats

Currently `nvvidconv` supports the NVIDIA input and output formats for scaling described in the following table:

Input Format	Output Format
NV12	NV12
I420	I420
	RGBA

To scale between NVIDIA formats

- Scale between NVIDIA Formats with the following commands:

```
gst-launch-1.0 filesrc location=1280x720_30p.mp4 ! qtdemux ! h264parse
! omxh264dec ! nvvidconv ! 'video/x-raw(memory:NVMM), width=(int)640,
height=(int)480, format=(string)I420' ! omxh264enc ! qtmux ! filesink
location=test.mp4 -e

gst-launch-1.0 filesrc location=1280x720_30p.mp4 ! qtdemux ! h264parse
! omxh264dec ! nvvidconv ! 'video/x-raw(memory:NVMM), width=(int)640,
height=(int)480, format=(string)RGBA' ! nvoverlaysink -e

gst-launch-1.0 nvcamerasrc fpsRange="30 30" ! 'video/x-
raw(memory:NVMM), width=(int)1920, height=(int)1080,
format=(string)I420, framerate=(fraction)30/1' ! nvtee ! nvvidconv !
'video/x-raw(memory:NVMM), width=(int)640, height=(int)480,
format=(string)NV12' ! omxh264enc ! qtmux ! filesink location=test.mp4
-e
```

VIDEO CROPPING WITH GSTREAMER-1.0

The NVIDIA proprietary nvvidconv Gstreamer-1.0 plug-in also allows you to perform video cropping.

To crop video

- Crop video with the following commands:

```
gst-launch-1.0 filesrc location=<filename_1080p.mp4> ! qtdemux !
h264parse ! omxh264dec ! nvvidconv left=400 right=1520 top=200
bottom=880 ! nvoverlaysink display-id=1 -e
```

VIDEO TRANSCODE WITH GSTREAMER-1.0

You can perform video transcoding between the following video formats.

H.264 Decode to VP8 Encode (NVIDIA-accelerated decode to NVIDIA-accelerated encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! h264parse ! omxh264dec ! nvvidconv ! 'video/x-
raw(memory:NVMM), format=(string)I420’ ! omxvp8enc ! qtmux name=mux !
filesink location=<Transcoded_filename.mp4> demux.audio_0 ! queue !
aacparse ! mux.audio_0 -e
```

VP8 Decode to H.264 Encode (NVIDIA-accelerated decode to NVIDIA-accelerated encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux
name=demux demux.video_0 ! queue ! omxvp8dec ! nvvidconv ! 'video/x-
raw(memory:NVMM), format=(string)I420’ ! omxh264enc ! qtmux name=mux !
filesink location=<Transcoded_filename.mp4> demux.audio_0 ! queue !
aacparse ! mux.audio_0 -e
```

MPEG-4 Decode to VP8 Encode (NVIDIA-accelerated decode to NVIDIA-accelerated encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux
name=demux demux.video_0 ! queue ! mpeg4videoparse ! omxmpeg4videodec !
nvvidconv ! 'video/x-raw(memory:NVMM), format=(string)I420’ !
omxvp8enc ! qtmux name=mux ! filesink
location=<Transcoded_filename.mp4> demux.audio_0 ! queue ! aacparse !
mux.audio_0 -e
```

MPEG-4 Decode to H.264 Encode (NVIDIA-accelerated decode to NVIDIA-accelerated encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux
name=demux demux.video_0 ! queue ! mpeg4videoparse ! omxmpeg4videodec !
nvvidconv ! 'video/x-raw(memory:NVMM), format=(string)I420’ !
omxh264enc ! qtmux name=mux ! filesink
location=<Transcoded_filename.mp4> demux.audio_0 ! queue ! aacparse !
mux.audio_0 -e
```

H.264 Decode to MPEG-4 Encode (NVIDIA-accelerated decode to OSS software encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux
name=demux demux.video_0 ! queue ! h264parse ! omxh264dec ! nvvidconv !
```

```
avenc_mpeg4 ! qtmux name=mux ! filesink
location=<Transcoded_filename.mp4> demux.audio_0 ! queue ! aacparse !
mux.audio_0 -e
```

VP8 Decode to MPEG-4 Encode (NVIDIA-accelerated decode to OSS software encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux
name=demux demux.video_0 ! queue ! omxvp8dec ! nvvidconv !
avenc_mpeg4 ! qtmux name=mux ! filesink
location=<Transcoded_filename.mp4> demux.audio_0 ! queue ! aacparse !
mux.audio_0 -e
```

H.264 Decode to Theora Encode (NVIDIA-accelerated decode to OSS software encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! h264parse ! omxh264dec ! nvvidconv ! theoraenc
! oggmux name=mux ! filesink location=<Transcoded_filename.ogg> -e
```

VP8 Decode to Theora Encode (NVIDIA-accelerated decode to OSS software encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! omxvp8dec ! nvvidconv ! theoraenc ! oggmux
name=mux ! filesink location=<Transcoded_filename.ogg> -e
```

MPEG-4 Decode to Theora Encode (NVIDIA-accelerated decode to OSS software encode)

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux
demux.video_0 ! queue ! mpeg4videoparse ! omxmpeg4videodec !
nvvidconv ! theoraenc ! oggmux name=mux ! filesink
location=<Transcoded_filename.ogg> -e
```

CUDA VIDEO POST-PROCESSING WITH GSTREAMER-1.0

This section describes Gstreamer-1.0 plug-ins for CUDA post-processing operations.

gst-videocuda

This GStreamer-1.0 plug-in performs CUDA post-processing operations on decoder-provided EGL images and render video using `nveglglessink`.

The following are sample pipeline creation and application usage commands.

Sample decode pipeline

```
gst-launch-1.0 filesrc location=<filename_h264_1080p.mp4> ! qtdemux
name=demux ! h264parse ! omxh264dec ! videocuda ! nveglglessink max-
lateness=-1 -e
```

Sample decode command

```
nvgstplayer-1.0 -i <filename_h264_1080p.mp4> --svd="omxh264dec" --
svc="videocuda" --svs="nveglglessink # max-lateness=-1" --disable-
vnative --no-audio --window-x=0 --window-y=0 --window-width=960 --
window-height=540
```

gst-nvivafilter

This NVIDIA proprietary GStreamer-1.0 plug-in performs pre/post and CUDA post-processing operations on CSI camera captured or decoded frames, and renders video using overlay video sink or video encode.

Sample decode pipeline

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux ! h264parse !
omxh264dec ! nvivafilter cuda-process=true customer-lib-
name="libnvsample_cudaprocess.so" ! 'video/x-raw(memory:NVMM),
format=(string)NV12' ! nvoverlaysink -e
```

Sample CSI Camera pipeline

```
gst-launch-1.0 nvcamerasrc fpsRange="30 30" ! 'video/x-
raw(memory:NVMM), width=(int)3840, height=(int)2160,
format=(string)I420, framerate=(fraction)30/1' ! nvtee ! nvivafilter
cuda-process=true customer-lib-name="libnvsample_cudaprocess.so" !
'video/x-raw(memory:NVMM), format=(string)NV12' ! nvoverlaysink -e
```

Note: See nvsample_cudaprocess_src.tbz2 package for the libnvsample_cudaprocess.so library sources. A Sample CUDA implementation of libnvsample_cudaprocess.so can be replaced by a custom CUDA implementation.

VIDEO ROTATION WITH GSTREAMER-1.0

The NVIDIA proprietary `nvvidconv` Gstreamer-1.0 plug-in also allows you to perform video rotation operations.

The following table shows the supported values for the `nvvidconv flip-method` property.

Flip Method	Property value
identity - no rotation (default)	0
counterclockwise - 90 degrees	1
rotate - 180 degrees	2
clockwise - 90 degrees	3
horizontal flip	4
upper right diagonal flip	5
vertical flip	6
upper-left diagonal	7

Note: Get information on nvvidconv flip-method property with the `gst-inspect-1.0 nvvidconv` command.

To rotate video 90 degrees counterclockwise

- To rotate video 90 degrees in a counterclockwise direction, enter the following command.

```
gst-launch-1.0 filesrc location=<filename.mp4>! qtdemux name=demux !
h264parse ! omxh264dec ! nvvidconv flip-method=1 ! 'video/x-
raw(memory:NVMM), format=(string)I420' ! nvoverlaysink -e
```

To rotate video 90 degrees clockwise

- To rotate video 90 degrees in a clockwise direction, enter the following command:

```
gst-launch-1.0 filesrc location=<filename.mp4> ! qtdemux name=demux !
h264parse ! omxh264dec ! nvvidconv flip-method=3 ! 'video/x-
raw(memory:NVMM), format=(string)I420’ !
omxh264enc ! qtmux ! filesink location=test.mp4 -e
```

Rotate 180 degrees

- To rotate video 180 degrees, enter the following command:

```
gst-launch-1.0 nvcamerasrc fpsRange="30.0 30.0" ! 'video/x-
raw(memory:NVMM), width=(int)1920, height=(int)1080,
format=(string)I420, framerate=(fraction)30/1' ! nvtee ! nvvidconv
flip-method=2 ! 'video/x-raw(memory:NVMM), format=(string)I420' !
nvoverlaysink -e
```

To scale and rotate video 90 degrees counterclockwise

- To scale and rotate video 90 degrees counterclockwise, enter the following command:

```
gst-launch-1.0 filesrc location=<filename_1080p.mp4> ! qtdemux !
h264parse ! omxh264dec ! nvvidconv flip-method=1 ! 'video/x-
raw(memory:NVMM), width=(int)480, height=(int)640, format=(string)I420'
! nvoverlaysink -e
```

To scale and rotate video 90 degrees clockwise

- To scale and rotate video 90 degrees clockwise, enter the following command:

```
gst-launch-1.0 nvcamerasrc fpsRange="30.0 30.0" ! 'video/x-
raw(memory:NVMM), width=(int)1920, height=(int)1080,
format=(string)I420, framerate=(fraction)30/1' ! nvtee ! nvvidconv
flip-method=3 ! 'video/x-raw(memory:NVMM), width=(int)480,
height=(int)640, format=(string)I420' ! nvoverlaysink -e
```

To scale and rotate video 180 degrees

- To scale and rotate video 180 degrees, enter the following command:

```
gst-launch-1.0 filesrc location=<filename_1080p.mp4> ! qtdemux !
h264parse ! omxh264dec ! nvvidconv flip-method=2 ! 'video/x-
raw(memory:NVMM), width=(int)640, height=(int)480, format=(string)I420'
! nvoverlaysink -e
```

INTERPOLATION METHODS FOR VIDEO SCALING

The NVIDIA proprietary `nvvidconv` Gstreamer-1.0 plug-in allows you to choose the interpolation method used for scaling.

The following table shows the supported values for the `nvvidconv interpolation-method` property.

Interpolation Method	Property Value
nearest	0
linear	1
smart (default)	2
bilinear	3

Note: Get information on `nvvidconv interpolation-method` property

with the gst-inspect-1.0 `nvvidconv` command.

To use bilinear interpolation method for scaling

- Enter the following command:

```
gst-launch-1.0 filesrc location=<filename_1080p.mp4>! qtdemux
name=demux ! h264parse ! omxh264dec ! nvvidconv interpolation-
method=3 ! 'video/x-raw(memory:NVMM), format=(string)I420,
width=1280, height=720' ! nvoverlaysink -e
```

EGLSTREAM PRODUCER EXAMPLE

The NVIDIA-proprietary nveglstreamsrc and nvvideosink Gstreamer-1.0 plug-ins allow simulation of an EGLStream producer pipeline (for preview only.)

To simulate an EGLStream producer pipeline

- Enter the following command:

```
nvgstcapture-1.0 --camsrc=3 --nvvideosink-create-eglstream
```

EGL IMAGE TRANSFORM EXAMPLE

The NVIDIA proprietary nvegltransform Gstreamer-1.0 plug-in allows simulation of an EGLImage transform pipeline.

To simulate an EGL Image transform pipeline

- Enter the following command:

```
rmc
gst-launch-1.0 filesrc location=<filename_h264_1080p.mp4>  ! qtdemux
! h264parse ! omxh264dec ! nvvidconv ! 'video/x-raw(memory:NVMM),
width=(int)1280, height=(int)720, format=(string)NV12' !
nvegltransform ! nveglglessink -e
```

GSTREAMER BUILD INSTRUCTIONS

This section provides a procedure for building current versions of gstreamer.

Using gst-install to build GStreamer

This release contains the `git-install` script to install a specific GStreamer version. To install, execute:

```
gst-install [--prefix=<install_path>] [--version=<version>]
```

Where:

- `<install_path>` is the location where you are installing GStreamer
- `<version>` is the GStreamer version

For example:

```
gst-install --prefix=/home/ubuntu/gst-1.6.0 --version=1.6.0
```

To build GStreamer manually

1. Download the latest version of gstreamer available at:

   ```
   http://gstreamer.freedesktop.org/src/
   ```

   The following are the files you need from version 1.6.0:

   - gstreamer-1.6.0.tar.xz
   - gst-plugins-base-1.6.0.tar.xz
   - gst-plugins-good-1.6.0.tar.xz
   - gst-plugins-bad-1.6.0.tar.xz
   - gst-plugins-ugly-1.6.0.tar.xz

2. Install needed packages with the following command:

```
sudo apt-get install build-essential dpkg-dev flex bison autotools-
dev automake liborc-dev autopoint libtool gtk-doc-tools
libgstreamer1.0-dev
```

3. In the ~/ directory, create a gst_<version> directory, where <version> is the version number of gstreamer you are building.
4. Copy the downloaded tar.xz files to the gst_<version> directory.
5. Uncompress the tar.xz files in the gst_<version> directory.
6. Set the PKG_CONFIG_PATH with the following command:

```
export PKG_CONFIG_PATH=/home/ubuntu/gst_1.6.0/out/lib/pkgconfig
```

7. Build gstreamer (in this example, gstreamer-1.6.0) with the following commands:

```
./configure --prefix=/home/ubuntu/gst_1.6.0/out
make
make install
```

8. Build gst-plugins-base-1.6.0 with the following commands:

```
sudo apt-get install libxv-dev libasound2-dev libtheora-dev libogg-
dev libvorbis-dev
./configure --prefix=/home/ubuntu/gst_1.6.0/out
make
make install
```

9. Build gst-plugins-good-1.6.0 with the following commands:

```
sudo apt-get install libbz2-dev libv4l-dev libvpx-dev libjack-
jackd2-dev libsoup2.4-dev libpulse-dev
./configure --prefix=/home/ubuntu/gst_1.6.0/out
make
make install
```

10. Obtain and build gst-plugins-bad-1.6.0 with the following commands:

```
sudo apt-get install faad libfaad-dev libfaac-dev
./configure --prefix=/home/ubuntu/gst_1.6.0/out
make
make install
```

11. Obtain and build gst-plugins-ugly-1.6.0 with the following commands:

```
sudo apt-get install libx264-dev libmad0-dev
./configure --prefix=/home/ubuntu/gst_1.6.0/out
make
make install
```

12. Set the LD_LIBRARY_PATH environment variable with the following command:

```
export LD_LIBRARY_PATH=/home/ubuntu/gst_1.6.0/out/lib/
```

13. Copy the `nvidia gstreamer-1.0` libraries to the `gst_1.6.0` plugin directory using the following command:

```
cd /usr/lib/arm-linux-gnueabihf/gstreamer-1.0/
cp libgstnv* libnvgst* libgstomx.so ~/gst_1.6.0/out/lib/gstreamer-
1.0/
```

The `nvidia gstreamer-1.0` libraries include:

```
libgstnvcamera.so
libgstnveglglessink.so
libgstnveglstreamsrc.so
libgstnvegltransform.so
libgstnvivafilter.so
libgstnvvidconv.so
libgstnvvideosink.so
libnvgstjpeg.so
libgstomx.so
```

NVGSTCAPTURE-1.0 OPTION REFERENCE

This section describes the options available in the `nvgstcapture-1.0` application.

NVGSTCAPTURE APPLICATION OPTIONS

Nvgstcapture-1.0 command-line options are described in the following table.

Application Options		
Option	**Description**	**Notes**
--prev_res	Preview area width and height, e.g., --prev_res=3	-
--cus-prev-res	Custom preview width and height for CSI only	-
--image_res	Image width and height, e.g., --image_res=3	-
--video_res	Video width and height, e.g., --video_res=3	-
-m, --mode	Capture mode.	1-Still 2-Video
-v, --video_enc	Video encoder type.	0-H.264 (hardware) 1-VP8(hardware) 2-MPEG-4 (software) 3-H.263 (software)
-b, --enc-bitrate	Video encoding Bit-rate(in bytes)	Example: --enc-bitrate=4000000
--enc-profile	Video encoder profile (only for H.264)	0-Baseline 1-Main 2-High
-j, --image_enc	Image encoder type.	0-jpeg_SW[jpegenc] 1-jpeg_HW[nvjpegenc]
-k, --file_type	Container file type.	0-MP4

		1-3GP 2-AVI
--cap-dev-node	Video capture device node.	0=/dev/video0[default] 1=/dev/video1 2=/dev/video2
--svs	Chain for video preview.	-
--file-name	File name for capture.	“nvcamtest” is used by default.
--camsrc	Camera source.	0-v4l2 1-csi (default) 2-videotest 3-eglstream
--orientation	Camera sensor orientation value(CSI only)	-
-w, --whitebalance	White balance value for capture. (CSI only)	-
-s, --scene-mode	Camera scene-mode value. (CSI only)	-
-c, --color-effect	Camera color effect value. (CSI only)	-
--auto-exposure	Camera auto-exposure value. (CSI only)	-
--flash	Camera flash value. (CSI only)	-
--flicker	Camera flicker detection and avoidance mode value. (CSI only)	-
--contrast	Camera contrast value. (CSI only)	-
--saturation	Camera saturation value. (CSI only)	-
--edge-enhancement	Camera edge enhancement value. (CSI only)	-
--tnr_strength	Camera TNR strength value. (CSI only)	-
--tnr_mode	Camera TNR mode value. (CSI only)	-
--sensor-id	Camera Sensor ID value. (CSI only)	-
--display-id	Display ID value (for nvoverlaysink only)	-
--eglstream-id	Select EGLStreamProducerID value (for CSI EGLStream). Default is 0.	-
--aeRegion	ROI for AE coordinates (top, left, bottom, right) and weight, in that order. (CSI only)	Example: --aeRegion="30 40 200 200 1.2"
--wbRegion	ROI for AWB coordinates (top, left, bottom, right) and weight in that order. (CSI only)	Example: --wbRegion="30 40 200 200 1.2"

--fpsRange	FPS range values (low, high) (CSI only)	Example: --fpsRange="15 30"
--wbGains	White Balance (WB) gains values (R, GR, GB, B) in that order. (CSI only)	Example: --wbGains="1.2 1.4 0.8 1.6"
--overlayConfig	Overlay Configuration Options index and coordinates in (index, x_pos, y_pos, width, height) order.	Example: --overlayConfig="0, 0, 0, 1280, 720"
--enable-meta	Enables Sensor MetaData reporting if the sensor has the capability to provide the embedded metadata.	-
--eglConfig	EGL window Coordinates (x_pos y_pos) in that order.	Example: --eglConfig=”50 100”
--enable-exif	Enable Exif data	-
--dump-bayer	Dump bayer data in addition to image capture	-
--exposure-time	Capture exposure time value. (CSI only)	Example: --exposure-time=0.033
Help Options		
Option	**Description**	**Notes**
-h, --help	Show help options.	-
--help-all	Show all help options.	-
--help-gst	Show Gstreamer options.	-

CSI CAMERA SUPPORTED RESOLUTIONS

CSI camera supports the following image resolutions:

- 640x480
- 1280x720
- 1920x1080
- 2104x1560
- 2592x1944
- 2616x1472
- 3840x2160
- 3896x2192
- 4208x3120

CSI CAMERA RUNTIME COMMANDS

CSI camera runtime commands are described in the following table.

Command	Description	Notes
h	Help	-
q	Quit	-
mo:<value>	Set capture mode	1-image 2-video
gmo	Get capture mode	-
sid:<value>	Set sensor ID	-
gsid	Get sensor ID	-
so:<val>	Set sensor orientation	(0): none (1): Rotate counter-clockwise 90 degrees (2): Rotate 180 degrees (3): Rotate clockwise 90 degrees
gso	Get sensor orientation	-
wb:<value>	Set white balance mode	0-off 1-auto 2-incandescent 3-fluorescent 4-warm-fluorescent 5-daylight 6-cloudy-daylight 7-twilight 8-shade
gwb	Get white balance mode	-
scm:<value>	Set scene mode	0-face-priority 1-action 2-portrait 3-landscape 4-night 5-night-portrait 6-theatre 7-beach 8-snow 9-sunset 10-steady-photo 11-fireworks 12-sports 13-party 14-candle-light 15-barcode
gcm	Get scene mode	-
ce:<value>	Set color effect mode	1-off 2-mono 3-negative 4-solarize 5-sepia 6-posterize 7-aqua

gce	Get color effect mode	-
ae:<value>	Set auto-exposure mode	1-off 2-on 3-OnAutoFlash 4-OnAlwaysFlash 5-OnFlashRedEye
gae	Get auto exposure mode	-
f:<value>	Set flash mode	0-off 1-on 2-torch 3-auto
gf	Get flash mode	-
fl:<value>	Set flicker detection and avoidance mode	0-off 1-50 Hz 2-60 Hz 3-auto
gfl	Get flicker detection and avoidance mode	-
ct:<value>	Set contrast	0-1, e.g., ct:0.75
gct	Get contrast	-
st:<value>	Set saturation	0-2, e.g., st:1.25
gst	Get saturation	-
ext:<value>	Set exposure time (in seconds)	e.g., ext:0.033
gext	Get exposure time	-
ee:<value>	Set edge enhancment	0-1, e.g., ee:0.75
gee	Get edge enhancment	-
aer:<value>	Set ROI coordinates for AE (top, left, bottom, right) and weight	e.g., aer:20 20 400 400 1.2
gaer	Get ROI for AE	-
wbr:<value>	Set ROI coordinates for AWB (top, left, bottom, right) and weight	e.g., wbr:20 20 400 400 1.2
gwbr	Get ROI for AE	-
fpsr:<value>	Set FPS range (low, high)	e.g., fpsr:15 30
gfpsr	Get FPS range	-
wbg:<value>	Set WB gains (R, GR, GB, B)	e.g., wbg:1.2 2.2 0.8 1.6
gwbg	Get WB gains	-
ts:<value>	Set TNR strength	0-1, e.g., ts:0.75
gts	Get TNR strength	-
tnr:<value>	Set TNR mode	0-Original 1-Outdoor-low-light 2-Outdoor-medium-light

		3-Outdoor-high-light 4-Indoor-low-light 5-Indoor-medium-light 6-Indoor-high-light
gtnr	Get TNR mode	-
j	Capture one image.	-
jx<delay>	Capture after a delay of <delay>, e.g., jx5000 to capture after a 5-second delay	-
j:<value>	Capture <count> number of images in succession, e.g., j:6 to capture 6 images.	-
1	Start recording video	-
0	Stop recording video	-
gpcr	Get preview resolution	-
gicr	Get image capture resolution	-
gvcr	Get video capture resolution	-

USB CAMERA RUNTIME COMMANDS

USB camera runtime commands are described in the following table.

Command	Description	Notes
h	Help	-
q	Quit	-
mo:<value>	Set capture mode	1-image 2-video
gmo	Get capture mode	-
j	Capture one image.	-
jx<delay>	Capture after a delay of <delay>, e.g., jx5000 to capture after a 5-second delay	-
j:<value>	Capture <count> number of images in succession, e.g., j:6 to capture 6 images.	-
1	Start recording video	-
0	Stop recording video	-
pcr:<value>	Set preview resolution	0-176x144 1-320x240 2-640x480 3-1280x720
gpcr	Get preview resolution	-

gicr	Get image capture resolution	-
gvcr	Get video capture resolution	-
br:<value>	Set encoding bit rate (in bytes)	e.g., br:4000000
gbr	Get encoding bit rate	-
cdn:<value>	Set capture device node	0-/dev/video0 1-/dev/video1 2-/dev/video2
gcdn	Get capture device node	-

Runtime video encorder configuration options are described in the following table.

Command	Description	Notes
br:<val>	Sets encoding bit-rate (in bytes)	Example: br:4000000
gbr	Gets encoding bit-rate (in bytes)	-
ep:<val>	Sets encoding profile (for H.264 only)	Example: ep:1 (0): Baseline (1): Main (2): High
gep	Gets encoding profile (for H.264 only)	-
Enter+f	Forces IDR frame on video encoder (for H.264 only)	-

NOTES

- The nvgstcapture-1.0 application generates image and video output files in the same directory as the application itself.
- Filenames for image and video content are in the formats `nvcamtest<counter>.jpg` and `nvcamtest<counter>.mp4` respectively, where <counter> is a counter starting from 0 every time you run the application. Rename or move files between runs to avoid overwriting results you want to save.
- Default H.263 encode resolution is 704x576(4CIF) in AVI container formats.Use `--camsrc=2` for H.263 video encode.
- The nvgstcapture-1.0 application supports native capture(video only) mode by default.
- Advance features, like setting zoom, brightness, exposure, and whitebalance levels, are not supported for USB camera.

VIDEO ENCODER FEATURES

Gstreamer-1.0 support the following features, respectively:

Video Encoder Feature	gst-omx (nvgstcapture-1.0)
H.264 Baseline / Main profile	✓
bitrate	✓
insert-spsppsatidr	✓
rc-mode	-
control-rate	✓
iframeinterval	✓
qp-range	✓
temporal-tradeoff	✓
bit-packetization	✓
quality-level	✓
low-latency	✓
slice-header spacing	✓
force-IDR	✓
profile	✓
vbv-size	✓
sliceintrarefreshenable	✓
sliceintrarefreshinterval	✓

SUPPORTED CAMERAS

This section describes the supported cameras.

CSI CAMERAS

- Jetson TX1 currently supports only 1 CSI RAW BAYER sensor.
- The platform has been validated with a single OV5693 sensor for capture on L4T.
- The camera module is interfaced with the Tegra platform via MIPI-CSI.
- Tested using the nvgstcapture application.

USB 2.0 CAMERAS

The following cameras have been validated on Tegra platforms for Android and L4T with USB 2.0 ports. These cameras are UVC compliant.

- Logitech c920 (preferred)

  http://www.logitech.com/en-in/product/hd-pro-webcam-c920

- Logitech c910

  http://www.amazon.com/Logitech-HD-Pro-Webcam-C910/dp/B003M2YT96

- Rocketfish™ HD Webcam Pro

  http://www.rocketfishproducts.com/products/computer-accessories/RF-HDWEB10.html?supportTab=open

- Creative Live! Cam Socialize HD 1080

  http://support.creative.com/Products/ProductDetails.aspx?catID=218&CatName=Web+Cameras&subCatID=231&subCatName=MIDI+Keyboards&prodID=20165&prodName=Live!+Cam+Socialize+HD+1080&bTopTwenty=1&VARSET=prodfaq:PRODFAQ_20165,VARSET=CategoryID:218

INDUSTRIAL CAMERA DETAILS

The following USB 3.0 Industrial cameras are supported on Jetson-TX1 under L4T:

- See3CAM_CU130

  http://www.e-consystems.com/UltraHD-USB-Camera.asp

  - USB 3.0
  - UVC compliant
  - 3840 x 2160 at 30 FPS | 4224 x 3156 at 13 FPS
  - Purpose - Embedded Navigation
  - Test using the `nvgstcapture` app.
  - Issues encountered:
    - FPS cannot be fixed. Changes based on exposure.
    - FPS cannot be changed. Needs payment to vendor to get the support added to their firmware.

- MQ003CG-CM

  http://www.ximea.com/en/products/usb3-vision-cameras-xiq-line/mq003cg-cm

  - USB 3.0
  - Non-UVC compliant
  - 640 x 480 at 500 FPS
  - Purpose - Embedded Robotics
  - Installation and Verification on Jetson TX1:

    1. Add the user to the plugdev group:

       ```
       sudo gpasswd -a ubuntu plugdev
       ```

       Re-login.

    2. Install tools for the application:

       ```
       apt-get install libgstreamer0.10-dev libgstreamer-plugins-
       base0.10-dev libgtk2.0-dev g++"
       ```

    3. Download XIMEA Linux Software Package:

       ```
       wget http://www.ximea.com/downloads/recent/XIMEA_Linux_SP.tgz
       ```

       Untar:

       ```
       tar xzf XIMEA_Linux_SP.tgz
       cd package
       ```

4. Open the install file and replace

```
elif [ "${arch:0:3}" == "arm" ]
```

with

```
elif [ "$arch" == "aarch64" ]
```

5. Start installation:

```
./install
```

Install USB3 camera:

```
./install -cam_usb30
```

Install graphical desktop:

```
sudo apt-get update
sudo apt-get install ubuntu-desktop
```

6. Reboot. The system boots to the graphical desktop.
7. To access sample apps:
   - xiSample: run from `/package/bin` folder
   - streamViewer
     - `make` from `/package/examples/streamViewer` folder
     - run from the `/package/bin` folder

Notice

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