Technical Application Note

Using Linux with USB 3.0

Technical Application Note TAN2012007
Revised October 17, 2013

1.1. Subject

Technical Application Note (TAN2012007): Using Linux with USB 3.0

1.2. Applicable Product(s)

- **FlyCapture SDK Version 2.4**
- **Point Grey USB 3.0 cameras (Note: Ladybug5 is not supported on Linux.)**

1.3. Application Note Description

This Application Note explains the components and steps that are necessary to install and configure Linux for use with FlyCapture and USB 3.0.

1.4. Intended Audience

This Technical Application Note is intended for users of Point Grey USB 3.0 imaging cameras who want to program and operate cameras in a Linux environment.

Testing is ongoing. Wherever possible limitations have been noted; however, as more testing is completed this information may change. All possible configurations may not experience the same results.

1.5. Overview

The following topics are covered:

1.6. Supported System Configuration

Before installing, you must have the following prerequisites:

- A computer with a Gen2 PCIe slot is required to achieve maximum USB 3.0 transfer rates
- A USB 3.0 cable
- Linux distribution. The recommended version is 12.04
  http://www.ubuntu.com
- A Point Grey USB 3.0 imaging camera: Flea3 USB 3.0 or Grasshopper3 USB 3.0
  This TAN does not apply to other Point Grey imaging cameras (FireWire, USB 2.0, GigE, or CameraLink) or the Ladybug5 spherical camera.

For information on supported USB 3.0 system components, please see Knowledge Base Article 368.

For information on using Linux with other Point Grey Imaging Cameras, please see Knowledge Base Article 330.

The configuration of the test environment we used was:

Operating System	Ubuntu 12.04 LTS (32- and 64-bit)
Kernels	3.5.7.0 3.5.3.0 3.5.2.0 3.5.1.0 3.5.0-15-generic
Processor	Intel Core i3-2120 CPU @ 3.30 GHz Intel Core i7-2600K CPU @ 3.40 GHz
Memory	4 GB
USB3 Controllers	On board USB3.0 controller (NEC chipset) USB3.0 PCIe card controller (NEC chipset)
Cameras	Flea3 FL3-U3-32S2C (1.34.3.0) Flea3 FL3-U3-13S2C (1.34.3.0)

1.7. Installing and Configuring Linux

For step by step Ubuntu installation instructions see the Ubuntu documentation at:

https://help.ubuntu.com/12.04/installation-guide/index.html

Ubuntu 12.04 is the long term support (LTS) release that Point Grey supports. Ubuntu 12.04.2 provides USB3 support.

For FlyCapture2 to run on a Linux Ubuntu system, the following dependencies must be installed:

- libgtkmm-2.4-dev
- libglademm-2.4-dev
- libusb-1.0

These libraries are usually packaged with Ubuntu distributions or updates. If they are not pre-installed, use the `apt-get` console command, as in the following example:

Ubuntu 12.04:

```
user$: sudo apt-get install libgtkmm-2.4-dev libglademm-2.4-dev libusb-1.0-0
```

The raw1394 *module that is installed with the* libraw1394-8 *package may not load after a reboot, causing a FlyCapture bus event error and failure to start an application. To fix, add* raw1394 *to the* /etc/modules *file. If problems persist, add* video1394 *as well.*

1.8. Checking your Linux Version

If you have already installed a version of Ubuntu but are unsure if it supports USB3 run the following command:

```
$ uname -r
```

The results look like this:

```
3.5.0-<specific release>
```

If the version is 3.5.0 or greater, your version supports USB3 and you can skip to Section 1.10 Configuring USBFS.

If the version is less than 3.5.0, run the update manager tool to install the newest updates, or run the following command:

```
$ sudo apt-get update && sudo apt-get upgrade
```

To install the kernel run the following command:

```
$ sudo apt-get install linux-generic-lts-quantal
```

If you prefer not to upgrade, proceed to Section 1.9 Compiling a Custom Kernel for USB3 Support (below) to manually configure your system.

1.9. Compiling a Custom Kernel for USB3 Support

Ubuntu 12.04.2 provides USB3 support without having to compile a custom kernel.

To compile Linux Kernel the following is required:

- gcc latest version
- ncurses development package
- Up-to-date system packages

To install the dependencies run the following commands in terminal and type the password for the user, when prompted.

Gcc Installation

```
$ sudo apt-get install gcc
```

Ncurses dev package

```
$ sudo apt-get install libncurses5-dev
```

Update to the newest packages

```
$ sudo apt-get update && sudo apt-get upgrade
```

1.9.1. Getting the Kernel

1. Download the kernel from kernel.org. The kernel with USB3 support is 3.5-rc3. To download Kernel version 3.5-rc3 run this command:

   ```
   $ wget http://www.kernel.org/pub/linux/kernel/v3.0/testing/linux-3.5-rc3.tar.bz2
   ```

2. Extract the kernel package into the /usr/src directory. First locate where the package was downloaded (most commonly in the Downloads directory):

   ```
   $ cd Downloads/
   ```

3. Untar the package into /usr/src. You will need root permissions to do this.

   ```
   $ sudo tar -xvf linux-3.5-rc3.tar.bz2 -C /usr/src
   ```

   The unpacking may take some time.

4. Once unpacked, go to that directory to proceed with configuring the kernel.

   ```
   $ cd /usr/src/linux-3.5-rc3/
   ```

1.9.2. Configuring the Kernel

Most of the default options for the kernel are appropriate for our use. However, you must select the ext4 file system and enable USB3 support.

1. To start configuration, run this command:

   ```
   $ sudo make menuconfig
   ```

2. From the Kernel Configuration menu, select File systems, and ensure ext4 is selected.

3. From the Device Drivers menu, select USB Support, and ensure that xHCI USB3 is selected.
4. Exit and save the configuration. This creates a file called .config in your root kernel src directory.
5. Open the .config file in a text editor:

   ```
   $ sudo gedit .config
   ```

6. Find the rts5139 module and comment it out using #.

This removes this configuration for one specific kernel driver for a realtek memory card reader which caused issues during testing.

1.9.3. Compiling and Installing the Kernel

Compilation can take about an hour.

- To compile run this command:

  ```
  $ sudo make
  ```

  When asked if you want to add the commented out module, answer N.

- To install run this command:

  ```
  $ sudo make modules_install install
  ```

This creates a number of files under your /boot/ directory and also makes an entry in grub.cfg for the new kernel. You should check that you have all these files in the /boot/ directory:

- System.map-3.5.0-rc3
- vmlinuz-3.5.0-rc3
- initrd.img-3.5.0-rc3
- config-3.5.0-rc5

Once the kernel is compiled, reboot your computer. It can now capture images up to 2 MB.

1.10. Configuring USBFS

To be able to capture images over 2 MB, extend the USBFS limit on how many buffers can be locked into the driver. This is done by updating the boot params in grub.

1. Open the /etc/default/grub file in any text editor. Find and replace:

   ```
   GRUB_CMDLINE_LINUX_DEFAULT="quiet splash"
   ```

   With this:

   ```
   GRUB_CMDLINE_LINUX_DEFAULT="quiet splash usbcore.usbfs_memory_mb=1000"
   ```

2. Update grub with these settings:

   ```
   $ sudo update-grub
   ```

3. To manually set the max usbfs memory limit run this command:

   ```
   $ sudo modprobe usbcore usbfs_memory_mb=1000
   ```

4. Reboot and test a USB3 camera.

1.11. Installing the FlyCapture SDK

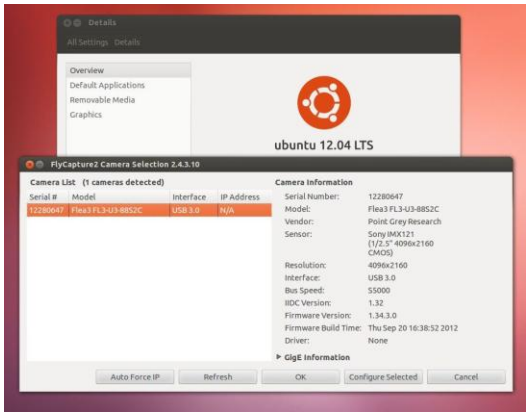
To install the FlyCapture2 SDK:

1. Download FlyCapture2 SDK from the Point Grey Downloads webpage. You will need a downloads account to access the Download links.
2. Unpack the software in the directory where you want to install it. There are ten packages:
   - libflycapture-<version>_<platorm>.deb
   - libflycapture-<version>_<platorm>-dev.deb
   - libflycapturegui-<version>_<platorm>.deb
   - libflycapturegui-<version>_<platorm>-dev.deb
   - libflycapture-c-<version>_<platorm>.deb
   - libflycapture-c-<version>_<platorm>-dev.deb
   - libflycapturegui-c-<version>_<platorm>.deb
   - libflycapturegui-c-<version>_<platorm>-dev.deb
   - flycap-<version>_<platorm>.deb
   - flycapture-doc-<version>_<platform>.deb

   The packages with a preceding 'lib' are all the shared objects and their respective dev packages. The flycap package installs the capture application which can be launched by typing 'flycap' in a terminal or through the Applications menu. The flycapture-doc package contains our documentation in pdf format.
3. Run the install script in the same directory into which you unpacked the software. '

   ```
   user$ sudo sh install_flycapture.sh
   ```
4. Follow the instructions of the script. This installs all the FlyCapture2 libraries, example code, sample applications, and documentation.

   Additionally, the script prompts you to configure udev so that devices can be used by a particular user. If you choose to configure devices, the script changes permissions on the nodes by overwriting the default Ubuntu permissions and giving the user full read and write access to the device nodes.
5. Restart your computer for the user permissions to take effect.



Screenshot of FlyCapture2

1.12. Compiling the Examples

The FlyCapture SDK includes a number of example applications to help get you started in programming common API tasks. The example files are installed under `/usr/src/flycapture/src/`.

We suggest copying the extracted folder and sub-folders to a location with write access.

To compile the examples, install the GNU C++ (g++) compiler that is included with the build-essential package:

```
user$ sudo apt-get install build-essential
```

Some of the examples are GUI-based. The gtk and glade libraries are required to build these examples. These libraries should already be installed under Section 0. Note that the **FlyCaptureGUI** example must be built before the **FlyCap2** or **FlyCapture2GUITest** examples can be built.

To compile a specific example, run the makefile located in the example directory. Binaries are copied to the bin directory, and libraries are copied to the lib directory. For example:

```
user$ cd <extraction folder>/FlyCapture-<version>/src/FlyCapture2Test
user$ make
```

1.13. Limitations Using Linux

Linux users do **not** have access to Microsoft Windows-only technologies such as:

- DirectShow
- Cognex AIK
- Twain
- Managed .NET API
- ActiveX

FlyCapture2 on a Linux device does **not** support:

- DriverControlGUI
- RegistryControl

Some users may experience streaming errors when using a custom Format 7 video mode at certain resolutions. To correct the error, increment the height or width of the image by one step or use a standard video mode.

1.14. Viewing Images and Videos

We suggest the following tools for viewing previously recorded images and videos. Point Grey does not officially endorse these tools.

For image viewing:

- gimp
- ImageJ

For video viewing:

- VLC media player

For working with Glade files:

- Glade

1.15. Removing FlyCapture

To remove FlyCapture, run the uninstall script.

```
user$: sudo sh remove_flycapture
```

Delete any extracted files or newly compiled files on your system.

The uninstall script also removes the udev rules therefore restoring the original Ubuntu permissions on the device nodes.

1.16. Additional Downloads and Support

Point Grey Research Inc. endeavors to provide the highest level of technical support possible to our customers. Most support resources can be accessed through the Support section of our website.

Creating a Customer Login Account

The first step in accessing our technical support resources is to obtain a Customer Login Account. This requires a valid name and email address. To apply for a Customer Login Account go to the Downloads page.

Knowledge Base

Our Knowledge Base contains answers to some of the most common support questions. It is constantly updated, expanded, and refined to ensure that our customers have access to the latest information.

Product Downloads

Customers with a Customer Login Account can access the latest software and firmware for their cameras from our Downloads page. We encourage our customers to keep their software and firmware up-to-date by downloading and installing the latest versions.

Contacting Technical Support

Before contacting Technical Support, have you:

1. *Read the product documentation and user manual?*
2. *Searched the Knowledge Base?*
3. *Downloaded and installed the latest version of software and/or firmware?*

If you have done all the above and still can't find an answer to your question, contact our Technical Support team.