The World's Sixth Sense®

Using Linux with USB3

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Applicable Products

- FlyCapture® SDK version 2.4 or later
- USB 3.1 cameras, excluding Blackfly S

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 3.1. 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.

Supported System Configuration

Before installing, you must have the following prerequisites:

- A computer with a Gen2 PCIe slot is required to achieve maximum USB 3.1 transfer rates.
- A USB 3.1 cable.
- Linux distribution Ubuntu 12.04 or later. Download from http://www.ubuntu.com.
- USB 3.1 imaging camera. This TAN does not apply to other FLIR machine vision cameras (FireWire, USB 2.0, GigE, or CameraLink).

Note: For information on supported USB 3.1 system components, please see TAN2011005 Recommended USB 3.1 System Components. For information on using Linux with other FLIR machine vision cameras, please see TAN2009003 Getting Started with FlyCapture 2.x and Linux.

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

USB 3.1 Controllers	On board USB 3.1 controller (NEC chipset) USB 3.1 PCIe card controller (NEC chipset)
Cameras	Flea®3 FL3-U3-32S2C (1.34.3.0) Flea®3 FL3-U3-13S2C (1.34.3.0)

Installing and Configuring Linux

For Ubuntu installation instructions, see the Ubuntu documentation at:

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

Note: Ubuntu 12.04.2 provides USB 3.1 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 16.04:

```
user$: sudo apt-get install libraw1394-11 libgtkmm-2.4-1v5 libglademm-2.4-1v5
libgtkglextmm-x11-1.2-dev libgtkglextmm-x11-1.2 libusb-1.0-0
```

Ubuntu 14.04:

```
user$: sudo apt-get install libraw1394-11 libgtkmm-2.4-1v5 libglademm-2.4-1v5
libgtkglextmm-x11-1.2-dev libgtkglextmm-x11-1.2 libusb-1.0-0
```

Ubuntu 12.04:

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

Note: 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 this, add

raw1394 to the /etc/modules file. If the problems persist, add video1394 as well.

Checking your Linux Version

If you have already installed a version of Ubuntu but are unsure if it supports USB 3.1, run the following command:

```
$ uname -r
```

The results look like this:

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

If the version is 3.5.0 or newer, it supports USB 3.1 and you can move to the next section, Configuring USBFS.

If the version is older 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 Compiling a Custom Kernel for USB 3.1 Support to manually configure your system.

Note: Ubuntu 12.04.2 provides USB 3.1 support without having to compile a custom kernel.

Configuring USBFS

By default, Linux limits image capture to 2 MB. 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. You can set the memory limit until the next reboot, or set it permanently.

- To set the maximum usbfs memory limit until the next reboot, run this command:

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

This method does not work with Ubuntu 14.04 or newer. With Ubuntu 14.04, users must set the memory limit permanently.

- To set the maximum usbfs memory limit permanently:

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. Reboot and test a USB 3.1 camera.

If this method fails to set the memory limit, run the following command:

```
$ sudo sh -c 'echo 1000 > /sys/module/usbcore/parameters/usbfs_memory_mb'
```

To confirm that you have successfully updated the memory limit, run the following command:

```
cat /sys/module/usbcore/parameters/usbfs_memory_mb
```

Installing the FlyCapture SDK

To install the FlyCapture2 SDK:

1. Download FlyCapture2 SDK from our Downloads webpage. You will need a downloads account to access the 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
   - libflycaptureregui-<version>_<platorm>.deb
   - libflycaptureregui-<version>_<platorm>-dev.deb
   - libflycapture-c-<version>_<platorm>.deb

- libflycapture-c-<version>_<platorm>-dev.deb
- libflycaptureregui-c-<version>_<platorm>.deb
- libflycaptureregui-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 entering 'flycap' in a terminal or through the applications menu. The flycapture-doc package contains documentation in pdf format.

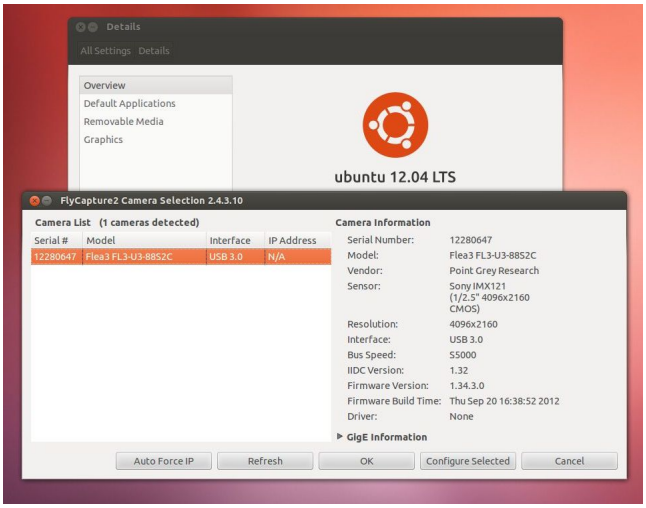
3. Run the install script in the same directory into which you unpacked the software.

```
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.

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.



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/.

Copy 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
```

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
- Recording window in FlyCap2 viewer

```
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.
```

Viewing Images and Videos

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

For image viewing:

- gimp
- ImageJ

For video viewing:

- VLC media player

For working with Glade files:

- Glade

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.

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

Compiling a Custom Kernel for USB 3.1 Support

Note: Ubuntu 12.04.2 provides USB 3.1 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 enter 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
```

Getting the Kernel

1. Download the kernel from kernel.org. The kernel with USB 3.1 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. 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/
```

Configuring the Kernel

Most of the default options for the kernel are appropriate. However, you must select the ext4 file system and enable USB 3.1 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 #.

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

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. Verify that you have all of 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. To capture images larger than 2 MB, follow the instructions in Section 1.7 Configuring USBFS.

Downloads and Support

FLIR 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.

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 our Downloads page.

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

Finding Information

FlyCapture SDK—The FlyCapture SDK provides API examples and the FlyCap camera evaluation application. Available from our Downloads page.

API Documentation—The installation of the FlyCapture SDK comes with API references for C++, C#, and C code. Available from Start Menu→All Programs→Point Grey FlyCapture2 SDK→Documentation

Product Documentation—The camera's *Getting Started Manual* provides information on installing components and software needed to run the camera. The *Technical Reference* provides information on the camera's specifications, features and operations, as well as imaging and acquisition controls. They are available from the Downloads page.

Knowledge Base—A database of articles and application notes with answers to common questions as well as articles and tutorials about hardware and software systems. Available from our Knowledge Base.

Learning Center—Our Learning Center contains links to many resources including videos, case studies, popular topics, other application notes, and information on sensor technology.

Contacting Technical Support

Before contacting Technical Support, have you:

1. Read the product documentation?
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.