



NVIDIA TEGRA LINUX DRIVER PACKAGE

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Developers' Guide



Note: Apparent hyperlinks in this document are a legacy of the HTML version and may not operate as expected in the PDF version.

Overview

Welcome to *NVIDIA Tegra Linux Driver Package Developers' Guide*. Engineers can use this document to learn about working with NVIDIA® Tegra® Linux Driver Package, sometimes referred to as Linux for Tegra (L4T).

Important: This documentation is preliminary and subject to change. Please see your NVIDIA representative for additional information and to request documentation updates.

Read the following sections to get started using Tegra Linux Driver Package.

- [Package Manifest](#)—describes the top level directories and files installed when expanding the release TAR file.
- [Getting Started](#)—provides requirements and set up information to help you get started using the package.
- [U-Boot Guide](#)—describes the U-Boot implementation for L4T.
- [Software Features](#)—describes the software features supported by the release.
- [Licenses](#)—provides license information for Tegra and 3rd-party software.
- [FAQ](#)—provides answers to frequently asked questions.
- [Glossary](#)—provides definitions of key terms.

Package Manifest

The NVIDIA® Tegra® Linux Driver Package is provided in the following tar file:

`<platform>_Tegra-Linux-R15.beta.1.0_<release_type>.tbz2`

where `<release_type>` is `armel` (for softfp ABI) or `armhf` (for hard-float ABI).

The following table lists the top level directories and files that are created when you expand the tar file.

Filename	Description
<code>./rootfs</code>	Directory containing <code>README.txt</code> .
<code>./rootfs/README.txt</code>	This file explains how to copy the sample file system here.
<code>./kernel</code>	-
<code>./bootloader</code>	-
<code>./bootloader/<platform></code>	-
<code>./bootloader/<platform>/BCT</code>	-
<code>./bootloader/<platform>/cfg</code>	-
<code>./nv_tegra</code>	-
<code>./nv_tegra/nv_sample_apps</code>	-
<code>./nv_tegra/nv_sample_apps/nvgst</code>	-
<code>./nv_tegra/x</code>	-
<code>./apply_binaries.sh</code>	A script to apply <code>nv_tegra</code> components.
<code>./flash.sh</code>	A script that flashes the boot loader and kernel from the package.
<code>./zImage_to_uimg.sh</code>	A script that creates the <code>vmlinux.uimg</code> with <code>mkimage</code> for use as the kernel image for u-boot

Note: The `<platform>` in `/bootloader/<platform>` specifies the development system. For Tegra 3 series code-name “cardhu”, for Tegra 2 series code-name “ventana”.

Documentation

Tegra Linux Driver Package also includes the following documentation:

- `Tegra_Linux_Driver_Package_Release_Notes_<ver>.pdf`

- Tegra_Linux_Driver_Package_Documents_<ver>.tar

Where <ver> is the version of the release, such as R15.beta.

Section Overview

This section provides information about the contents of the tar file in the Tegra Linux Driver Package and includes the following topics:

- [Kernel](#)
- [Boot Loader](#)
- [NV Tegra](#)
- [Base TGZ](#)

Kernel

This section describes the major components included in the `./kernel` directory.

Filename	Description
<code>./install_3rdparty.sh</code>	A script to download the toolchain to the local computer.
<code>./zImage</code>	A kernel binary image.
<code>./kernel_sync.sh</code>	A script to download the source code that the kernel binary image was built from.
<code>./LICENSE</code>	A license file for “GNU GENERAL PUBLIC LICENSE”.
<code>./kernel_supplements.tbz2</code>	Loadable kernel modules specific to the kernel defconfig enabled for the device.
<code>./kernel/vmlinux.uimg</code>	A u-boot kernel binary image.

Boot Loader

This section describes the files provided in the `./bootloader` directory.

Filename	Description
<code>./mkbootimg</code>	A tool used for img creation.
<code>./nvflash</code>	The NVIDIA flashing tool.
<code>./LICENSE.mkbootimg</code>	A license file for the mkbootimg tool.
<code>./mkimage</code>	A u-boot tool for vmlinux.uimg creation
<code>./<platform></code>	<platform> specifies the development system, cardhu for Tegra3, or ventana for Tegra 2 devices.
<code>./<platform>/fastboot.bin</code>	The boot loader binary file.
<code>./<platform>/<platform>_emmc.hush</code>	The local storage device u-boot hush file.
<code>./<platform>/<platform>_net.hush</code>	The network u-boot hush file.

./<platform>/uboot_sync.sh	A script to download the source code that the u-boot binary image was built from.
./<platform>/u-boot.bin	The u-boot binary image.
./<platform>/BCT/ cardhu_12Mhz_H5TC2G83BFR_333Mhz_1GB_emmc_SDIN5C2-16G_x8.bct	BCT for Cardhu.
./<platform>/BCT/ E1186_Hynix_1GB_H5TC2G83BFR- PBA_375MHz_110622_sdmmc4_x8.bct	BCT for Cardhu.
./<platform>/BCT/ ventana_A03_12MHz_EDB8132B1PB6DF_300Mhz_1GB_emmc_T HGBM1G6D4EBAI4.bct	BCT for Ventana.
./<platform>/cfg/gnu_linux_fastboot_emmc_full.cfg	Platform-specific CFG file.
./<platform>/cfg/gnu_linux_fastboot_emmc.cfg	Platform-specific CFG file.

NV Tegra

This section describes the major components included in the `./nv_tegra` directory.

Filename	Description
./LICENSE	Tegra software license.
./LICENSE.gst-openmax	License file for libgstomx.so.
./x/tegra_drv.abi5.so	Tegra X driver ABI 5.
./x/tegra_drv.abi6.so	Tegra X driver ABI 6.
./x/tegra_drv.abi7.so	Tegra X driver ABI 7.
./x/tegra_drv.abi8.so	Tegra X driver ABI 8.
./x/tegra_drv.abi10.so	Tegra X driver ABI 10.
./x/tegra_drv.abi11.so	Tegra X driver ABI 11.
./x/tegra_drv.abi12.so	Tegra X driver ABI 12.
./base.tgz	The NVIDIA driver components.
./nv_sample_apps/nvgst/nvgstapps.tgz	The nvgstplayer and nvgstcapture multimedia test applications.

Base TGZ

This section describes the files included in the `./base.tgz` file.

Filename	Description
./etc	-
./home	-
./lib	-
./usr	-
./etc/nv_tegra_release	The tegra driver versioning file.

./etc/X11	-
./etc/X11/xorg.conf	The xorg configuration file.
./home/ubuntu	-
./lib/firmware/	-
./lib/firmware/nvavp_os_*.bin	NVIDIA AVP Kernel firmware
Restricted codec: ./lib/firmware/nvavp_vid_ucode_alt.bin	NVIDIA video decoders
Restricted codec: ./lib/firmware/nvmm_jpegenc.axf	JPEG Encoder. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_manager.axf	Multimedia Manager Kernel driver. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_aacdec.axf	AAC decoder. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_adtsdec.axf	ADTS decoder running on AVP. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_mp3dec.axf	MP3 decoder. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_mpeg4dec.axf	MPEG-4 video decoder. Not included in the base release; available through a separate software license agreement.
./lib/firmware/nvrm_avp.bin	AVP kernel firmware.
Restricted codec: ./lib/firmware/nvmm_h264dec.axf	H.264 video decoder. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_h264dec2x.axf	H.264 video decoder driver. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_service.axf	NVIDIA multimedia services firmware. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_jpegdec.axf	JPEG image decoder. Not included in the base release; available through a separate software license agreement.
Restricted codec: ./lib/firmware/nvmm_wavdec.axf	WAV decoder. Not included in the base release; available through a separate software license agreement.
./lib/firmware/nvrm_avp*.bin	AVP kernel firmware.
./lib/modules/	-
./usr	-
./usr/lib	-
./usr/lib/xorg	-

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./usr/lib/gstreamer-0.10/libgstomx.so	OpenMax Driver.
./usr/lib/libcgdrv.so	NVIDIA Tegra OpenGL ES 2.0 shader compiler.
./usr/lib/libEGL.so	OpenGL ES driver file.
./usr/lib/libGLESv1_CM.so	OpenGL ES driver file.
./usr/lib/libGLESv2.so	OpenGL ES driver file.
./usr/lib/libKD.so	OpenKODE driver.
./usr/lib/libnvapputil.so	Host (x86) shared object for application utilities.
./usr/lib/libnvavp.so	User-space interface to the AVP for audio/video acceleration via the nvavp kernel driver
./usr/lib/libnvcwm.so	Compositing Window Manager library.
./usr/lib/libnvdc.so	DC driver file.
./usr/lib/libnvddk_2d.so	DDK 2D.
./usr/lib/libnvddk_2d_v2.so	DDK 2D.
./usr/lib/libnvddk_blockdevmgr.so	NVIDIA block device driver
./usr/lib/libnvddk_disp.so	Display abstraction driver file.
./usr/lib/libnvddk_kbc.so	NVIDIA keyboard controller driver
./usr/lib/libnvddk_mipihsi.so	High-speed interface for MIPI.
./usr/lib/libnvddk_nand.so	NVIDIA NAND driver
./usr/lib/libnvddk_sdio.so	NVIDIA MMC driver
./usr/lib/libnvddk_se.so	NVIDIA Security Engine driver
./usr/lib/libnvddk_snor.so	NVIDIA SNOR driver
./usr/lib/libnvddk_spif.so	NVIDIA SPIF driver
./usr/lib/libnvddk_usbphy.so	NVIDIA USB phy driver
./usr/lib/libnv dioconverter.so	Multimedia DIO converter.
./usr/lib/libnv dispatch_helper.so	NvRM daemon dispatch helper.
./usr/lib/libnv dispmgr_d.so	Display Manager interface.
./usr/lib/libnv dispmgr_impl_do.so	Server-side Display manager driver file.
./usr/lib/libnvflash.so	NvFlash helper library.
./usr/lib/libnvmm_audio.so	Audio codecs and components.
./usr/lib/libnvmm_camera.so	Multimedia camera driver file.
./usr/lib/libnvmm_contentpipe.so	Content pipe implementation (file source abstraction).
./usr/lib/libnvmm_image.so	Image codecs.
./usr/lib/libnvmm_manager.so	Multimedia Manager kernel driver.
./usr/lib/libnvmm_misc.so	Miscellaneous multimedia components.
./usr/lib/libnvmm_parser.so	Parser.
./usr/lib/libnvmm_service.so	Multimedia Framework kernel services HAL.

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./usr/lib/libnvm_m.so	NVIDIA Multimedia Framework.
./usr/lib/libnvm_m_utils.so	Multimedia Framework utilities.
./usr/lib/libnvm_m_video.so	NVIDIA Multimedia Framework.
./usr/lib/libnvm_m_writer.so	3GP writer block on CPU.
/usr/lib/libnvmmlite.so	NVIDIA Multimedia driver
/usr/lib/libnvmmlite_audio.so	NVIDIA Multimedia audio driver
/usr/lib/libnvmmlite_image.so	NVIDIA Multimedia image driver
/usr/lib/libnvmmlite_utils.so	NVIDIA Multimedia utilities
/usr/lib/libnvmmlite_video.so	NVIDIA Multimedia video driver
./usr/lib/libnvodm_disp.so	ODM kit display driver.
./usr/lib/libnvodm_dvtuner.so	Applies to: Ventana and Cardhu releases: Tegra development platform ODM adaptation for digital TV tuner.
./usr/lib/libnvodm_hdmi.so	ODM kit HDMI driver.
./usr/lib/libnvodm_imager.so	Tegra development platform ODM adaptation for imager.
./usr/lib/libnvodm_misc.so	ODM kit.
./usr/lib/libnvodm_query.so	ODM Query interface.
./usr/lib/libnvomxilclient.so	OpenMAX IL client.
./usr/lib/libnvomx.so	OpenMAX IL implementation.
./usr/lib/libnvos.so	NVIDIA OS abstraction library.
/usr/lib/libnv_parser.so	Parser used for NVIDIA NvMMLite
./usr/lib/libnvrm_graphics_impl.so	API layer in RM daemon
./usr/lib/libnvrm_graphics.so	Resource Manager (NvRM) graphics host, AVP communication library, and graphics drivers
./usr/lib/libnvrm_impl.so	NvRm.
./usr/lib/libnvrm.so	Resource Manager kernel interface.
./usr/lib/libnvsm.so	NVIDIA shader manager library.
./usr/lib/libnvtestio.so	Target (ARM) shared object for test I/O utilities.
./usr/lib/libnvtestresults.so	Test results shared object.
./usr/lib/libnvtvmr.so	Multimedia Tegra video mixer/renderer.
./usr/lib/libnvwinsys_kd.so	OpenKODE winsys interface.
./usr/lib/libnvwinsys.so	Winsys library.
./usr/lib/libnvwsi.so	NVIDIA windowing system integration for EGL.
./usr/sbin	-
./usr/lib/xorg/modules/drivers/tegra_drv.abi*.so	Tegra X abi drivers.

Getting Started

This section contains information to help you get started using this pre-release of NVIDIA® Tegra® Linux Driver Package. It covers the following topics:

- [Requirements](#)
- [Boot Options](#)
- [Setting Up Your Environment](#)
- [Setting Up Your File System](#)
- [Configuring NFS Root on the Linux Host](#)
- [Setting Power Saving Options](#)
- [Flashing the Boot Loader and Kernel](#)
- [Synchronizing the Kernel Sources and Tool Chain](#)
- [Building the NVIDIA Kernel](#)
- [Configuring ALSA](#)
- [Using Example Applications](#)

Requirements

The following lists the requirements to use this Tegra Linux Driver Package release:

- Host PC running Linux. Ubuntu 10.04 is used in examples in this document, but other distributions should also work.
- A kernel image (zImage). Tegra Linux Driver Package does contain a kernel image (zImage), and you can also download and rebuild from source. After you have a zImage, you can create the `vmlinux.uing` that is used for U-Boot booting. For more information, see [Synchronizing the Kernel Sources and Tool Chain](#) in this guide.
- Boot loader. This can be Fastboot or U-Boot. Flashing on Tegra 3 series (code-named Cardhu) and Tegra 2 series (code-named Ventana) developer boards requires a boot loader. This boot loader can be either the Fastboot utility or U-Boot, both of which are included in this release.
- A rootfs device which can be an SD card, a USB hard disk, or USB stick formatted to EXT3, or it is also possible to use the target device's internal memory, or your Linux Host PC hard-drive through NFS.
- (Cardhu) A USB Micro-B plug to USB Std A female cable to plug into the board's recovery port.
- (Ventana) A USB Micro-B plug to Std A female cable to plug into the board's recovery port [J10].

- The NVIDIA binaries provided for Tegra 2 devices code-named “Ventana” may be able to support the Tegra 2 devices code-named “Harmony”.

Boot Options

It is currently possible to boot Tegra Linux Driver Package on the Tegra 2 series Ventana developer board, as well as Tegra 3 series Cardhu with a root file system from:

- USB stick or USB hard disk
- SD card
- eMMC
- Network file system (NFS)

Setting Up Your Environment

The following subsections contain information to help you get started using this pre-release of Tegra Linux Driver Package. They cover the following topics:

- [Extracting Tegra Linux Driver Package](#)
- [Setting Up Your Board](#)

Extracting Tegra Linux Driver Package

Note: The procedures in this document assume you extract the release package in ~/.

To extract Tegra Linux Driver Package

- Extract the package manually by executing the following command:

```
$ sudo tar -vxjf <platform>_Tegra-Linux-R15.beta.1.0_<release_type>.tbz2
```

where <release_type> is armel (for softfp ABI).

Setting Up Your Board

Tegra Linux Driver Package requires a Tegra 2 series developer board (Ventana), or a Tegra 3 series (Cardhu) as well as a host PC running Linux. Please consult your board documentation for steps on how to setup and configure your board.

Prerequisites

- You need a device specified above in the “Boot Options” topic (formatted to EXT3). (It can also be a memory card with a USB adapter.) You also need a mini-B USB male-to-USB Std A female cable to plug into the board’s recovery port [J3].

- In your environment for the developer board:
 - If your developer board is Ventana set:


```
$ export TARGET_BOARD=ventura
```
 - If your developer board is Cardhu set:


```
$ export TARGET_BOARD=cardhu
```

Setting Up Your File System

This section describes the steps for setting up your file system. You must set up the root file system and copy the file system to your boot device.

- [About the Root File System](#)
- [Setting Up the Root File System](#)
- [Determining the Success of a Driver Update](#)
- [Installing Additional Packages](#)
- [Configuring NFS Root on Your Linux Host](#)

About the Root File System

To replicate the sample file system, the `ttys0.conf` and `nv.conf` files have been added. Both are accessible from the provided sample file system and are placed in the user-generated file system, should you decide to replicate the rootfs.

The provided sample root file system was created with Rootstock 0.1.99.4 using this command:

```
$ sudo rootstock --fqdn tegra-ubuntu --login ubuntu --password
ubuntu --imagesize 1G -d natty --seed ubuntu-minimal,xserver-
xorg-core,xinit,xterm,alsa-utils,wireless-
tools,wpa_supplicant,x11-xserver-utils,openssh-client,openssh-
server
```

This creates a file system with the hostname `tegra-ubuntu`, the username `ubuntu`, and the password `ubuntu`.

Note: The provided sample target file system does not come with pre-generated ssh host keys. These host keys can be re-generated with the following command:

```
$ ssh-keygen -t rsa -f /etc/ssh/ssh_host_rsa_key
```

View the `ssh-keygen` man page for other `-t` options.

We have also made the following changes:

- Added: `/etc/init/{ttyS0.conf, nv*, wpa_supplicant.conf}`
- Modified: `/etc/{init/ssh.conf, X11/Xwrapper.conf, resolve.conf}`
- Deleted: `/etc/ssh/ssh_host_*`

To replicate these changes in your own rootstock file-system, copy or make similar modifications from those files to your own rootstock file system.

The following packages are installed by default:

- ubuntu-minimal
- xserver-xorg-core
- x11-xserver-utils
- xinit
- xterm
- alsa-utils
- wireless-tools
- wpa_supplicant
- openssh-client
- openssh-server

Setting Up the Root File System

The next step in booting the target board is to configure the root file system. Follow the procedures in this section to set up the rootfs and to copy the file system to the rootfs device.

Note: The instructions below use the sample file system that is provided by NVIDIA as the base. If you would like to use your own, set the LDK_ROOTFS_DIR environment variable to point to where your rootfs is located and skip Steps 1 and 2.

To set up the rootfs

1. Download the following file to your home directory:

`Tegra-Linux-Sample-Root-Filesystem_<release_type>.tar.gz`

where <release_type> is armel (for softfp ABI).

This file contains the NVIDIA-provided sample root file system.

2. Extract the compressed file as follows:

- Navigate to the rootfs directory for the extracted NVIDIA driver package with this command:

```
$ cd <your_L4T_root>/Linux_for_Tegra/rootfs
```

where <your_L4T_root> is your L4T root directory, which is assumed to be your home directory (~).

For more information, see [Extracting Tegra Linux Driver Package](#) in this section.

- Extract the sample file system to the rootfs directory with this command:

```
$ sudo tar xzpf ../../Tegra-Linux-Sample-Root-Filesystem_<release_type>.tar.gz
```

3. Run the `apply_binaries.sh` script to copy the NVIDIA user space libraries into the target file system:

```
$ sudo ./apply_binaries.sh
```

Note: The `apply_binaries.sh` installs the appropriate default version, for the provided sample file system, of the Tegra X driver by creating a sym-link to point to the proper ABI. The script installs the sym-link to the following location in the rootfs:

```
./usr/lib/xorg/modules/drivers/tegra_drv.so
```

If you are using a different rootfs, or if you already have configured your rootfs, you can apply the NVIDIA user space libraries by setting the `LDK_ROOTFS_DIR` environment variable to point to your rootfs. Then run the script, as shown above, to copy the binaries into your target file system.

To install a different X driver Application Binary Interface (ABI):

- Use the `apply_binaries.sh` script and pass the `-abi <number>` flag by executing:

```
$ sudo ./apply_binaries.sh -abi <number>
```

where `<number>` is the ABI version to install, either 5, 6, 7, 8, 10, 11, or 12. The ABI default value for the X driver is 'X ABI version 10' and it is the version that is compatible with the provided sample file system. You can find the version to use in the sample file system by following the directions listed below.

To determine the X driver ABI of the X server used in the root file system:

- Start X once on the Tegra device.
- Examine the resulting file `/var/log/Xorg.0.log`, which will contain something like the following:

```
(II) Module ABI versions:
X.Org ANSI C Emulation: 0.4
X.Org Video Driver: 8.0
```

The X.Org Video Driver line reports the ABI version. The sample Ubuntu 11.04-based root file system uses X driver ABI 10.

4. Load the target file system that you have generated onto the first partition of a device (either a USB stick, an SD card, or a USB hard drive) and attach that device to the target board.
5. Power on the target board and the image should load.
6. Set up access to the board over a serial port by opening a terminal on the host PC and setting:
 - 115200 baud
 - 8-bit
 - Parity none
 - 1 stop bit

To copy the file system to the external rootfs device

1. Plug your rootfs device into the host PC.
2. If your device is not formatted as Ext3, enter the following command to format it with an Ext3 file system:

```
$ sudo mkfs.ext3 /dev/sd<port>1
```

where <port> is the port your device is mounted. You can use the `dmesg` command to determine the port.

3. If needed, mount your device with the following command:

```
$ sudo mount /dev/sdX1 <mntpoint>
```

where <mntpoint> is your rootfs device's mount point.

4. Copy the file system. If `LDK_ROOTFS_DIR` is set, execute these commands:

```
$ cd ${LDK_ROOTFS_DIR}
$ sudo tar -cpf - * | ( cd <mntpoint> ; sudo tar -xpf - )
```

If it is not set, copy the rootfs directory that is included in the release by executing the following commands:

```
$ cd <your_L4T_root>/rootfs
$ sudo tar -cpf - * | ( cd <mntpoint> ; sudo tar -xpf - )
```

Once you have flashed your board, you can then unmount the disk and plug it to the board. For more information about flashing, see the [Flashing the Boot Loader and Kernel](#) in this section. For information about configuring your board setup, see the hardware documentation for your developer board.

Updating drivers on an existing target system

These instructions are for the situation where there was a previous release or driver package loaded onto a target board and that target device is booted.

Prerequisite

You must attach an Ethernet cable to the device through either the Ethernet port (if available) or through the USB Ethernet adaptor. Alternatively, you can connect through Wi-Fi if the appropriate driver and firmware are enabled and installed.

To update drivers on an existing target system

1. Log into the target device.
2. Download the NVIDIA Tegra Linux driver release and the additional support packages (for example the codec's package) from the `nvidia.com` links with `wget`. For example, to download the last (not the latest) release do the following:

```
wget
http://developer.nvidia.com/sites/default/files/akamai/tools/files/l4t/r15_alpha/cardhu_Tegra-Linux-R15.alpha.1.0.tbz2
```

```
wget
http://developer.nvidia.com/sites/default/files/akamai/tools/f
iles/14t/r15_alpha/cardhu_Tegra-Linux-codecs-
R15.alpha.1.0.tar.gz
```

Note: The release shown in this example is a previous release and not the current release.

3. Extract the release For more information, see [Extracting Tegra Linux Driver Package](#) in this section.
4. Set the LDK_ROOTFS_DIR variable to point to the root '/' directory.


```
$ export LDK_ROOTFS_DIR=/
$ echo ${LDK_ROOTFS_DIR}
```
5. Go into the Linux_for_Tegra directory.


```
$ cd Linux_for_Tegra
```
6. Run the `apply_binaries.sh` script to install the NVIDIA drivers onto your target board. For more information, see [Setting Up the Root File System](#) in this section.
7. (Optional) Change your X driver ABI as a variable passed into `apply_binaries`. For more information, see [Setting Up the Root File System](#) in this section.
8. For the codecs, or other additional packages, extract the files, being sure to extract them to your root '/' directory. For more information, see [Installing Additional Packages](#) in this section.

Determining the Success of a Driver Update

You can determine whether a driver update went successfully.

To determine the success of a driver update

- Execute the following command on a booted target device:

```
$ cat /etc/nv_tegra_release | grep -v -P '^#.*$' | shasum -c
```

Installing Additional Packages

This section explains how to install the additional NVIDIA packages, additional Ubuntu packages, and Google Chrome.

Installing Additional NVIDIA Packages

NVIDIA may supply additional packages. You can install these packages onto the target device's root file system. These may include the following packages:

- `restricted_codecs.tbz2`, which is included in the `<target_board>_Tegra-Linux-codecs-<version>_<release_type>.tar.gz`
- `wifi.tbz2` file

Directly after the "apply_binaries" step in [Setting Up the Root File System](#), you can install the package into the configured rootfs.

To install an NVIDIA package when the rootfs is already installed on the device

1. Mount the target rootfs device to /mnt:

```
$ sudo mount <device> /mnt
```

where <device> is the device such as /dev/sda1.

2. Install the package:

```
$ tar -C /mnt -xjf <path-to>/<package_name>
```

where <package_name> is one of the packages.

For example, if you have the restricted_codecs.tbz2 file located in:

```
<home>/restricted_codecs.tbz2
```

then your line will look like:

```
$ tar -C /mnt -xjf <home>/restricted_codecs.tbz2
```

3. Unmount the device with this command:

```
$ sudo umount <device>
```

and attach the device to the target board.

Installing Additional Ubuntu Packages

This section explains how to install additional packages from Ubuntu by using the provided sample file-system. For example, you may wish to download the following packages:

- openssh-server for remotely logging in
- ubuntu-desktop for the standard Ubuntu graphical user interface

Prerequisite

You must attach an Ethernet cable to the device through either the Ethernet port (if available) or through the USB Ethernet adaptor, or connect through Wi-Fi if the appropriate driver and firmware are enabled and installed.

To install more packages

1. Boot the target device.
2. Turn on networking by executing:


```
$ sudo dhclient
```
3. Install packages using apt-get. For example, to install wget execute this command:

```
$ sudo apt-get install wget
```

Installing Google Chrome

You can install Google Chrome from the command line, without using a browser.

Note: These installation procedures are untested.

To install Google Chrome from the command line

1. Download and install a Linux-repository public key from Google:

```
$ wget -q -O - https://dl-  
ssl.google.com/linux/linux_signing_key.pub | sudo apt-key add  
-
```

2. Add the key to the repository:

```
$ sudo add-apt-repository 'deb  
http://dl.google.com/linux/chrome/deb/ stable main'
```

3. Update the repository and install the browser:

```
$ sudo apt-get update
```

4. Install the Google Chrome Stable version with:

```
$ sudo apt-get install google-chrome-stable
```

Or install the beta version (latest version) with:

```
$ sudo apt-get install google-chrome-beta
```

For instructions on installing Google Chrome, see:

http://www.ubuntuupdates.org/ppa/google_chrome

Configuring NFS Root on the Linux Host

To boot the target device from NFS, you must provide an NFS root mount point on your Linux host machine. The procedure in this section describes the basic steps to do so.

Prerequisites

- You must have Ethernet connection to install packages on the host.
- You must have an Ethernet connection on the target, as well.

To configure NFS root on the Linux host

1. Install the nfs components on your host machine:

```
$ sudo apt-get install nfs-common nfs-kernel-server
```

2. The NFS server needs to know which directories you want to 'export' for clients. This information is specified in the `/etc/exports` file.

- Modify `/etc/exports` to look somewhat like this:

```
$ /nfsroot
*(rw,nohide,insecure,no_subtree_check,async,no_root_squash)
```
 - After adding the entry, restart using the following command:

```
$ sudo /etc/init.d/nfs-kernel-server restart
```
3. Create an `/nfsroot` directory on your Linux host machine:

```
$ sudo mkdir /nfsroot
```
 4. Copy the file system to the `nfsroot` directory:

```
$ cd ./rootfs
$ sudo tar -cpf - * | ( cd /nfsroot ; sudo tar -xpf - )
```
 5. Export the root point:

```
$ sudo exportfs -a
```

Alternatively, you can export or un-export all directories by using the `-a` and `-u` flags. The following command un-exports all directories:

```
$ sudo exportfs -au
```
 6. (Optional) If the Ubuntu firewall blocks NFS root access, it must be disabled depending upon your configuration. You can do so with the following command:

```
$ sudo ufw disable
```
 7. If there are issues performing the NFS boot, to separately verify everything on the 'host' machine is configured properly, you can perform the following step on a booted target board through USB/SD/internal eMMC. It should be possible to mount the host NFS root point on the target device:

```
$ mkdir rootfs
$ sudo mount -v -o nfsvers=3 <IP-ADDR>:/nfsroot rootfs
```

Where `<IP-ADDR>` is the IP address of the Linux Host machine as taken from the "ifconfig" command. This proves that the host configuration is correct.

Note: You must install the `nfs-common` package using the following command prior to executing the mount command on the target machine:

```
$ sudo apt-get install nfs-common
```

To boot the target with the NFS root point, see [Flashing the Boot Loader and Kernel](#) section and be sure to include the `-N` option for the nfs root point.

Setting Power Saving Options

This section explains how to enable the hotplug driver and the Tegra CPU power-gated state (LP2) for power savings on the target board.

Enabling the Auto-Hotplug Driver

The auto-hotplug driver implements the policy for when to bring cores online/offline. The auto_hotplug driver also implements the policy for when to switch clusters, i.e. when to switch from companion CPU to main CPU or vice versa. Cluster switching is transparent to the OS. The switch happens when software enters a power-gated state on one CPU core and hardware resumes the execution on a different physical CPU core.

To enable the auto-hotplug driver

- Enter the following command:

```
$ echo 1 > /sys/module/cpu_tegra3/parameters/auto_hotplug
```

Enabling the Tegra CPU Power-Gated State (LP2)

With the LP2 power state, the CPU core is power-gated if supported by the hardware. If all CPU cores on the VDD_CPU power rail are in LP2, Tegra hardware signals the PMIC to turn off the regulator.

To enable the LP2 power state

- Enter the following command:

```
$ echo Y > /sys/module/cpuidle/parameters/lp2_in_idle
```

Flashing the Boot Loader and Kernel

This section describes the steps that must be taken to boot the target board (Ventana or Cardhu) and provides usage information for the `flash.sh` script.

Flash Procedure

The first step is to flash the board with the boot loader and kernel.

Prerequisites

The following directories must be present:

- `/bootloader`—boot loader plus flashing tools (NvFlash, CFG, BCTs, etc.)
- `/kernel`—a kernel zImage plus scripts to sync/build the kernel
- `/rootfs`—the root file system that you download
- `/nv_tegra`—NVIDIA® Tegra® user space binaries

You must also have the USB cable connected to the recovery port prior to running the commands listed below. For more information, see the [Requirements](#) topic.

To flash the boot loader and kernel

1. You must first put the target board into reset/recovery mode. Do so by first powering on the board and then holding the recovery button and pressing the reset button.
2. Now run the `flash.sh` script that is in the top level directory of this release. The script must be supplied with the device name that it will have in the root file system:

```
$ sudo ./flash.sh <target_board> <rootdev>
```

- If the root file system will be on a USB disk, execute the script as follows:

```
$ sudo ./flash.sh <target_board> sda1
```

Otherwise, if the root file system will be on an SD card, execute the script as follows:

```
$ sudo ./flash.sh <target_board> mmcblk1p1
```

Where `<target_board>` is `ventana` or `cardhu`, depending upon your target device.

The above examples are for fastboot. For U-Boot, add the following argument:

```
-L <PATH_TO_U-BOOT_BIN_FILE>
```

For example:

```
$ sudo ./flash.sh -L bootloader/<target_board>/u-boot.bin  
<target_board> <rootdev>
```

The boot loader and kernel will load.

Flash Script Usage

You can find the most up-to-date usage information by running the `flash.sh` script included in the release. The basic usage information is as follows.

Usage

```
sudo ./flash.sh [options] <target_board> <rootdev>
```

Where you specify the required parameters and one or more of the options shown in the following table.

Parameters	Description
<target_board>	Is one of <code>ventana</code> or <code>cardhu</code> .
<rootdev>	Is one of following:
	For Ventana
	<code>mmcblk0p1</code> Specifies internal eMMC.
	<code>mmcblk1p1</code> Specifies external SDCARD.
	<code>sda1</code> Specifies external USB device (such as, USB memory stick or HDD).
	<code>eth0</code> Specifies nfsroot via external USB Ethernet interface.
	For Cardhu

	mmcblk0p1	Specifies internal eMMC.
	mmcblk1p1	Specifies external SDCARD.
	sda1	Specifies external USB device (such as, USB memory stick or HDD).
	eth0	Specifies nfsroot via external USB Ethernet interface.
Options	Description	
-h	Specifies to print this usage information.	
-b <bctfile>	Specifies the NvFlash Boot Configuration Table (BCT) file.	
-c <cfgfile>	Specifies the NvFlash configuration file.	
-f <flashapp>	Path to flash application: nvflash or tegra-rcm	
-k <partition id>	Specifies the kernel partition ID to be updated (minimum = 5).	
-n <nfs args>	Specifies the static NFS network assignments: <Client IP>:<Server IP>:<Gateway IP>:<Netmask>	
-o <odmdata>	Specifies the ODM data value: 0x30098011 (ventura) 0x80080105 (Cardhu A01) 0x40080105 (Cardhu A02)	
-s <ubootscript>	HUSH bootscript file for U-Boot.	
-F <flasher>	Flash server such as fastboot.bin	
-L <bootloader>	Specifies the boot loader, such as fastboot.bin.	
-C <cmdline>	Specifies the kernel command line. Warning: This manual kernel command line should be *FULL SET*. Upon detecting the manual command line, the boot loader overrides the entire kernel command line with this <cmdline> input.	
-D <boot Device>	Specifies eMMC or NAND.	
-K <kernel>	Specifies the kernel image, such as zImage.	
-I <initrd>	Specifies initrd file. Null initrd is the default.	
-R <rootfs dir>	Specifies the sample rootfs directory.	
-N <nfsroot>	Specifies the nfsroot, for example: <my IP addr>:/my/exported/nfs/rootfs	
-S <size>	Specifies the rootfs size in bytes. This is valid only for internal rootdev.	
-B <tegra binary>	Specifies the Tegra binary TGZ file.	
-X <xabi tgz>	Specifies the X driver ABI TBZ2 file.	
-O <xorg.conf file>	Specifies the xorg.conf file to override the default.	
-Z	Show variables.	

Synchronizing the Kernel Sources and Tool Chain

You can manually rebuild the kernel used for this package. Internet access is required to do so. All the related scripts are located in the kernel directory.

Prerequisites

- You must install Git. This can be done on Ubuntu 10.04 by running the following command:

```
$ sudo apt-get install git-core
```
- Your system must have the default Git port 9418 open for outbound connections.

To rebuild the kernel

1. Get the kernel source by running the `kernel_sync.sh` script:

```
$ cd ./kernel/
$ ./kernel_sync.sh
```

Which will prompt you to enter a 'tag' name, which is provided in the release notes. Alternatively, you can provide the 'tag' name when calling the script. For example:

```
$ ./kernel_sync.sh <TAG_NAME>
```

—Or—

You can also manually sync the sources, as follows:

```
$ cd <myworkspace>
$ git clone git://nv-tegra.nvidia.com/linux-2.6.git
kernel_sources
$ cd kernel_sources
$ git checkout <TAG_NAME>
```

where `<TAG_NAME>` is the 'tag' name that is available in the release notes.

You can sync to any Linux tag you would like, but the tag provided in the release notes will sync the sources to the same sources the release binary was built from. To see a list of the available release tags, use:

```
$ git tag -l `tegra-l4t*`
```

2. Install the tool chain by running the `install_3rdparty.sh` script:

```
$ ./install_3rdparty.sh
```

Building the NVIDIA Kernel

Follow the steps in this procedure to build the NVIDIA kernel.

Prerequisites

- You have downloaded the kernel source code.

To build the Tegra Kernel

1. Export the following environment variables:

```
$ export CROSS_COMPILE=<crossbin>
$ export TEGRA_KERNEL_OUT=<outdir>
$ export ARCH=arm
```

where:

- <crossbin> is the prefix applied to form the path to the tool chain for cross compilation, e.g., gcc. For the CodeSourcery tool chain, it will look something like:

```
<csinstall>/arm-2009q1-203-arm-none-linux-gnueabi/bin/arm-
none-linux-gnueabi-
```

- <outdir> is the desired destination for the compiled kernel.

2. Execute the following commands:

```
$ cd <myworkspace>/kernel
$ mkdir $TEGRA_KERNEL_OUT
```

- For Tegra 3, Cardhu, use:

```
$ make O=$TEGRA_KERNEL_OUT tegra3_defconfig
```

- For Tegra 2 Ventana use:

```
$ make O=$TEGRA_KERNEL_OUT tegra_defconfig
```

Where <myworkspace> is the parent of the Git root.

Configuring ALSA

This topic documents how to configure the Advanced Linux Sound Architecture (ALSA) to enable playback. It pertains to both the Cardhu and Ventana boards.

To playback using headset

Execute the following command:

```
$ amixer cset numid=45 1
```

To playback using speaker on Cardhu

- Execute the following commands:

```
$ amixer cset numid=42 2
$ amixer cset numid=43 2
$ amixer cset numid=44 63,63
```

```
$ amixer cset numid=45 4
$ amixer cset numid=49 1
$ amixer cset numid=50 1
$ amixer cset numid=51 1
$ amixer cset numid=52 1
$ amixer cset numid=53 1
$ amixer cset numid=54 1
$ amixer cset numid=55 1
$ amixer cset numid=56 1
$ amixer cset numid=29 120,120
```

Using Example Applications

This section describes two example applications you can use to test multimedia and OpenGL/EGL functionality on NVIDIA Tegra platforms.

- [OpenGL/EGL Gears Test Application](#)
- [GStreamer and NvGstPlayer](#)
- [Camera Capture Application \(NvGstCapture\)](#)

OpenGL/EGL Gears Test Application

If you would like to run a sample OpenGL/EGL test application, you can run the open-source Gears application.

To install and run Gears test application

1. Boot the target system with Ethernet connection and install the `mesa-utils-extra` package.

```
$ sudo apt-get install mesa-utils-extra
```
2. Manually create the sym-links in the target root file-system for `/usr/lib/libEGL.so.1` and `/usr/lib/libGLESv2.so.2`.

```
$ mv /usr/lib/libEGL.so /usr/lib/libEGL.so.1
$ mv /usr/lib/libGLESv2.so /usr/lib/libGLESv2.so.2
$ ln -s /usr/lib/libEGL.so.1 /usr/lib/libEGL.so
$ ln -s /usr/lib/libGLESv2.so.2 /usr/lib/libGLESv2.so
```
3. At this point you should be able to run the application with the following steps:

```
$ export DISPLAY=:0
$ X&
$ /usr/bin/es2gears
```

GStreamer and NvGstPlayer

You can use the GStreamer open source multimedia framework and NvGstPlayer for testing multimedia. This section tells you how to install and use these applications. This section includes the following sub-topics.

- [Installing GStreamer](#)
- [Using NvGstPlayer](#)
- [NvGstPlayer Examples](#)

Installing GStreamer

You install GStreamer from the Internet directly on the target. There is a wrapper library called `gst-openmax` that is an interface between GStreamer and OpenMAX, which enables accelerated NVIDIA plug-ins in the GStreamer framework

For more information about GStreamer, see the following website:

<http://gstreamer.freedesktop.org>

NvGstPlayer is a multimedia player test application.

To install GStreamer on the target

1. Execute:

```
$ sudo apt-get -y install gstreamer-tools
$ sudo apt-get -y install gstreamer0.10-plugins-good
$ sudo apt-get install gstreamer0.10-plugins-base
$ sudo apt-get -y install alsa-utils
$ sudo apt-get -y install gstreamer0.10-alsa
$ sudo apt-get -y install gstreamer0.10-ffmpeg # required for
nvgstcapture
```

2. Once this is installed you can see if the installation is complete by typing the following:

```
gst-inspect | grep qtdemux
```

To install GStreamer-0.10 on Cardhu

1. Execute the following command:

```
$ sudo apt-get install gstreamer-tools gstreamer0.10-alsa
gstreamer0.10-plugins-good gstreamer0.10-plugins-base
gstreamer0.10-ffmpeg
```

2. Place `nvgstplayer` from the `libraries` dir to `/home/ubuntu`.
3. Execute the following commands at the Ubuntu prompt, which specify the headset route and volume increase:

```
xinit &
export DISPLAY=:0
amixer cset numid=45 1
amixer cset numid=38 63,63
```

Using NvGstPlayer

NvGstPlayer is a command line media file player. It will play audio/video files encapsulated in MP4, 3GP, AVI, ASF, WMA, MKV, M2TS, WEBM, MOV. This section describes NvGstPlayer usage, runtime commands, default settings, and important notes.

Usage

```
./nvgstplayer [OPTIONS]
```

Where you can specify one or more of the options shown in the following table.

Option	Description
-?, --help	Specifies to show help options.
--help-all	Specifies to show all help options.
--help-gst	Specifies to show GStreamer options.
-u, --urifile	Specifies the path of the file containing the URIs.
-i, --uri	Specifies the input URI.
-e, --elemfile	Specifies the element(s) (properties) file.
-n, --loop	Specifies the number of times to play the media.
--startper	Specifies the position is in % of duration, to start the media from.
-a, --start	Specifies the start of the segment in media, in milliseconds.
-d, --duration	Specifies the play duration of the segment in media, in milliseconds.
--no-sync	Specifies to disable audio/video synchronization.
--use-playbin	Specifies to use Playbin, which are ready made collections of elements provided by GStreamer.
--no-audio	Specifies to disable audio.
--no-video	Specifies to disable video.
--disable-anative	Specifies disable native audio rendering.
--enable-aparse	Specifies use audio elementary stream parser.
--enable-vparse	Specifies to use video elementary stream parser.
-x, --gap	Specifies the command interval in seconds, for automated testing.
-p, --pauses	Specifies the number of times to pause the media, -1 until EOS.
--seekper	Specifies the position is in % of duration, to seek the media to (segment).
-s, --seeks	Specifies the position in milliseconds, to seek the media (in segment), for example: -s a:b:c.
-w, --image-display-time	Specifies the image display time, in seconds.
--show-tags	Specifies to show tags (metadata), if available.
--stats	Specifies to show stream statistics, if enabled.

Runtime Commands

You can execute the following commands while running the test.

Option	Description
q	Quit the application.
Up Key,]	Go to next track.
c	Restart the current track.
Down Key, [Go to the previous track.
i	Query for position.
d	Query for duration.
s:<val>	Seek to <val> position in milliseconds, for example: s:45120.
v:<val>	Seek to <val> percent of the duration, for example: v:54.
f:<val>	Seek by <val> milliseconds, relative to current position, for example: f:23901.
Left Key, <	Seek backwards by 10 seconds.
Right Key, >	Seek forward by 10 seconds.
p	Pause the media.
r	Resume the media.

Default Settings

The following shows the default settings.

Option	Default
seekper	0
gap	3 seconds
pause	2.5 seconds
videosink	nv_gl_eglimagesink
audiosink	alsasink

Important Notes

- Options—except elements path—can be given both from the command line as well as from a URI file.
- If options have been specified in a URI file, then the command line option will not work until the option from the configuration file finishes execution.
- If p is -1 then playback will pause until the end of segment (EOS) with the interval of gap seconds.
- To create the pipeline, this application selects elements based on their ranks automatically. So if you want to stop this default behavior and want the application to use some particular elements, then specify those elements in elements file and use that file with -e option.

- All command line arguments will apply to all streams in the URIs file unless explicitly specified for a stream in URI file. For example:

```
./nvgstplayer -u uri -e elem --no-audio
```

specifies all the streams in the URIs file will play without audio.

- If URI file is mentioned along with the command line URI, then only the command line URI will be executed.
- Command line URI is for quick testing of a URI.
- URI should have an absolute path.

NvGstPlayer Examples

This section provides example commands, elements file, and URIs file.

Example Commands

Option	Description	Example Command
--urifile	This file will have the streams, along with the options.	<code>./nvgstplayer --urifile=uri_avi</code>
--elemfile	This file will have elements (decoders, sink) and its properties.	<code>./nvgstplayer -u uri_avi --elemfile=elems</code>
--uri	This plays the stream as a command line argument.	<code>./nvgstplayer --uri=/home/ubuntu/<filename>.mp4</code>
--loop	This specifies the stream should be played 4 times.	<code>./nvgstplayer --urifile=uri_avi --loop=4</code>
--startper	This specifies to start the media from 1 percent of the duration, and to start the segment at 70 seconds.	<code>./nvgstplayer --urifile=uri_avi --startper=1 --start=70000</code>
--start	This specifies to start the segment in media at 10 seconds.	<code>./nvgstplayer --urifile=uri_avi --start=10000</code>
--duration	Plays for a duration of 90 seconds.	<code>./nvgstplayer --urifile=uri_avi --duration=90000</code>
--no-sync	Disables all A/V sync.	<code>./nvgstplayer --urifile=uri_avi --no-sync</code>
--use-playbin	Uses Playbin.	<code>./nvgstplayer --urifile=uri_avi --use-playbin</code>
--no-audio	Disables audio.	<code>./nvgstplayer --urifile=uri_avi --no-audio</code>
--no-video	Disables video.	<code>./nvgstplayer --urifile=uri_avi --no-video</code>
--disable-anative	Disables native audio rendering.	<code>./nvgstplayer --urifile=uri_avi --disable-anative</code>
--enable-aparse	Forces the use of audio parser.	<code>./nvgstplayer --urifile=uri_avi --enable-aparse</code>
--enable-vparse	Forces the use of video parser.	<code>./nvgstplayer --urifile=uri_avi --enable-vparse</code>

--gap	This specifies to wait 5 seconds before executing the next command, and pauses 4 times.	./nvgstplayer --urifile=uri_avi --gap=5 --pause=4
--pauses	This specifies to pause 7 times.	./nvgstplayer --urifile=uri_avi --pause=7
--seekper	This specifies to seek to 1 percent of duration, 75 times.	./nvgstplayer --urifile=uri_avi --seekper=1 --seeks=75
--seeks	This specifies to seek the media to 15 seconds, 30 seconds, and 60 seconds.	./nvgstplayer --urifile=uri_avi --seeks=15000:30000:60000
--image-display-time	This specifies to display the image for 5 seconds.	./nvgstplayer --uri=/home/ubuntu/mickey.gif --image-display-time=5
--stats	This specifies to show the stream statistics, which are saved in the following file: <code>gst_statistics.txt</code>	./nvgstplayer -u uri --stats

Example Elements File

The following shows an example of an `elems` file, which is used in Number 2 in the below execution description.

```
#Decoders
[decode_videompeg4]
name=nv_omx_mpeg4dec

[decode_audioaac]
name=nv_omx_aacdec

[decode_audiomp3]
name=nv_omx_mp3dec

[decode_videoh264]
name=nv_omx_h264dec

#Sinks
[sink_video]
name=nv_gl_eglimagesink

[sink_audio]
name=alsasink
```

In the previous example name is the property of element. You can mention other properties of element followed by name property, each on separate line, if they exist. For example, you can mention as follows:

```
#Sinks
[sink_video]
name=nv_gstbin_videosink
rendertarget=1
```

Example URIs File

The following shows an example of `uris` file, which is used in Number 2 and Number 3 in the below execution descriptions.

```
[/home/ubuntu/All_streams/<filename>.3gp]
seekper=1
seeks=25;0;65

[/home/ubuntu/All_streams/<filename>.mpg]
pauses = 5
gap = 7

[/home/ubuntu/All_streams<filename>.wmv]
startper = 1
start = 50

[/home/ubuntu/All_streams/<filename>.avi]
start = 20000
duration= 10000
```

Execution Descriptions

```
./nvgstplayer -i <filename>.mp4
```

The application will play the `<filename>.mp4` stream until end of stream (EOS) and will exit.

```
./nvgstplayer -u uris -e elems
```

- The stream `<filename>.3gp` will play with seeks to 25% duration, then 0% duration (i.e., start of stream) and then 65% duration of the stream. And then will play until EOS.
- Then the next stream from `uris` file will be taken up, (i.e., `<filename>.mpg`). This stream will pause 5 times with the gap of 7 seconds between two consecutive pauses.
- Then the next stream from URIs file will be taken up, (i.e., `<filename>.wmv`). This stream will
- Start from 50% duration of the stream.
- Then the next stream from URIs file will be taken up, (i.e., `<filename>.avi`).
- This stream will start from 00:00:20 and playback will happen for next 10 seconds.

```
./nvgstplayer -u uris --no-sync
```

All the streams from `uris` file will play without AV sync. All command line arguments will apply to all streams in the `uris` file, unless explicitly specified for a stream in `uris` file.

```
./nvgstplayer -i <filename>.mp4 --loop=3 --pauses=4
seeks=10000:0:45000
```

`<filename>.mp4` will be played 3 times, and each playback will pause for 4 times and will seek to 10th sec, then 0th sec, and then 45th sec of the playback.

```
./nvgstplayer. -i <filename>.mp4 -p 2 -x 3 -
s:10000:20000:30000:40000
```

This playback will have 2 pauses and seeks to 10th second, then 20th second, then 30th second, then 40th second, and the consecutive pauses and seeks will have a gap of 3 seconds.

```
./nvgstplayer -i rtsp://10.25.20.77/mp4/AAC/<filename>.mp4
```

Player provides RTSP/HTTP streaming support. The stream <filename>.mp4 will be played until EOS.

Camera Capture Application (NvGstCapture)

This section documents the following new `nvgstcapture` application options:

- [Camera Options](#)
- [Preview Options](#)
- [Still Capture Options](#)
- [Video Capture Options](#)
- [Audio Capture Options](#)
- [Common Options](#)

This section documents the following new `nvgstcapture` application options:

Camera Options

Capture Features	Application options	Gst Camera Application Commands
Camera type selection	Value : [USB/On Board]	Default : On Board
Camera sensor type selection	Value : [Bayer/YUV]	Default : Bayer
Camera location selection	Value : [ID][front/back]	Default : back
Camera Capture Mode selection	Value : [video(0)/image(1)]	"mo:0" or "mo:1" where, (0): video (1): image
Take image/snap	start Capture	"2"
Take video record	Start/stop Recording	Start : "1" & Stop : "0"
Camera focus position control	Value : [auto:-1][0,-1]	Not implemented in this release
Camera exposure control	Value : auto[-1]/[ms]	Exposure:val= -1 - 2147483647, -1=auto ex:<val>, eg : "ex:-1"
Camera iso control (exposure control)	Value : auto[-1]/[num] [100 200 400 800]	ISO Mode: val= 100,200,400,800, -1=auto io:<val>, eg : "io:200"

Camera contrast control	Value : [0,100]	Contrast: Range val= 0 - 100 ct:<val>, eg : "ct:50"
Camera flash control	Value : [auto/on/off]	Flash: xx:<val> , eg : "xx:0" (0): on (1): off
Camera zoom control	Value : [1.0,8.0]	Zoom: Range val= 1-8 z:<wscale>x<hscale> , eg : "z:2x2"
Camera Pre-capture converge control	Value : [on/off]	Default : on
Camera halfpress with 3A control	Value : [on/off][flag-ms]	Default : on
Camera brightness control	Value : [num(0,100)]	Brightness: Range val= 0 - 100 bt:<val>, eg : "bt:50"
Camera saturation control	Value : [num(0,100)]	Saturation: Range val= - 100 - 100 st:<val>, eg : "st:50"
Camera hue control	Value : [num(0,100)]	Hue: Range val= 0 - 100 ht:<val>, eg : "ht:50"
Camera white balance control	Value : [off,sunlight, cloudy,shade, tungsten,fluorecent, flash,horizon,auto]	White Balance: wb:<val> , eg : "wb:1" (0) : off (1) : auto (2) : sunlight (3) : cloudy (4) : shade (5) : tungsten (6) : fluorescent (7) : incandescent (8) : flash (9) : horizon
Camera shot mode	Value : [Normal/Continuous shot/ Out-focusing shot/Smile shot/ Panorama shot]	Default : Normal (Single shot)

Camera image filter control (color effect)	Value : [none,bw, sepia,emboss, negative,solarize, posterize]	Filter Control: ft:<val> , eg : "ft:0" (0) : none (2) : emboss (3) : negative (10) : solarize (805306368) : posterize (805306369) : sepia (805306370) : bw
Camera pause preview after capture	Value : [on/off]	Default: on
Camera flicker control	Value : [auto/off/50,60]	Flicker Control: fl:<val> , eg : "fl:1" (0) : off (1) : auto (2) : 50Hz (3) : 60Hz
Camera edge enhancement control	Value : [-1.0,1.0]	Edge Enhancement: Range val= -1 - 1.1, >1.0=off ee:<val> , eg : "ee:1.0"
Camera meter mode control (exposure control)	Value : [spot/center/matrix]	Metering: mt:<val>, eg : "mt:2" (0) : average (1) : spot (2) : matrix

Preview Options

Capture Features	Application Options	Gst Camera Application Commands
Camera preview resolution	Value : [width x height]	Resolution value : pr:<w>x<h> , eg "pr:640x480" [174x144,320x240,640x480, 720x480,1280x720,1920x1080]

Still Capture Options

Capture Features	Application Options	Gst Camera Application Commands
------------------	---------------------	------------------------------------

Camera still capture resolution	Value : [width x height]	Resolution value : cr:<w>x<h> , eg "cr:640x480" [174x144,320x240,640x480,800x600, 720x480,1280x720,1280x960(1 MP), 1600x1200(2 MP),2048x1536(3 MP), 2240x1680(4 MP),2560x1920(5 MP)]
Image encoder type selection Note: Applicable to JPEG only.	Value : [JPEG](Def:JPEG)	Image Encoder: val= nv_omx_jpegenc ie:<val> Default : JPEG only
JPEG encode in various chroma subsampling	Value : [4:2:0 / 4:2:2]	Default : (4:2:0)
Image quality control	Value : [Normal,Fine,Super fine]	Default : Normal

Video Capture Options

Capture Features	Application Options	Gst Camera Application Commands
Camera video capture resolution	Value : [width x height]	Resolution value : cr:<w>x<h> , eg "cr:1280x720" [174x144,320x240,640x480, 720x480,1280x720,1920x1080]
Video encoder type selection Note: Applicable to H.264 only.	Value : [H264/MPEG4/H263]	Video Encoder: val= nv_omx_h264enc ve:<val> Default : H264 only
Video encode quality level control	Value : [0=low,1=medium,2=high]	Default : medium

Audio Capture Options

Capture Features	Application Options	Gst Camera Application Commands
Audio encoder type selection Note: Applicable to AAC only.	Value : [AAC/AMR]	Audio Encoder: val= nv_omx_aacenc ae:<val> Default : AAC only
Audio record sample rate control	Value : [16K,32K,44.1K,48K]	Default : 44.1 kHz
Audio channel control	Value : [1,2]	Default : 2(stereo)

Common Options

Capture Features	Application Options	Gst Camera Application Commands
Record file type selection Note: Applicable to MP4 only.	type : [3GP,MP4]	Default : mp4
Voice control Note: On only.	Value : [on/off]	Default : on

Basic NvGstCapture Functions

Follow these steps to install the `nvgstcapture` application.

To install `nvgstcapture`

1. Follow installation steps for in [Installing GStreamer](#) in this section.
2. Start X Windows, and execute:

```
$ export DISPLAY=:0
$ xinit &
```

3. Enable microphone input, as follows:

```
$ amixer cset numid=82 on
$ amixer cset numid=71 1
$ amixer cset numid=1 on
$ amixer cset numid=4 on
$ amixer cset numid=77 0
$ amixer cset numid=74 on
$ amixer cset numid=42 63,63
$ amixer cset numid=2 31,31
$ amixer cset numid=5 31,31
```

4. Run `nvgstcapture` application:

```
$ nvgstcapture
```

5. When `nvgstcapture` is running you can type commands to do video and camera capture.

Note: At this point, the `nvgstcapture` application does not look like it is accepting input but it is.

Additional Notes

- The output files are JPG/MP4.
- The filenames are named as `nvgsttest(%d).jpg` or `nvgsttest(%d).mp4`. The `%d` indicates a counter starting from 0 every time the application is launched.

CAUTION: Be sure to backup the recorded files if you need them before launching the application again; otherwise, if you start `nvgstcapture` and take an image, then close it and restart and take another image, the image taken originally taken is overwritten.

- The output is saved in the \$HOME directory.
- For a JPEG, enter:

```
mo:1          <PRESS ENTER>
2             <PRESS ENTER>
```

- For a video, enter:

```
mo:0          <PRESS ENTER>
1             <PRESS ENTER>
0             <PRESS ENTER>
```

For more advanced operations of `nvgstcapture`, follow the instructions listed in the Commands column in the [Camera Capture Application \(nvgstcapture\)](#) topic.

U-Boot Guide

This document describes the U-Boot implementation for NVIDIA® Tegra® Linux Driver Package. It covers the following topics:

- [Requirements](#)
- [Using Device Tree Compiler](#)
- [Downloading and Building U-Boot](#)
- [Adding a Compiled Kernel to the Root File System](#)
- [Flashing U-Boot](#)
- [RootFS Tested by Device](#)
- [Example Hush Boot Scripts](#)
- [Debugging U-Boot Environment](#)

Requirements

This topic provides software requirements and prerequisites, including Linux kernel options that are required for Tegra Linux Driver Package (L4T).

- U-Boot.

Functionality was validated using an Ubuntu 10.04 host system; however, later versions or alternative Linux distributions may work with host-specific modifications.

- Tegra Linux Driver Package (L4T).

Download the latest L4T package from the Tegra Developer Zone and follow the installation instructions in the user documentation. You can find L4T on the Tegra Developer Zone:

<http://developer.nvidia.com/linux-tegra>

- Flex and Bison.

The U-Boot makefiles require flex and bison to parse various configuration files. If flex and bison are not already installed on your host machine, you can install them with the following command:

```
$ sudo apt-get install flex bison
```

- Device Tree Compiler (dtc).

You must either ensure that `dtc` is available to be passed in as a variable to the U-Boot make system or make it available in the host machine's local command path. Most of the `dtc` packages available from standard Linux distribution package management systems (like `apt`) are not yet updated with a version of `dtc` with the features required by the U-Boot makefile. Therefore, an example of building `dtc` from source is included in this section. For the procedure, see [Using Device Tree Compiler](#) in this section.

- `mkimage` Image Tool (`mkimage`).

The U-Boot image tool must be installed on the host machine. This tool is what generates the `vmlinux.ubimg` from the kernel zImage. If `mkimage` is not installed, it can be obtained by building the top-level U-Boot make target. For more information on building U-Boot, see [Downloading and Building U-Boot](#) in this section. The `mkimage` tool can then be found in the U-Boot source directory at:

```
./tools/mkimage
```

- Cross Compiler for ARM.

For more information, see [Synchronizing the Kernel Sources and Tool Chain](#) in [Getting Started](#).

- U-Boot source.

For more information, see [Downloading and Building U-Boot](#) in this section.

- Kernel source.

For information, see the following sections in [Getting Started](#):

- [Setting Up Your Environment](#)
- [Synchronizing the Kernel Sources and Tool Chain](#)
- [Building the NVIDIA Kernel](#)

Also, see [Adding a Compiled Kernel to the Root File System](#) in this section.

Using Device Tree Compiler

This topic provides an example of building the Device Tree Compiler (`dtc`) from source to include the features required by the U-Boot makefile.

To build `dtc` from source

1. If you do not want to pass in `dtc` as a parameter to the U-Boot environment, ensure a local command path (such as `./usr/local/bin` or another choice) is at the beginning of the shell command path.

```
$ export PATH=<local_command_path>:${PATH}
```

Note: The dtc makefile installs the binary into the first entry of shell PATH variable, so it is important that the local command path is at the beginning of the shell PATH variable.

2. Create a directory to contain the dtc source code and change directories into it:

```
$ mkdir -p <dtc_src_dir>
$ cd <dtc_src_dir>
```

3. Download dtc source code by executing the following `git clone` command:

```
$ git clone http://git.jdl.com/software/dtc.git
```

Note: At time of publication, the tested commit ID for dtc is:

```
a6e6c60e3a97a6b3a033cd052bb3740fd53cbf4c
```

4. Build and optionally install dtc by executing:

```
$ cd <dtc_src_dir>/dtc
$ make
```

Or, alternatively, if you want it installed on your local host file system execute:

```
$ make install
```

Note: if you specified just `make` be sure to pass in the following to the U-Boot `make` system:

```
DTC=${PATH_TO_DTC_TOOL_BINARY}
```

Where `PATH_TO_DTC_TOOL_BINARY` is the location of the dtc binary, such as:

```
<dtc_src_dir>/dtc/dtc
```

Downloading and Building U-Boot

This topic provides the steps to follow when downloading and build U-Boot for flashing to the Tegra device.

To download and build U-Boot

1. Download the Tegra Linux Driver Package (L4T) U-Boot source code by executing the following commands:

```
$ mkdir -p <uboot_src_dir>
$ cd <uboot_src_dir>
$ git clone -n git://nv-tegra.nvidia.com/3rdparty/u-boot.git
```

Alternatively, you can use the `uboot_sync.sh` script that is provided in the release under the `bootloader/<platform>` directory and skip step 2 below.

When running `uboot_sync.sh`, if no parameters are provided, the script prompts for the `<TAG_NAME>`, which is provided in the release notes. Also, you can run the script by passing the `<TAG_NAME>` in as follows:

```
$ cd $RELEASE/bootloader/<PLATFORM>
$ ./uboot_sync.sh <TAG_NAME>
```

2. Check out the git tag name:

```
$ cd u-boot
$ git checkout -b mybranchname <tag_name>
```

where <tag_name> is provided in the Release Notes.

3. Set the build environment:

```
$ export ARCH=arm
$ export CROSS_COMPILE=<toolchain>/../bin/arm-none-linux-
gnueabi-
$ export CONFIG_L4T=1
$ export USE_PRIVATE_LIBGCC=yes
$ export DTC=<dtc_binary_location>
```

4. Build U-Boot by executing:

```
$ cd <uboot_src_dir>/u-boot
$ make distclean
$ make cardhu_config
$ make
```

5. Copy U-Boot for flashing to the device:

```
$ cp u-boot.bin
<L4T_path>/Linux_for_Tegra/bootloader/<platform>
```

Note: Before copying U-Boot, it is recommended that you back up the `u-boot.bin` file in this directory.

6. If using network booting, follow these steps:

- Execute the following command:

```
$ sudo apt-get install tftpd
```

- Locate and edit the following file:

```
/etc/inetd.conf
```

Ensure it has following line:

```
tftp dgram udp wait nobody /usr/sbin/tcpd/usr/sbin/in.tftpd
/tftpboot
```

- Execute the following commands:

```
$ cd /etc/init.d; ./openbsd-inetd restart
$ cp <L4T_path>/Linux_for_Tegra/bootloader/<platform>
/tftpboot
```

Adding a Compiled Kernel to the Root File System

This topic describes the steps to create and install into the sample file system the kernel image that U-Boot needs.

Prerequisites

- You have compiled the kernel as described in [Getting Started](#) in this guide.

To configure the file system for U-Boot

1. Copy the compiled zImage kernel over the current Tegra Linux Driver Package (L4T) release kernel.

Note: You may want to rename the existing release kernel before overwriting it.

```
$ cp arch/arm/boot/zImage <L4T_path>/Linux_for_Tegra/kernel
```

2. Create vmlinux.ubimg from zImage (kernel for flashing) by executing the following steps, depending upon how the root file system (RootFS) is installed:

- For a RootFS installed in the internal eMMC, where you reflash the entire rootfs onto the internal eMMC, no action is required. The `flash.sh` script executes all required steps.
- For a RootFS installed on external storage, such as an SD Card or USB stick, U-Boot looks for the following file:

```
/boot/vmlinux.ubimg
```

Therefore, you must perform the following steps to copy it onto the external rootfs device:

```
$ cd <L4T_path>/Linux_for_Tegra
$ ./zImage_to_ubimg.sh
```

The `zImage_to_ubimg.sh` script runs `mkimage` with the appropriate parameters to create the `vmlinux.ubimg` file in the kernel directory. The `apply_binaries` script copies the `vmlinux.ubimg` in the kernel directory into the rootfs directory in the `/boot` folder. You can then install the rootfs directory onto your device. For information on installing the rootfs directory onto your device, see [Setting Up the Root File System](#) in [Getting Started](#). Alternatively, if you have already installed your rootfs onto a device, you can manually copy the `vmlinux.ubimg` file that is created from the `zImage_to_ubimg.sh` script onto the previously installed root file system.

- For a network RootFS, do the following:

Run the `zImage_to_ubimg.sh` script to create the `vmlinux.ubimg` file from your zImage in the kernel directory. The `zImage_to_ubimg.sh` script runs `mkimage` with the appropriate parameters.

```
$ ./zImage_to_ubimg.sh
```

Run the `apply_binaries` script (or just manually copy the `ubimg` file) so that the `vmlinux.ubimg` file in the kernel directory is placed in the `${LDK_ROOTFS_DIR}/boot` (by default `rootfs/boot`) directory. Use the rootfs with the updated `vmlinux.ubimg` file and configure NFS boot as described in this guide. For more information, see [Configuring NFS Root on the Linux Host](#) in [Getting Started](#).

Flashing U-Boot

This section presents the theory of usage for flashing U-Boot followed by the commands used to flash. It contains the following topic:

- [eMMC Partition as Script Partition](#)
- [Fastboot Creation of GPT](#)
- [Example eMMC Layout with Script Partition](#)
- [Flash Commands](#)

eMMC Partition as Script Partition

Because you use the standard NvFlash Utility and the `fastboot.bin` flash application, U-Boot shares the same internal eMMC partition layout as fastboot does. The only difference is that L4T U-Boot does not use the `kernel` partition in the usual fashion: U-Boot uses the `kernel` partition as its **boot-script partition**. Additionally, U-Boot expects the kernel file named `vmlinux.uring` in the following directory:

```
<rootfs>/boot
```

Fastboot Creation of GPT

Fastboot creates the GPT partition, which contains the secondary GUID Partition Table (GPT) that must be located in the last 512-byte (B) sector of the boot device.

Note: The boot device is not necessarily the same as the rootfs device.

The logical block addressing (LBA) of the last-512-B sector varies from device to device. Both U-Boot and the kernel know how to query the hardware to obtain the LBA of the last 512-B sector.

Example eMMC Layout with Script Partition

This topic provides an example eMMC layout showing the script partition and configuration (CFG) file contents.

U-Boot shares the same layout as fastboot; the layout is described in the following released configuration file:

```
gnu_linux_fastboot_emmc_full.cfg
```

The kernel partition (name=LNK) gets used as the script partition.

Example CFG Contents

```
[device]
type=sdmmc
instance=3
```

```
[partition]
name=BCT
id=2
type=boot_config_table
allocation_policy=sequential
filesystem_type=basic
size=4194304
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0
```

```
[partition]
name=PT
id=3
type=partition_table
allocation_policy=sequential
filesystem_type=basic
size=2097152
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0
```

```
[partition]
name=EBT
id=4
type=bootloader
allocation_policy=sequential
filesystem_type=basic
size=2097152
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0
filename=fastboot.bin
```

```
[partition]
name=SOS
id=5
type=data
allocation_policy=sequential
filesystem_type=basic
size=6291456
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0
#filename=recovery.img
```

```
[partition]
name=LNK
id=6
type=data
allocation_policy=sequential
filesystem_type=basic
```



```

size=8388608
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0
filename=boot.img

[partition]
name=GP1
id=7
type=GP1
allocation_policy=sequential
filesystem_type=basic
size=2097152
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0

[partition]
name=APP
id=8
type=data
allocation_policy=sequential
filesystem_type=basic
size=1073741824
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0
filename=system.img

[partition]
name=CAC
id=9
type=data
allocation_policy=sequential
filesystem_type=basic
size=4194304
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0

[partition]
name=MSC
id=10
type=data
allocation_policy=sequential
filesystem_type=basic
size=2097152
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0

[partition]

```

```

name=USP
id=11
type=data
allocation_policy=sequential
filesystem_type=basic
size=4194304
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0

[partition]
name=UDA
id=12
type=data
allocation_policy=sequential
filesystem_type=basic
size=0xFFFFFFFFFFFFFFFF
file_system_attribute=0
partition_attribute=0
allocation_attribute=0x808
percent_reserved=0

[partition]
name=GPT
id=13
type=GPT
allocation_policy=sequential
filesystem_type=basic
size=0xFFFFFFFFFFFFFFFF
file_system_attribute=0
partition_attribute=0
allocation_attribute=8
percent_reserved=0

```

Flash Commands

This topic provides the commands to use to flash U-Boot so that you can boot the device either from internal eMMC, from SD Card, or from an IP network.

To flash U-Boot to boot from internal eMMC

- Execute the following command:

```
$ sudo ./flash.sh -L bootloader/<platform>/u-boot.bin
<platform> mmcblk0p1
```

Where <platform> is the device, such as cardhu for Tegra 3 or ventana for Tegra 2.

To flash U-Boot to boot from SD Card

- Execute the following command:

```
$ sudo ./flash.sh -L bootloader/<platform>/u-boot.bin
<platform> mmcblk1p1
```

Where <platform> is the device, such as cardhu for Tegra 3 or ventana for Tegra 2.

To flash U-Boot to boot from an IP network

- Execute the following command:

```
$ sudo ./flash.sh -L bootloader/<platform>/u-boot.bin -N
<IPA>:/<platform> [-n <target IPA>:<host IPA>:<gateway
IPA>:<netmask>] <platform> eth0
```

Where <platform> is the device, such as cardhu for Tegra 3 or ventana for Tegra 2.

RootFS Tested By Device

This topic provides the results of testing the root file system location by device. The “Y” citations shown in the following table indicate that proper U-Boot initialization and hand-off to the kernel occurred, but this does not guarantee a fully-functional system.

Note: U-Boot is functional on both Cardhu (T30) and Ventana (T20), but the kernel for T20 does not work properly with U-Boot. T30 is booting as is but T20 has clock initialization problems and does not boot as-is with the provided kernel.

RootFS Location	Cardhu	Ventana
mmcblk0p1	Y	Y*
mmcblk1p1	Y	Y*
sda1	Y	Y*
eth0	Y	Y*
eth1	Y	Not tested
usb0	Not tested	Not tested
mtdblock1	Unsupported	Unsupported
* Kernel failure due to uninitialized graphics clock problems.		

Example Hush Boot Scripts

This section provides example boot scripts for eMMC, SD Card, USB, and Network booting.

To minimize the foot print of the binary, U-Boot is designed to be configured by compile-time switches; however, in the Tegra Linux Driver (L4T) environment, it is desirable to have flash-time switches available to accommodate various L4T use cases.

Therefore, to support flash-time switching, L4T implements a **script partition** concept, and the script partition can be edited and flashed to alter the U-Boot environment variables and boot parameters.

There are two example Hush Shell script files supplied in Tegra Driver for Linux release: `<platform>_emmc.hush` and `<platform>_net.hush`. Hush is a command line shell similar to Bourne Shell. L4T uses Hush as a Bourne Shell-like U-Boot command-line interpreter.

eMMC Hush Script

The eMMC Hush script handles booting with boot order from all local storage devices, such as internal eMMC, SD Card, and USB devices. This script checks the USB device first, the SD Card next, and then the internal eMMC memory. During these checks, if U-Boot finds a valid `vmlinux.uimg` kernel image file, it boots off of the device where it found the kernel image.

The Hush script can be edited to set desired U-Boot boot strapping characteristics. You can find the eMMC Hush script at the following location:

```
bootloader/<platform>/<platform>_emmc.hush
```

where `<platform>` is the device, such as `cardhu` for Tegra 3 or `ventana` for Tegra 2.

Example Script Contents

The following shows the contents of the eMMC Hush script.

```
#
# U-boot environment for local storage boot.
#
usbname=sda
pn=1
#
# Static env:
#
board=cardhu
mmcname=mmcblk
loadaddr=0x80408000
baudrate=115200
bootdelay=3
bootfile=vmlinux.uimg
console=ttyS0,115200n8
stderr=serial,lcd
stdin=serial,tegra-kbc
stdout=serial,lcd
user=user
videospec=tegrafb
serial#=1
#
# Board Specific variable env:
#
```

```
# tegra_fbmem: handled by u-boot runtime.
lp0_vec=0x00002000@0x9C406000
#
# Multi purpose env containers:
#
platform_extras=vmalloc=128M mem=1024M@2048M
extra_bootargs=usbcore.old_scheme_first=1 core_edp_mv=1300
panel=lvds tegraid=30.1.2.0.0 debug_uartport=lsport smp
#
# Local Storage Boot Scripts:
#
regen_all=setenv common_bootargs console=${console}
console=tty1 lp0_vec=${lp0_vec} video=${videospec}
${platform_extras} ${dev_extras} noinitrd; setenv bootargs
${common_bootargs} ${extra_bootargs} ${bootdev_bootargs}
mmc_setup=setenv bootdev_bootargs
root=/dev/${mmcname}${mmcdev}p${pn} rw rootwait gpt; run
regen_all
mmc_boot=run mmc_setup; mmc rescan ${mmcdev}; ext2load mmc
${mmcdev}:${pn} ${loadaddr} /boot/${bootfile}; bootm
${loadaddr}
mmc0_boot=setenv mmcdev 0; run mmc_boot
mmc1_boot=setenv mmcdev 1; run mmc_boot
usb_setup=setenv bootdev_bootargs root=/dev/${usbname}${pn} rw
rootwait; run regen_all
usb_boot=usb start; run usb_setup; ext2load usb 0:${pn}
${loadaddr} /boot/${bootfile}; bootm ${loadaddr}
bootcmd=run usb_boot; run mmc1_boot; run mmc0_boot
```

Net Hush Script

The Net Hush script handles booting from the Network File System (NFS). You can find the Net Hush script at the following location:

```
bootloader/<platform>/<platform>_net.hush
```

where <platform> is the device, such as cardhu for Tegra 3 or ventana for Tegra 2.

Example Script Contents

The following shows the contents of the Net Hush script.

```
#
# U-boot environment for network boot.
#
# Static env:
#
board=cardhu
mmcname=mmcblk
loadaddr=0x80408000
baudrate=115200
bootdelay=3
bootfile=vmlinux.uimg
```

```

console=ttyS0,115200n8
stderr=serial,lcd
stdin=serial,tegra-kbc
stdout=serial,lcd
user=user
videospec=tegrafb
serial#=1
#
# All CAP nfs info tokens needs to be replaced with proper
values as follow:
# IPADDR ----- 172.17.187.71
# SERVERIP --- 172.17.186.62
# GATEWAYIP -- 172.17.186.62
# NETMASK ---- 255.255.252.0
# NFSARGS ---- ip=:::::eth0:on or
ip=cip:sip:gip:mask::eth0:off
# NFSROOT ---- 172.17.187.62:/cardhu_nfsroot
#
ipaddr=IPADDR
serverip=SERVERIP
gatewayip=GATEWAYIP
netmask=NETMASK
tftppath=TFTPPATH
nfsbootargs=root=/dev/nfs NFSARGS nfsroot=NFSROOT
#
# Board Specific variable env:
#
# tegra_fbmem: handled by u-boot runtime.
lp0_vec=0x00002000@0x9C406000
#
# Multi purpose env containers:
#
platform_extras=vmalloc=128M mem=1024M@2048M
extra_bootargs=usbcore.old_scheme_first=1 core_edp_mv=1300
panel=lvds tegraid=30.1.2.0.0 debug_uartport=lsport smp
#
# Local Storage Boot Scripts:
#
regen_all=setenv common_bootargs console=${console}
console=tty1 lp0_vec=${lp0_vec} video=${videospec}
${platform_extras} ${dev_extras} noinitrd; setenv bootargs
${common_bootargs} ${extra_bootargs} ${bootdev_bootargs}

regen_net_bootargs=setenv bootdev_bootargs rw ${nfsbootargs} ;
run regen_all

nfs_setup=setenv autoload n; run regen_net_bootargs
nfs_boot=run nfs_setup; dhcp; tftpboot ${loadaddr}
${tftppath}; bootm ${loadaddr}

bootcmd=usb start; run nfs_boot

```

Debugging U-Boot Environment

This section provides some debugging tips for your U-Boot environment. The examples shown, however, do not represent a comprehensive listing for U-Boot functionality. For a full listing of supported commands and their usage by U-Boot, see the U-Boot documentation and source.

For example, one common problem that can occur is when you create your own kernel and U-Boot has trouble finding it. To verify that U-Boot can read the device and also see the files in the file system, the commands listed in examples in this section may be beneficial. If a boot device is not found or the device has trouble booting with kernel other than the reference kernel provided in the Tegra Linux Driver Package (L4T) release, check the examples in this section for debug assistance.

Interrupting U-Boot

You can interrupt U-Boot during boot.

To interrupt U-Boot

- Press any key during boot.

Getting Help

On the U-Boot terminal screen, you can type `help` at any time for the list of supported commands from the U-Boot terminal.

To see the U-Boot Help screen on Tegra 3

- Enter:

```
Tegra3 # help
```

The below shows example Help information printed when executing `help` on a Tegra 3 device.

```
?          - alias for 'help'
base       - print or set address offset
bdinfo    - print Board Info structure
boot      - boot default, i.e., run 'bootcmd'
bootd     - boot default, i.e., run 'bootcmd'
bootm     - boot application image from memory
bootp     - boot image via network using BOOTP/TFTP protocol
cls       - clear screen
cmp       - memory compare
coninfo   - print console devices and information
cp        - memory copy
crc32     - checksum calculation
dcache    - enable or disable data cache
dhcp      - boot image via network using DHCP/TFTP protocol
```

```

echo      - echo args to console
editenv   - edit environment variable
env        - environment handling commands
exit      - exit script
ext2load  - load binary file from a Ext2 filesystem
ext2ls    - list files in a directory (default /)
false     - do nothing, unsuccessfully
fatinfo   - print information about filesystem
fatload   - load binary file from a dos filesystem
fatls     - list files in a directory (default /)
fdt       - flattened device tree utility commands
go        - start application at address 'addr'
gpio      - GPIO access
help      - print command description/usage
i2c       - I2C sub-system
icache    - enable or disable instruction cache
iminfo    - print header information for application image
imxtract  - extract a part of a multi-image
itest     - return true/false on integer compare
loadb     - load binary file over serial line (kermit mode)
loads     - load S-Record file over serial line
loady     - load binary file over serial line (ymodem mode)
loop      - infinite loop on address range
md        - memory display
mm        - memory modify (auto-incrementing address)
mmc       - MMC sub system
mmcinfo   - display MMC info
mtest     - simple RAM read/write test
mw        - memory write (fill)
nm        - memory modify (constant address)
ping      - send ICMP ECHO_REQUEST to network host
printenv  - print environment variables
reset     - Perform RESET of the CPU
run       - run commands in an environment variable
saveenv   - save environment variables to persistent storage
setenv    - set environment variables
sf        - SPI flash sub-system
showvar   - print local hushshell variables
sleep     - delay execution for some time
source    - run script from memory
sspi      - SPI utility command
test      - minimal test like /bin/sh
tftpboot  - boot image via network using TFTP protocol
time      - run a command and report its run time
true      - do nothing, successfully
usb       - USB sub-system
usbboot   - boot from USB device
version   - print monitor, compiler and linker version

```

Listing a Directory Structure

You can list the directory structure of a particular device. For example, you can list the directory structure of sda1 in U-Boot by typing: usb 0:1 (for usb device 0 partition 1).

To list the directory structure

- Execute the following command:

```
Tegra3 # ext2ls usb 0:1
```

Note: This works on ext3 file systems, as well.

Example output follows:

```
<DIR>      4096 .
<DIR>      4096 ..
<DIR>      4096 bin
<DIR>      4096 boot
<DIR>      4096 dev
<DIR>      4096 etc
<DIR>      4096 home
<DIR>      4096 lib
<DIR>      4096 lost+found
<DIR>      4096 media
<DIR>      4096 mnt
<DIR>      4096 opt
<DIR>      4096 proc
<DIR>      4096 root
<DIR>      4096 sbin
<DIR>      4096 selinux
<DIR>      4096 srv
<DIR>      4096 sys
<DIR>      4096 tmp
<DIR>      4096 usr
<DIR>      4096 var
```

Listing the Contents of a Directory

You can list the contents of any directory.

To list contents of a directory

- Execute following command:

```
Tegra3 # ext2ls usb 0:1 $DIRECTORY
```

where \$DIRECTORY is an expected path on the device.

For example, to list contents of the /boot directory where the vmlinux.uring file should be, execute:

```
Tegra3 # ext2ls usb 0:1 /boot
```

Printing the U-Boot Environment

You can print the entire U-Boot environment.

To print the U-Boot environment

- Execute the following command:

```
Tegra3 # printenv
```

Printing/Setting Environment Variables

You can print and set variables in the environment.

To print a variable in the environment

- Execute the following command:

```
Tegra3 # printenv $ENV_VARIABLE
```

where `$ENV_VARIABLE` refers to an environment variable in U-Boot.

For example, to print the boot device partition number, execute:

```
Tegra3 # printenv pn
```

Output can be as follows:

```
pn=1
```

To set a variable in the environment

- Execute the following command:

```
Tegra3 # setenv $ENV_VARIABLE $NEW_VALUE
```

where `$ENV_VARIABLE` refers to an environment variable in U-Boot and `$NEW_VALUE` is the new value for that variable.

For example, to set the partition number variable, enter the following command:

```
Tegra3 # setenv pn 1
```

Software Features

This section describes the software features expected to be supported with this release of NVIDIA® Tegra® Linux Driver Package, which provides users with a complete package to bring up Linux on certain Tegra devices.

This release supports NVIDIA® Tegra® 3 series: Ventana T3T (code-name Cardhu) and NVIDIA® Tegra® 2 series: Ventana T2T (code-name Ventana). Additional application processors may be supported in a later release.

Note: Always check the *Release Notes* for constraints related to these features.

Read the following sections to learn more about supported features in this release.

- [Linux](#)
- [Graphics and Multimedia](#)
- [Decoders](#)
- [Encoders](#)
- [Container Formats](#)
- [Streaming Protocols](#)
- [Displays](#)
- [Playback](#)
- [Camera](#)
- [Power](#)
- [Boot Loaders](#)

Linux

Kernel	Notes
Linux Kernel	3.1
Kernel Native Drivers	Notes
Audio	ALSA
External SD card	-
USB	Keyboard/mouse, mass storage device (MSD)
Wi-Fi	Firmware provided separately
Boot Devices	Notes
eMMC	-
External boot media	USB flash devices and hard-drives, SD Cards
Network file-system (NFS) boot	-
Additional Notes	
Unless otherwise noted, all features pertain to Cardhu and Ventana.	

Graphics and Multimedia

Media APIs	Notes
EGL 1.4 with EGLImage	-
GStreamer OpenMAX-IL plug-in	Both for playback and A/V capture
Open GL ES path extensions	-
OpenGL ES 1.1	-
OpenGL ES 2.0	For automatic stereo support
OpenMAX IL 1.1 decoding	Planned to be deprecated in a later release
OpenMAX IL 1.1 encoding	Planned to be deprecated in a later release
X11	ABI: 5, 6, 7, 8, 10, 11, 12
X Resize, Rotate and Reflect Extension (RandR) 1.3	-
Additional Notes	
Unless otherwise noted, all features pertain to Cardhu and Ventana.	

Decoders

Audio Decoders (Tegra 3/Tegra 2)

The features in this table are supported by both Tegra 3 and Tegra 2.

Audio Decode	Profile	Sampling	Bitrate
AAC+	AAC-LC with SBR; mono, stereo, and 2-channel mixing only	Up to 48 kHz	Up to 320 kilobits per second (Kbps)
AAC-LC	Mono, stereo, and 2-channel [5.1]	Up to 48 kHz	Up to 320 Kbps
eAAC+	AAC-LC with SBR+PS; mono, stereo, and 2-channel mixing only	Up to 48 kHz	Up to 320 Kbps
AMR-NB	1 channel	Up to 8 kHz	Up to 12.2 Kbps
AMR-WB	1 channel	Up to 16 kHz	Up to 23.85 Kbps
MP3	2 channel	Up to 48 kHz	Up to 320 Kbps
MPEG-2 (MPEG-1 Layer 2)	2 channel	Up to 48 kHz	Up to 320 Kbps
Vorbis	Ogg Audio	Up to 48 kHz	Up to 256 Kbps
WAV linear PCM	16-bit, 2 channels	Up to 48 kHz	-
WMA 9 Std.	Standard 2-channel	Up to 48 kHz	Up to 384 Kbps
WMA Lossless	Lossless: Up to N1 Profile; WMA 10: 2 channel	Up to 48 kHz	-
WMA Pro LBR 10	M2 Profile; 2 channel [5.1]	Up to 96 kHz	Up to 768 Kbps

Image Decoders (Tegra 3/Tegra 2)

The features in this table are supported by both Tegra 3 and Tegra 2.

Image Decode	Profile	Resolution	Notes
JPEG	Baseline	Up to 20 MP	Gstreamer JPEG decoder supported by default

Video Decoders (Tegra 3 only)

The features in this table are supported by Tegra 3.

Video Decode	Profile and Level	Sampling Frequency and Bit rate/Frame rate	Notes
--------------	-------------------	--	-------

Software Features

DivX 4/5/6	1080p HD Profile	Up to 1080p @ 30 fps Up to 10 Mbps	-
DivX 4/5/6	PlusHD	Up to 1080p @ 30 fps Up to 20 Mbps	-
H.263	Baseline Profile 0	Standard H.263 picture formats up to 4CIF @ 30 fps Up to 8 Mbps	Baseline Profile 0 Tools; Also supports custom formats at any resolution
H.264 AVC	Baseline Profile, Main Profile High Profile @ L4.1	Up to 720p @ 60 fps Up to 40 Mbps	-
H.264 AVC	Baseline Profile Main Profile High Profile @ L4.1	Up to 720p @ 60 fps Up to 40 Mbps	-
H.264 AVC	Baseline Profile Main Profile High Profile @ L4.1	Up to 1080i @ 60 fps Up to 40 Mbps	-
H.264 AVC	Baseline Profile Main Profile High Profile @ L4.1	Up to 1140p @ 30 fps Up to 40 Mbps	-
H.264 AVC (SEI)	High Profile	Up to 1080p @ 30 fps Up to 40 Mbps	-
MPEG-2 Video	Main Profile @ High Level	Up to 720p @ 60p Up to 80 Mbps	-
MPEG-2 Video	Main Profile @ High Level	Up to 1080p @ 30p/1080i 60 fps Up to 80 Mbps	-
MPEG-4	Advanced Simple Profile @ L5	Up to 1080p @ 30 fps Up to 10 Mbps	-
VC-1/WMV	Simple Profile	Up to 1080p @ 30 fps Up to 45 Mbps	-
VC-1/WMV	Main Profile	Up to 1080p @ 30 fps Up to 45 Mbps	-
VC-1/WMV	Advanced Profile	Up to 1080p @ 30 fps Up to 45 Mbps	-

Xvid	Highdef Profile	Up to 1080p @ 30 fps Up to 10 Mbps	-
------	-----------------	--	---

Video Decoders (Tegra 2)

The features in this table are supported by Tegra 2.

Video Decode	Profile and Level	Sampling Frequency and Bit rate/Frame rate	Notes
DivX 4/5/6	1080p HD	Up to 1080p 30 fps Up to 10 Mbps	-
H.263	Baseline Profile 0	Standard H.263 formats up to 4CIF 30 fps Up to 8 Mbps peak	Standard H.263 picture formats = SQCIF, QCIF, CIF, 4CIF; Also supports custom formats at any resolution
H.264	Baseline Profile @ L4	Up to 1080p 30 fps Up to 20 Mbps peak	
H.264 Dynamic Resolution Change (DRC)	-	-	AP20 only
H.264	Main Profile @ L2.2	Up to 576i 60 fps Up to 4 Mbps	CABAC; MBAFF; Interlaced
H.264	Main Profile @ L3.1	Up to 720p 30 fps Up to 4 Mbps	CAVLC; With weighted prediction
H.264	Main Profile @ L3.1	Up to 720p 30 fps Up to 5 Mbps	CABAC; CAVLC; No weighted prediction
H.264	High Profile @ L2.2	Up to 576i 60 fps Up to 4 Mbps	CABAC; MBAFF; Interlaced
H.264	High Profile @ L3.1	Up to 720p 30 fps Up to 4 Mbps	CAVLC; With weighted prediction
H.264	High Profile @ L3.1	Up to 720p 30 fps Up to 5 Mbps	CAVLC; CABAC; No weighted prediction
MPEG-4	Advanced Simple Profile @ L5	Up to 1080p 30 fps Up to 10 Mbps	-
VC-1	Simple Profile	Up to 1080p 30 fps Up to 10 Mbps	-
VC-1	Main Profile	Up to 1080p 30 fps Up to 10 Mbps	-

Software Features

VC-1	Advanced Profile	Up to 1080p 30 fps Up to 10 Mbps	-
Xvid	Highdef Profile	Up to 1080p 30 fps Up to 10 Mbps	-

Encoders

Audio Encoders (Tegra 3/Tegra 2)

The features in this table are supported by both Tegra 3 and Tegra 2.

Audio Encode	Profile	Resolution	Bit Rates	Notes
AAC-LC	-	-	Up to 320 kbps	-

Image Encoders (Tegra 3/Tegra 2)

The features in this table are supported by both Tegra 3 and Tegra 2.

Image Decode	Profile	Resolution	Bit Rates
JPEG	Exif	Up to 14 MP	Q-100

Video Encoders (Tegra 3)

The features in this table are supported by Tegra 3 only.

Video Encode	Profile and Level	Sampling Frequency and Bit rate/Frame rate	Notes
H.264	Baseline Profile	Up to 1080p 30 fps Up to 20 Mbps	-

Video Encoders (Tegra 2)

The features in this table are supported by Tegra 2 only.

Video Encode	Profile and Level	Sampling Frequency and Bit rate/Frame rate	Notes
H.264	Baseline Profile	Up to 1080p 24 fps Up to 14 Mbps	-

Container Formats

Codes are provided by GStreamer. You can download GStreamer codecs from the gstreamer opensource project at:

<http://gstreamer.freedesktop.org>

Or you can use `apt-get` in the provided Ubuntu-derived sample file system.

Hardware codecs are not included in the base release but can be provided separately under a software license agreement.

Streaming Protocols

Streaming protocols are provided by GStreamer. You can download GStreamer codecs from the gstreamer opensource project at:

<http://gstreamer.freedesktop.org>

Or you can use `apt-get` in the provided Ubuntu-derived sample file system.

Hardware codecs are not included in the base release but can be provided separately under a software license agreement.

Protocol	Notes
HTTP 1.0	ASF, AVI, 3GP, MOV, MP3, MP4, WMA, WMV
HTTP 1.1	ASF, AVI, 3GP, MOV, MP3, MP4, WMA, WMV
RTP/RTSP/RTCP	3GP, MP3
SDP (RFC 4566)	3GP

Displays

General	Notes
HDMI®	See the <i>Release Notes</i> for known issues.

Playback

General	Notes
NvGstPlayer application	-

Camera

General	Notes
NvGstCapture application	-

Power

General	Notes
DVFS	-
Tegra Active Power Management	Notes
Dynamic voltage scaling for core	-
Dynamic voltage scaling for CPU	-
Dynamic frequency scaling for CPU	-
Dynamic frequency scaling for memory controller	-
Dynamic frequency scaling for AVP	-
Dynamic frequency scaling for system buses	-
Low power idle state (LP2)	Cardhu only
Frequency-boosted burst modes	Cardhu only; CPU running at higher frequencies in single-core mode
EDP support	Cardhu only
External temperature sensing	-
CPU hotplug support	Cardhu only
Switch to ULP CPU mode	Cardhu only
Dynamic thermal throttling	Software with hardware fail-safe
DRAM self-refresh	
Ultra-Low Power Standby	Notes
Suspend (LP1)	-
Deep Sleep (LP0)	-
USB Suspend during Deep Sleep	-
Wake with power button and RTC	
Peripheral Power Management	Notes
NVIDIA Pixel Rendering Intensity and Saturation Management (PRISM)	Cardhu only; Display driver
Additional Notes	
Unless otherwise noted, all features pertain to Cardhu and Ventana.	

Boot Loaders

General	Notes
Fastboot	Supports booting from USB, SD card, internal memory (eMMC), and network file-system (NFS) boot
U-Boot	Source code available. Supports booting from USB, SD card, internal memory (eMMC), network file-system (NFS) boot, and Trivial File Transfer Protocol (TFTP) boot

Licenses

This section provides license information for the following:

- [NVIDIA Software](#)
- [Sample File System](#)
- [Package Codecs](#)
- [GST OpenMAX](#)
- [Linux Kernel](#)
- [mkbootimg and mkubootscript](#)
- [mkyaffs2img](#)
- [U-Boot and mkimage](#)

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Sample File System

The sample root file system is derived from Ubuntu Linux, version 11.04.

Information on re-creating the root file system is provided in the *Release Notes*. The license agreement for each software component is located in the software component's source code, made available from the same location from which this software was downloaded, or by request to oss-requests@nvidia.com.

Package Codecs

Note: This software license applies to codec package of NVIDIA® Tegra® Linux Driver Package.

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For the sake of clarity, the parties agree that, notwithstanding the preceding paragraph, any and all information identified as Confidential Information (as defined in the NDA) by the disclosing party in connection with this Agreement shall also be protected under the NDA; provided, however, that in the event of any conflict between the confidentiality obligations pursuant to this Agreement and the obligations pursuant to the NDA with regard to any Confidential Information (as defined in the NDA) in connection with this Agreement, including, without limitation, the source code to the Licensed Materials, the terms of this Agreement shall prevail.

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Licensed Materials for the authorized purposes described in this Agreement, at this time Licensee will comply with the termination provisions in Section 6.2 below.

6.2 Termination. Either party may terminate this Agreement immediately upon written notice for the material breach of the other party, which material breach is curable and has remained uncured for a period of thirty (30) days from the date of delivery of written notice thereof to the other party. Upon the termination or expiration of this Agreement,

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6.3 Survival. Those provisions in this Agreement, which by their nature need to survive the termination or expiration of this Agreement, The following Sections shall survive termination or expiration of the Agreement, including but not limited to Sections 1, 2.2, 2.3, 2.4, 3, 4, 5, 6.2 , 6.3, 7, 8, 9 and Exhibit A.

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9.3 Jurisdiction. The state and/or federal courts residing in Santa Clara County, California shall have exclusive jurisdiction over any dispute or claim arising out of this Agreement.

9.4 Severability. If for any reason a court of competent jurisdiction finds any provision of this Agreement, or portion thereof, to be unenforceable, that provision of the Agreement will be enforced to the maximum extent permissible so as to affect the intent of the parties, and the remainder of this Agreement will continue in full force and effect. This Agreement has been negotiated by the parties and their respective counsel and will be interpreted fairly in accordance with its terms and without any strict construction in favor of or against either party.

9.5 Amendments. The Agreement shall not be modified except by a written agreement that names this Agreement and any provision to be modified, is dated subsequent to the Effective Date, and is signed by duly authorized representatives of both parties.

9.6 No Waiver. No failure or delay on the part of either party in the exercise of any right, power or remedy under this Agreement or under law, or to insist upon or enforce performance by the other party of any of the provisions of this Agreement or under law, shall operate as a waiver thereof, nor shall any single or partial exercise of any right, power or remedy preclude other or further exercise thereof, or the exercise of any other right, power or remedy; rather the provision, right, or remedy shall be and remain in full force and effect.

9.7 No Assignment. This Agreement, and each party's rights and obligations herein, may not be assigned, subcontracted, delegated, or otherwise transferred by either

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gst-openmax (libgstomx.so)

Version 2.1, February 1999

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Version 2, June 1991

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```

<signature of Ty Coon>, 1 April 1989
Ty Coon, President of Vice

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U-Boot and mkimage

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=====

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FAQs

How do I use 64-bit Ubuntu with Tegra Linux Driver Package?

If you are running a 64-bit Ubuntu installation on the host PC, this release requires that you have 32-bit runtime support installed as well. The simple steps for installing 32-bit support on an Ubuntu host use the apt-get command.

To install 32-bit runtime support

- Execute the following commands:

```
$ sudo apt-get update
$ sudo apt-get install ia32-libs
```

Note: If ia32-libs is not installed, flashing the boot loader with the kernel (and, possibly, other steps in the process) will fail.

How do I use display mode and resolution configuration with the X RandR application?

You can use the X Resize, Rotate and Reflect Extension (RandR) extension to manipulate and configure the attached displays (both the internal panel and any externally connected HDMI® panel). The `xrandr (1)` utility is the most common way to do this.

A tutorial on xrandr can be found on the following website:

http://www.thinkwiki.org/wiki/Xorg_RandR_1.2

Are there generated ssh host keys for the sample file system?

There are no keys in the `/etc/ssh` directory of the provided sample file system. For information about creating the ssh host keys, see the `ssh-keygen` man page. For more information, see [About the Root File System](#) in [Getting Started](#).

How do I determine the X driver ABI of the X server used in the root file system?

By default all `tegra_drv.abi*.so` files are in the driver package. The `apply_binaries.sh` script creates a sym-link from `tegra_drv.so` to the default (or overridden) X ABI driver when running the script. For more information, see [Setting Up the Root File System](#) in [Getting Started](#).

Can I install a different X driver Application Binary Interface (ABI)?

Yes. For more information, see [Setting Up the Root File System](#) in [Getting Started](#).

How do I disable the Ubuntu firewall which is blocking NFS root access?

See [Configuring NFS Root on the Linux Host](#) in [Getting Started](#).

What is the sample rootfs log-in password?

The username is ubuntu and the password ubuntu. For more information about the sample file system, see [Setting Up Your File System](#) in [Getting Started](#).

How do I prevent the system display from blanking out?

Linux kernel 3.1 adds a power saving feature that blanks an idle system display, even when an application is running. The feature is called console blank (screen saver). It is defined as:

consoleblank= [KNL] The console blank (screen saver) timeout in seconds. Defaults to 10*60 = 10mins. A value of 0 disables the blank timer.

By passing arguments to the kernel command line, you can:

- Disable this feature or
- Set the timeout to a longer interval.

With the `flash.sh` script, you can override the kernel command line options passed from fastboot to the kernel. For more information, see [Flash Script Usage](#) in [Getting Started](#).

To disable the console blank (screen saver) feature from the kernel command line

1. Add the following line to the kernel parameters in the grub configuration:

```
'consoleblank=0'
```

2. View the current consoleblank value with the following command:

```
$ cat /sys/module/kernel/parameters/consoleblank
```

To disable the console blank feature with an escape sequence

- Enter the following escape sequence:

```
$ echo -ne "\033[9;0]"
```

To change the console blank timeout value with an escape sequence

- Enter the following escape sequence:

```
$ echo -ne "\033[9;<timeout>]"
```

where <timeout> is the timeout in seconds

For more information on this escape sequence, see the `console_codes(4)` man page documents. For information on the input/output controls that provide some of the same functionality, see the `console_ioctl(4)` man page.

Glossary

[\[3\]](#) [\[4\]](#) [\[A\]](#) [\[B\]](#) [\[C\]](#) [\[D\]](#) [\[E\]](#) [\[F\]](#) [\[G\]](#) [\[H\]](#) [\[I\]](#) [\[J\]](#) [\[K\]](#) [\[L\]](#) [\[M\]](#) [\[N\]](#) [\[O\]](#) [\[P\]](#) [\[Q\]](#) [\[R\]](#) [\[S\]](#) [\[T\]](#) [\[U\]](#) [\[V\]](#) [\[W\]](#)
[\[X\]](#) [\[Y\]](#) [\[Z\]](#)

3

3G

Third generation mobile phone standard/technology, based on standards defined by the International Telecommunication Union (ITU).

3G2

A standard for 3GP format for CDMA-based phones (3GPP2) and container format with filename extension (.3gp).

3GP

Simplified version of MPEG-4 Part 14 (.mp4) container format.

3GPP

3rd Generation Partnership Project. A collaboration among telecommunications associations to define globally applicable third generation (3G) mobile phone system specifications. For more information, see <http://www.3gpp.org>.

3P

Platform Programming Protocol, developed by NVIDIA for client-server communications between PC and device.

4

4CIF

4 x CIF (704 x 576), Common International Format (CIF) for horizontal and vertical resolutions of YCbCr.

A

A2DP

Advanced Audio Distribution Profile. For streaming stereo or mono audio from one device to another over Bluetooth. For more information, see <http://www.atheros.com/>.

AAC

Advanced Audio Coding. A lossy compression and encoding standard for digital audio.

AAC-LC

Advanced Audio Coding-Low Complexity. A standardized, lossy compression and encoding scheme for digital audio.

AAC+

Advanced Audio Coding Plus, or aacPlus. Same as High Efficiency AAC (HE-AAC), which extends the Low Complexity AAC (AAC LC) optimized for low-bit rate applications such as streaming audio.

ADB

Android Debug Bridge. A client-server tool for managing an emulator instance or Android-based device. For more information, see <http://developer.android.com/guide/developing/tools/adb.html>.

ADMA

Advanced Direct Memory Access.

ADPCM

Adaptive DPCM (differential pulse-code modulation).

AE

Auto exposure.

AES

Advanced Encryption Standard.

AF

Auto focus.

AGC

Automatic gain control.

ALSA

Advanced Linux Sound Architecture.

AMR

Adaptive multi-rate. An audio data compression scheme optimized for speech coding.

AMR-NB

Adaptive multi-rate (AMR) narrow band.

AMR-WB

Adaptive multi-rate wide band.

ANR

In Android, “Application Not Responding” error.

In camera, advanced noise reduction.

AP

Application Processor. An application processor is a computer that processes data (as opposed to one that controls data flow, like a database server). The Tegra® series application processors offer low power, high performance ARM® processors that handle 2D, 3D, audio, and high-definition (HD) video data streams. These decoding and encoding functionalities are provided by a set of interfaces including multiple memory, storage, video, audio, and peripheral interfaces.

AVC

Advanced Video Coding.

AVI

Audio Video Interleave. A multimedia container format, special-case Resource Interchange File Format (RIFF) file that can contain both audio and video data; this format enables synchronous audio-with-video playback. For more information, see [http://msdn.microsoft.com/en-us/library/ms779631\(VS.85\).aspx](http://msdn.microsoft.com/en-us/library/ms779631(VS.85).aspx).

AWB

Container format for AMR-WB speech encoding with filename extension (.awb).

B

BCB

Boot Control Block.

BCT

NVIDIA Boot Configuration Table.

bitblt

A graphics operation that combines several bitmap patterns into one, typically using a raster operator.

Bpp

Bytes per pixel, used to specify pixel depth (color depth).

bpp

Bits per pixel, used to specify pixel depth (color depth).

Bluetooth

Wireless standard for data exchange over short distances. For more information, see <http://www.bluetooth.com/English/Pages/default.aspx>.

BSAC

Bit Sliced Arithmetic Coding. An MPEG-4 standard (ISO/IEC 14496-3 subpart 4) for scalable audio coding.

BusyBox

Utility providing small versions of common UNIX utilities in a single executable. For more information, see <http://www.busybox.net>.

C

CABAC

Context-adaptive binary arithmetic coding. A type of entropy coding used in H.264/MPEG-4 AVC video encoding.

CBR

Constant bit rate.

CDC

USB Communications Device Class.

CDMA

Code division multiple access. Channel access method for radio communication.

CE

NVIDIA customer engineer.

Cg

C for Graphics. A high-level shading language for programming vertex and pixel shaders, created by NVIDIA Corporation.

CIF

Common International Format (352 x 288), standardizes horizontal/vertical resolutions for video.

color space

Specifies how color is represented, such as YUV, RGB, or gray scale.

D**D3DM**

Microsoft Direct3D Mobile technologies.

DCC

Debug communications channel.

DCT

Discrete cosine transform. A Fourier-related transform similar to the discrete Fourier transform (DFT), but using only real numbers.

DDI

Device driver interface for Windows CE.

DDK

NVIDIA® Driver Development Kit.

deprecated

This feature is slated to be removed at a later release. Developers should begin to remove dependencies on this feature in preparation for its eventual removal.

development system

Board with NVIDIA® Tegra® processor used to do engineering work, which is typically focused on firmware/software development. Development boards have a user manual but may or may not include detailed documents, like schematics.

DFS

Dynamic frequency scaling.

DIDIM

Dynamic Image-based Display Intensity Modulation, which has been renamed pixel rendering intensity and saturation management (PRISM) since CES 2012.

DivX

Codec by DivX, Inc., that uses lossy MPEG-4 Part 2 compression to compress lengthy video into small sizes with high visual quality and is often used for “ripping”. For more information, see <http://www.divx.com>.

DMO

Microsoft DirectX Media Object. For more information, see <http://msdn2.microsoft.com/en-us/library/ms783356.aspx>.

DPB

In H.264, Decode Picture Buffer.

DRC

Dynamic range compression.

DSI

Display Serial Interface a communication protocol specification by the Mobile Industry Processor Interface (MIPI) Alliance for reducing cost of displays in mobile devices.

DVB-H

Digital video broadcasting—handheld.

DVB-T

Digital video broadcasting — terrestrial.

DVFS

Dynamic voltage frequency scaling.

DVS

Dynamic voltage scaling.

E**eAAC+**

Enhanced AAC+. Combines HE-AAC v1 (or AAC+) coupled with Parametric Stereo to 3GPP.

ECI

NVIDIA Embedded Controller Interface. Communication interface between NVIDIA® Tegra® processor and an embedded controller (EC) for netbook/smartbook applications.

EGL

Embedded-Systems Graphics Library. For OpenGL ES.

eMMC

Embedded MMC. Developed by JEDEC and MMCA for embedded flash memory applications. For more information, see <http://www.mmca.org>.

EQ

Equalizer.

Escape code base + value

Microsoft supports definition of additional driver-specific escape codes, starting at an ESCAPECODEBASE of decimal value 100,000. So an NVIDIA-defined escape code whose value is 7 is actually 100007. ($100000 + 7 = 100007$)

Exif

Exchangeable image file format. A specification for digital camera image file formats.

Ext2

Second extended file system for the Linux kernel, designed to replace the extended file system (ext).

Ext3

Third extended file system. A journaling file system often used by the Linux kernel, the default file system for some distributions.

Ext4

Fourth extended file system. A journaling file system often used by the Linux kernel. It is the successor to Ext3.

F

Fastboot

Software supporting a protocol for updating flash file systems and unsigned partition images for Android-based devices.

Flash 11

Adobe multimedia platform enabling animation and interactivity on Web pages. For more information, see <http://get.adobe.com/flashplayer>.

FMO

Flexible macroblock ordering. Technique for restructuring the ordering of the representation of the fundamental regions in pictures, known as macroblocks. FMO is also referred to as slice groups and arbitrary slice ordering (ASO).

FOV

In photography, field of view.

G

GL ES

See [OpenGL ES](#).

GLSL

OpenGL Shading Language. A high level, C-language shading language.

GPIO

General purpose input/output. This is a generic pin on a chip whose behavior can be controlled with software.

GPS

Global positioning system.

GPU

Graphics processing unit.

H

H.263

A video codec standard for low-bit rate compressed format videoconferencing, designed by the ITU-T in a project ending in 1995/1996. For more information, see <http://en.wikipedia.org/wiki/H.263>.

H.264

A standard for video compression, also known as MPEG-4 Part 10, or AVC (for Advanced Video Coding). For more information, http://en.wikipedia.org/wiki/H.264/MPEG-4_AVC.

HD

High-definition.

HDCP

High-bandwidth Digital Content Protection. Digital copy protection technology developed by Intel Corporation to protect digital audio and video content as it travels across connections. For more information, see <http://www.digital-cp.com>.

HDMI

High-Definition Multimedia Interface. A compact audio/video connector interface used to connect HDMI-enabled digital audio devices for transmitting uncompressed digital streams. NVIDIA® Tegra® BSP incorporates support for HDMI® technology.

HID

Human interface device. A computer device that receives human input and may deliver output.

HSMMC

High-speed MultiMediaCard (MMC).

HTTP

Hypertext transfer protocol. A client-server communications protocol used for hyperlinked text documents on the Internet.

I

I2C

Inter-Integrated Circuit. A serial computer bus used to attach low-speed peripherals to an embedded system or cell phone.

I2S

Inter-IC Sound (or Integrated Interchip Sound). A serial bus interface standard for connecting to digital audio devices.

ID3

Metadata container typically used with MP3 formatted content.

IIR

Infinite impulse response, a property of signal processing systems.

ISDB-T

Terrestrial Integrated Services Digital Broadcasting.

ISP

File extension for NVIDIA Image Signal Processing pipeline (.isp) configuration files.

ISV

Independent software vendor.

J

JPEG

Method for compressing photographic images. For more information, see <http://www.jpeg.org>.

JTAG

Joint Test Action Group (JTAG). Common term used for the IEEE 1149.1 standard “Standard Test Access Port and Boundary-Scan Architecture” for testing printed circuit boards. In embedded development, in-circuit emulators use JTAG as a transport mechanism to provide a way into the embedded system for debugging.

L

LBR

Low bit rate.

LCD

Liquid crystal display.

LP

Low power, or low power filter bank.

M

M4A

Multimedia MPEG-4 container format file extension (.m4a), first popularized by Apple to assure presence of audio/video content as distinguished from .mp4 files which may or may not have video content.

M4B

Multimedia MPEG-4 container format file extension (.m4b) for audio book and podcast files. Typically contain metadata for chapters, images, and hyperlinks.

Meebo

An instant messaging program based on Ajax and libpurple free/open source library. For more information, see <http://www.meebo.com> and <http://www.pidgin.im>.

MIDI

Musical instrument digital interface. For synchronization of electronic musical instrument and computer communications of digital data events (such as for pitch and volume) in realtime.

MIO

Modular input/output. Enables adding peripheral cards to laser printers. For more information, see <http://www.hp.com/>.

MJPEG

Motion JPEG (M-JPEG) are video formats where video frames/ interlaced fields in digital video is compressed separately as a JPEG image.

MLC

Multilevel cell. Flash memory that stores more than one bit per cell by using voltage levels.

MMC

MultiMediaCard. Removable solid-state memory card for use in mobile devices. For more information, see <http://www.mmca.org>.

MOV

File format for QuickTime that functions as a multimedia container file containing one or multiple tracks that stores audio, video, effects, or text.

moviNAND

High-density MLC NAND Flash combined with MMC controller. For more information, see http://www.samsung.com/global/business/semiconductor/products/fusionmemory/Products_MoviNAND.html.

MP

Megapixel.

MP3

MPEG-1 Audio Layer 3. Also the container format or filename extension (.mp3) for MPEG-1 Audio Layer 3 files.

MP4

Container format or filename extension (.mp4) for MPEG-4 Part 14 files.

MPEG-2

Generic coding standard for movies, which specifies a combination of lossy video compression and lossy audio compression (audio data compression).

MPEG-4

MPEG-4 Part 2 video compression technology. A DCT compression standard belonging to the MPEG-4 ISO/IEC standard (ISO/IEC 14496-2). For more information, see <http://www.mpeg.org>.

MPIO

Multi-purpose input output. This is a type of pin-mux pad that can be configured as GPIO or SFIO.

MSC

Mass storage device class. USB Implementers Forum computing communications protocols for the Universal Serial Bus (USB). For more information, see http://www.usb.org/developers/devclass_docs/usb_msc_overview_1.2.pdf.

MSD

Mass storage device.

MSDN

Microsoft Developer Network. For more information, see <http://msdn2.microsoft.com/en-us/default.aspx>.

MTD

Memory technology device, used by Linux to interact with flash memory.

MVC

Multiview Video Coding (MVC), amends H.264/MPEG-4 AVC standard to enable encoding simultaneously from multiple cameras using a single video stream.

N**NAND**

Type of flash memory, typically used in USB devices and memory cards.

NB

Narrow band.

NDK

Android toolset enabling embedded components to use native code in Android applications. For more information, see <http://developer.android.com/sdk/ndk/overview.html>.

Netflix

Provides rental-by-mail of digital video content as well as Internet streaming on demand. For more information, see <https://www.netflix.com>.

NFS

Network File System, an open standard protocol.

Nv3P

NVIDIA platform programming protocol (includes 3P server and 3P client).

NvBL

NVIDIA Boot Library.

NvDDK

NVIDIA Driver Development Kit.

NVIDIA production mode

This is the mode in which Tegra chips are provided from NVIDIA. In this mode, fuses can still be programmed via recovery mode. Boot configuration tables (BCTs) and boot loaders are signed with a key of all 0's, but are not encrypted.

NvRM

NVIDIA Resource Manager.

O

OAL

OEM adaptation layer for Windows CE.

ODM

Original design or device manufacturer.

ODM non-secure mode

This is the mode in which ODMs ship products without stringent security mechanisms; however, in this mode, fuses can no longer be programmed. As in NVIDIA production mode, boot configuration tables (BCTs) and boot loaders are signed with a key of all 0's and not encrypted. This mode is sometimes called ODM production mode.

ODM secure mode

This is the mode in which ODMs ship products with strict security measures in force. Fuses cannot be programmed, and all boot configuration tables (BCTs), boot loaders, and microboots must be signed and encrypted with the secure boot key (SBK).

OEM

Original equipment manufacturer.

OGA

Container for Vorbis audio-only files. For more information, see <http://xiph.org>.

Ogg

Container for Vorbis codec. For more information, see <http://xiph.org>.

Ogg Vorbis

A free/open source, lossy audio codec (Vorbis) and its container (Ogg). For more information, see <http://xiph.org>.

OGM

Early file format for embedding video into Ogg. Use of this format is currently discouraged by Xiph. For more information, see <http://xiph.org>.

ONFI

Open NAND Flash Interface, an industry workgroup that build, design-in, or enable NAND Flash memory.

OpenAL

Free cross-platform audio API (resembling OpenGL API style) for efficient rendering of multichannel three dimensional positional audio.

OpenGL ES

A subset of OpenGL 3D graphics API designed for embedded systems, defined by the Khronos Group. For more information, see <http://www.khronos.org>.

OpenKODE

A set of APIs for handheld games and media applications providing a cross-platform abstraction layer for other “open” media technologies. For more information, see <http://www.khronos.org>.

OpenSL ES

Open Sound Library for Embedded Systems. A royalty-free, cross-platform, hardware-accelerated audio API for 2D and 3D audio. For more information, see <http://www.khronos.org>.

OpenMAX

An application programming interface that provides abstractions for routines especially useful for computer graphics, video, and sound, defined by the Khronos Group. For more information, see <http://www.khronos.org>.

OpenMAX IL

OpenMAX Integration Layer. Provides an abstraction layer API between a media framework, such as DirectShow, and a set of multimedia components, such as audio and video codecs. For more information, see <http://www.khronos.org>.

OpenVG

A standard API for hardware-accelerated 2D vector graphics, defined by the Khronos Group. For more information, see <http://www.khronos.org>.

OTA

Over-the-air or wireless.

OTG

USB On-The-Go.

P

platform

The code name of an NVIDIA® Tegra® development system, such as kai for Tegra Kai, cardhu for Ventana T3T, enterprise for Ventana T3S, or ventana for Ventana T2T.

PAN

Personal area networking. A Bluetooth profile. For more information, see <http://www.atheros.com/>.

PCM

Pulse-code modulation.

PIP

Picture-in-picture.

PMU

Power Management Unit.

pixel depth

Number of bits per pixel (bpp).

PRISM

NVIDIA Pixel Rendering Intensity and Saturation Management (PRISM) display technology (formerly known as [DIDIM](#)). To save battery life, PRISM separates color and backlight intensity while preserving fidelity, so the amount of backlighting needed is reduced without making images appear dim.

PS

Parametric stereo.

Q

QCELP

Qualcomm Code Excited Linear Prediction, also known as Qualcomm PureVoice. Speech codec that increases the speech quality of the IS-96A codec used in [CDMA](#). For more information, see <http://www.qualcomm.com/qct>.

QP

Quantization Parameter.

QuickTime

Apple multimedia framework for digital multimedia, text, animation, etc., playback/streaming. For more information, see <http://www.apple.com/quicktime/download>.

R

RCK

Recovery kernel.

RCM

Recovery mode messages.

RFC

Request for Comments.

RIL

Radio Interface Layer.

RNDIS

Remote NDIS. A specification for network devices on buses such as USB. For more information, see

<http://www.microsoft.com/whdc/device/network/NDIS/rmNDIS.mspx>.

ROP

Raster operator.

RTC

Real-time clock.

RTP

Real-time transport protocol for delivering A/V content over the Internet.

RTSP

Real time streaming protocol allowing clients to issue transport commands and control a streaming media server remotely.

S

SBC

Sub-band codec. For breaking signals into different frequency bands to encode them independently.

SBK

Secure boot key.

SBR

Spectral band replication.

scan code

The physical key on the keypad.

SCO

Synchronous Connection Oriented link. For a mono, PCM audio channel.

SD

Secure Digital card. Non-volatile memory card. For more information, see <http://www.sdcard.org/home>.

SDHC

Secure Digital High Capacity. For more information, see <http://www.sdcard.org/home>.

SDHCI

Secure Digital Host Controller Interface.

SDIO

Secure Digital Input Output. SD card combined with an I/O device. For more information, see <http://www.sdcard.org/home>.

SDRAM

Synchronous dynamic random access memory.

SDP

Session Description Protocol, an IETF Proposed Standard that describes streaming communication sessions to announce and invite the session and to negotiate parameters.

secure boot

A common term used to refer to a boot loader that uses enhanced security, such as asymmetric encryption (public key encryption). For more information, see the Windows CE 6.0 Technical Article "Secure Download Boot Loader in Windows Embedded CE" at <http://msdn2.microsoft.com/en-us/library/bb643805.aspx>.

SFIO

Special function input output. This term is a category of roles that MPIO pads can be configured with.

SHOUTcast

Cross-platform media-streaming server (freeware), developed by Nullsoft, which enables Internet radio network creation. For more information, see <http://www.shoutcast.com>.

SIP

Session Initiation Protocol. Signaling protocol from the Internet Engineering Task Force (IETF) used to control multimedia communication sessions for voice and video over Internet protocol (VoIP).

S-LINK

Simple link interface. A high-performance data acquisition standard where data will be collected and stored by computers at both ends of the link. For more information, see <http://hsi.web.cern.ch/HSI/s-link>.

SLC

Single-level cell. Flash memory that stores one bit per cell.

SMP

Symmetric multiprocessing.

SMS

Short Message Service. Allows sending short text messages between mobile telephone devices.

SNR

Signal-to-noise ratio.

Sorenson

Sorenson codec used in Apple's QuickTime and in Adobe Flash. For more information, see <http://www.sorensonmedia.com>.

SOC

System-on-chip, which integrates computer components and other electronics into a single integrated circuit or chip. Also SoC.

S/PDIF

Sony/Philips Digital Interface.

SPI

Serial Peripheral Interface bus. A full-duplex mode, synchronous serial data link.

SPI flash

Small, low-power flash memory that uses a serial interface (usually SPI) for sequential data access.

SRC

Sample rate conversion.

SSK

Unique, per-chip Secure Storage Key used to protect customer-defined data. Typically a 128-bit key computed from the following fuse settings:

- 128-bit customer-programmed SBK.
- 32-bit customer-programmed Device Key (DK).
- 64-bit NVIDIA-programmed Unique ID (UID), which is different for every chip.

Stagefright

Media framework new in Android 2.2. For more information see <http://developer.android.com/sdk/android-2.2-highlights.html#PlatformTechnologies>.

T

Tegra

The world's first mobile super chip. The families of Tegra chipsets for mobile devices include:

- Tegra 3
- Tegra 2
- Tegra APX

THD

Total harmonic distortion.

TVO

Television output.

U

UART

Universal asynchronous receiver/transmitter. Computer hardware that translates data between parallel and serial forms, usually used for computer or peripheral device serial communications over a serial port.

U-Boot

Das U-Boot, a free (GNU GPL software) bootstrap loader for embedded systems. For more information, see <http://www.denx.de/wiki/U-Boot>.

Ubuntu

Supported Linux operating system by certain Tegra-based development products. For the specific Ubuntu version supported, see your *Release Notes*. For more information about Ubuntu, see <http://www.ubuntu.com>.

UIP

Update Image Partition.

ULP

Ultra low power.

USB

Universal serial bus. A standard that allows connections of many peripherals via a standardized interface socket. For more information, see <http://www.usb.org>.

USBNET

Linux usbnet driver. For more information, see <http://www.linux-usb.org/usbnet/>.

USP

Update Staging Partition.

V

VAD

Voice activation detection.

VBO

An OpenGL extension for faster rendering of triangles.

VBR

Variable bit rate.

VC-1

Common name of the SMPTE 421M video codec standard from Microsoft. For more information, see

<http://www.microsoft.com/windows/windowsmedia/howto/articles/vc1techoverview.aspx>.

VoIP

Voice-over-Internet protocol. Transmits voice through the Internet or other packet-switched networks.

Vorbis

A free/open source, lossy audio codec (Vorbis). For more information, see

<http://xiph.org>.

VP6

TrueMotion VP6 video codec developed by On2 Technologies used in broadcasting, as well as by Adobe Flash and Flash Video files. For more information, see

<http://www.on2.com>.

W

WAV

Microsoft and IBM waveform audio format for storing audio bitstreams.

WEP

Wired Equivalent Privacy. Secures IEEE 802.11 wireless networks.

WMA

Microsoft Windows Media Audio technologies. Also the compressed audio file format (.wma).

WMA Lossless

Microsoft Window Media Audio lossless audio codec, provides duplication of original audio so that no data are lost.

WMA Pro

Microsoft Windows Media Audio Professional technologies.

WMA Pro LBR

Low bit rate mode of Microsoft Windows Media Audio Professional technologies.

WMV

Microsoft Windows Media Video technologies. Also the compressed video file format (.wmv).

WPA

Wi-Fi Protected Access. Certified security for wireless computer networks.

X

Xvid

Free video codec library based on the MPEG-4 standard. Xvid uses MPEG-4 Advanced Simple Profile (ASP) compression with video encoded with MPEG-4 ASP video, and so can be decoded by all MPEG-4 ASP-based decoders. For more information, see <http://www.xvid.org>.

Y

YAFFS

Yet Another Flash File System. The first file system designed for NAND flash.

Z

zImage

Conventional (but not required) name for the uncompressed kernel boot image file in Linux. **bzImage** is the compressed or “big” zImage file for systems requiring the kernel image to be under a certain size.

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