Baumer

Installation Guide for Linux

Baumer GAPI SDK v2.10.0

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1. Introduction

This installation guide is for users who wish to change camera settings, and capture and view camera images, as well as for programmers who need to integrate Baumer cameras into their own software.

2. Technical Background

2.1 Interfaces

Baumer GAPI SDK Linux supports the following interface:

- GigE
- USB3.0

2.2 Baumer GAPI SDK

Baumer GAPI is the abbreviation for Baumer “**G**eneric **A**pplication **P**rogramming **I**nterface”. With this API, Baumer provides an interface for optimal integration and control of Baumer cameras with Gigabit Ethernet(GigE) and cameras with a USB interface.

Baumer GAPI is based on GenICam. GenICam is a standard and stands for **Gen**eric **I**nterface for **Cam**eras.

The objective of the standard is to decouple industrial camera interface technology from the user application programming interface (API). Baumer GAPI has a GenICam interface.
The software package includes:

Tools
- Camera Explorer
- IP Config Tool

USB Interface
- USB Producer

GigE Interface
- GigE Producer

SDK
- C++
- Examples for C++
- Libraries

Documentation
- Programmer´s Guide
- Installation Guide
- Camera Explorer
- User Guides
- Flyer
- SFNC

2.2.1 Components of the Baumer GAPI stack

The Baumer GAPI stack is described below.

Working with Baumer Gigabit Ethernet cameras requires the installation of matching hardware (**A**) and a network interface card (NIC) which supports GigE, into your PC. Baumer recommends the employment of NICs with an Intel® chipset. The hardware is delivered with a hardware driver (**B**) which is required to establish communications between hardware and software.

After the hardware have been installed, the TCP/IP stack (**C**), which also covers the required UDP, is activated. This protocol family controls the data transfer between networked devices.
As standard, both control and stream data pass through the TCP/IP stack and are transferred to the interface plug-in - in this case a Gigabit Ethernet Plug-in (**D**).

This plug-in provides interface-specific pre-processing of Baumer GAPI (**F**) commands. The Gig Ethernet plug-in ensures the package structure conforms with the GigE Vision™ standard.

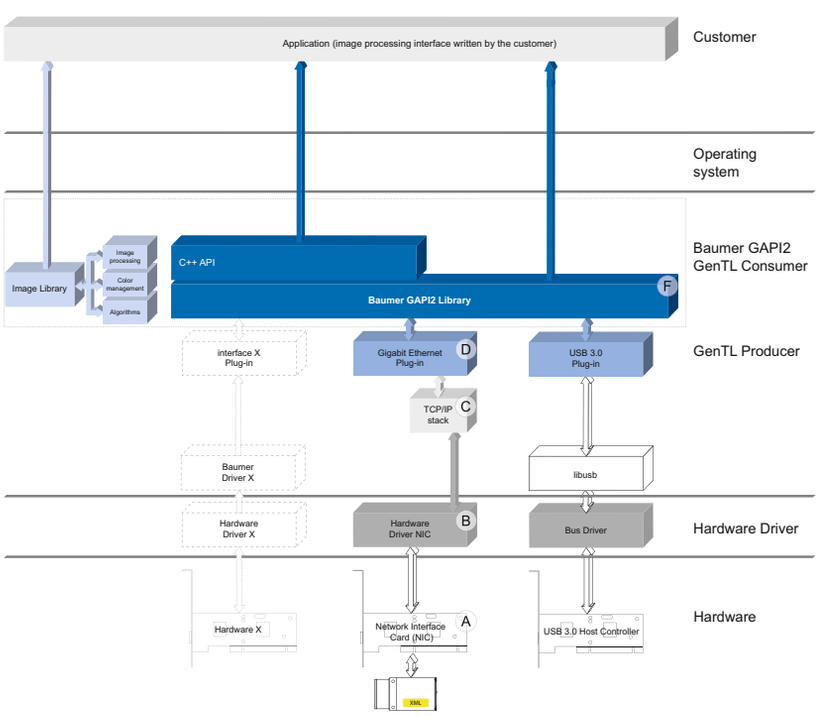


Fig. 1: Baumer GAPI Stack

3. General System Requirements

	Single-camera system Recommended	Multi-camera system Recommended
CPU	Intel(R) Core(TM) i5-2520M CPU @ 2.50GHz, Cores: 4	Intel(R) Core(TM) i7-3770 CPU @ 3.40GHz, Cores: 8
RAM	4 GB	8 GB
Operating system (OS)	(Linux Kernel ≥ 3.3) OpenSUSE 13.1 / 42.3 Ubuntu® 14.04 / 16.04 Fedora 26 / 27 Debian 8.10 / 9.3	
Compiler	GCC ≥ v 4.7	
C++ Version	C++11	
Graphics	Recommended resolution: 1280 x 1024; Color depth: at least 16 bit	
Ethernet	Gigabit Ethernet compliant NIC (Recommended: Intel® chipset)	

4. Installation

4.1 Hardware Installation / Configuration

Caution

Observe precautions for handling electrostatic sensitive devices!

Interface Card (GigE / USB) (see Fig. 1)

- Switch the PC off (**A**).
- Disconnect the power supply (**B**).
- Open the PC case (**C**).
- Place the interface card into an unused PCIe port (if necessary, remove the interface slot cover) (**D**).
- Close the PC case (**E**).
- Re-connect the power supply (**H**).

Camera (see Fig. 2)

- Connect the camera to the interface card (**1**) using an appropriate cable (**2**).
- If required, connect a trigger and/or flash to the Digital-IO supply (**3**).
- Connect the camera to a power supply (**4**) (if necessary).

Camera feedback (*VisiLine*®):

- Power on: LED green
- Readout active: LED yellow

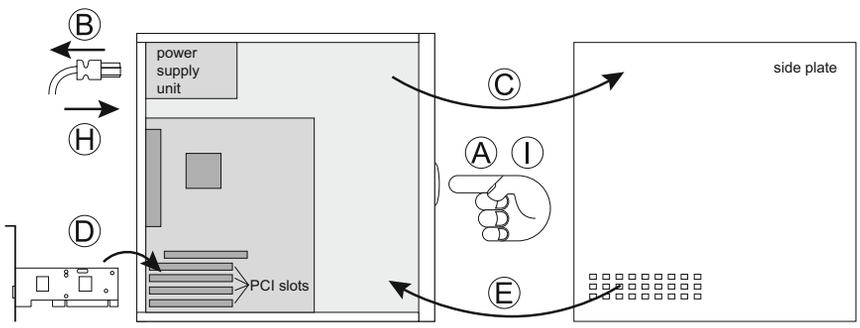


Fig. 2: Installation of the interface card

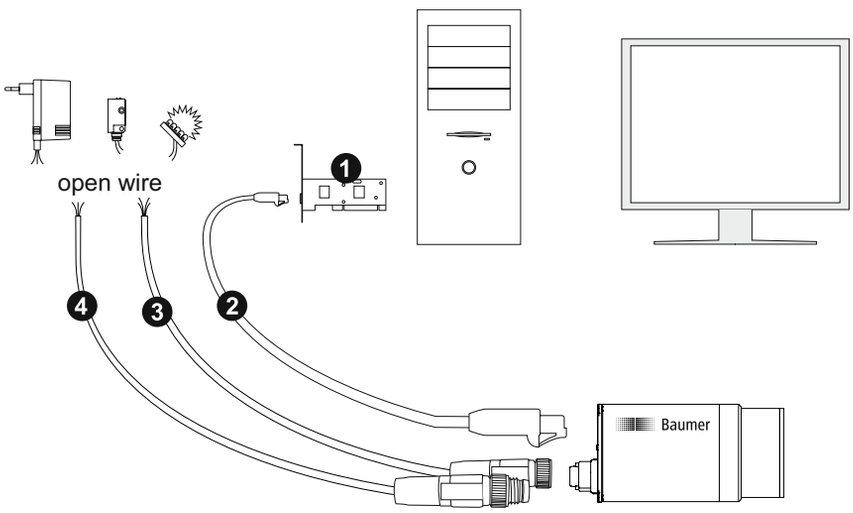


Fig. 3: Installation example (*VisiLine*® without PoE)

1 - Interface card; 2 - Data cable;
3 - Process interface cable; 4 - Power cable (if necessary)

4.2 Software Installation

Notice

Installing the package via the console [Terminal Program] is essentially the same for all versions of Linux. Therefore, this installation method is described here.

4.2.1 Preliminary steps

When preparing to install the actual Baumer software package, check the following items:

- If any other version of the Baumer GAPI SDK v2.x software is already installed on your system, these must be removed! You can have both Baumer GAPI SDK v1.x and Baumer GAPI 2.x installed on the system.

Download the correct version for your system

Notice

The required installer packets for the different Linux operating systems vary. Download the correct packet for your system!

1. Query the OS version of your system.

Input via the console [Terminal Program]:

```
lsb_release -a
```

Possible output:

```
No LSB modules are available.
Distributor ID: Debian
Description:    Debian GNU/Linux 7.11 (wheezy)
Release:        7.11
Codename:       wheezy
```

2. Query whether your system is 32 / 64 bit.

Input via the console [Terminal Program]:

```
uname -m
```

Possible outputs:

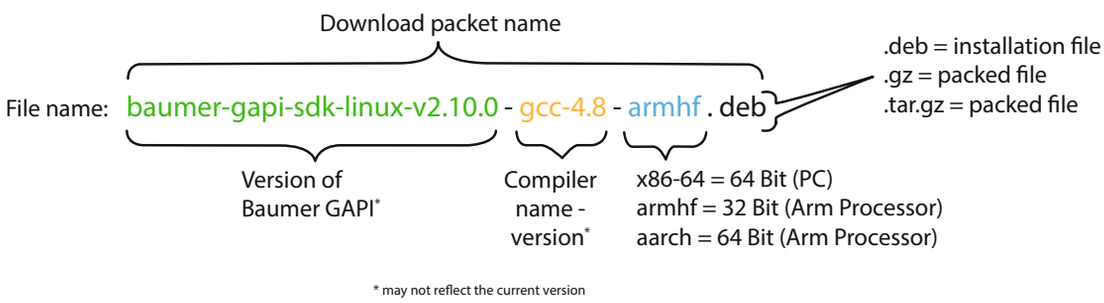
`x86_64` → you have a 64 bit system

`i686` → you have a 32 bit system

3. Download the correct installer packet for your system.

Download area: www.baumer.com/vision/login

Registration is required.



4.2.2 Installing Baumer GAPI SDK

1. Switch to admin mode.

Input via the console [Terminal Program]:

```
su root
```

In some distributions (e.g. Ubuntu®) you have to use:

```
sudo su root
```

Enter the administrator password:

```
Password: <your password>
```

2. Change to the download directory.

Input via the console [Terminal Program]:

```
cd Downloads/
```

Display the folder content:

```
ls
```

Possible output:

```
baumer-gapi-sdk-linux-v2.10.0-gcc-4.8-armhf.deb
```

3. Install the downloaded packet.

Debian/Ubuntu®: `apt install ./baumer-gapi-sdk-linux-v2.10.0-gcc-4.8-armhf.deb`

Notice

With older versions of `apt` (Debian ≤ 8 / Ubuntu® ≤ 14.04) local .deb files cannot be installed. In this case, proceed as follows:

```
dpkg -i ./baumer-gapi-sdk-linux-v2.10.0-gcc-4.8-armhf.deb

apt-get install -f
```

Fedora: `yum install baumer-gapi-sdk-linux-v2.9.2-22701-Debian-7.11-i686.rpm`

openSUSE: `zypper install baumer-gapi-sdk-linux-v2.9.2-22701-Debian-7.11-i686.rpm`

4.2.3 Querying the installed files

Input via the console [Terminal Program]:

```
dpkg-query -L baumer-gapi-sdk-linux
```

4.2.4 Querying information about the installed package

Input via the console [Terminal Program]:

```
apt show baumer-gapi-sdk-linux
```

5. Removal

5.1 Removing the installed package

1. Switch to admin mode.

Input via the console [Terminal Program]:

```
su root
```

In some distributions (e.g. Ubuntu®) you have to use:

```
sudo su root
```

Enter the administrator password:

```
Password: <your password>
```

2. Remove the installed package.

Debian/Ubuntu®: `apt remove baumer-gapi-sdk-linux`

To remove all dependencies: `apt autoremove baumer-gapi-sdk-linux`

Fedora: `yum remove baumer-gapi-sdk-linux`

openSUSE: `zypper remove baumer-gapi-sdk-linux`

6. Network Settings

To connect a Baumer Industrial Camera, configure the network interface of the computer. Therefore you need to know the IP address of your camera. The interface of the computer needs an address from the same subnet. In the following example the camera used the class C address `192.168.3.10`.

Notice

The cameras are delivered with activated DHCP and try to obtain an IP address from a DHCP server. If no DHCP server is found, e.g. when the camera is connected directly to the PC, the camera uses an IP address in the LLA area (`169.254.X.Y`).

The following chapters describes the configuration.

6.1 GigE camera

Notice

For full use of GigE Vision the blocking of the firewall must be repealed.

Method for Ubuntu > 16.04:

To configure the network settings for the transfer of data between the camera and your PC adjust the settings with the programs:

- iproute2
- Network Manager

Notice

MTU (Maximum Transmission Unit) or Jumbo Frames are Ethernet frames that exceed the standard frame size of 1518 bytes. Typical sizes include for example 4, 9, 12 or 16 KB.

However, there are no standards for MTUs, their size depends on the manufacturer.

They are used to decrease the interrupt load of all network devices involved.

In order to use MTUs, all network components must support this feature.

6.1.1 Configuring Single-GigE Interface

For a first test you can use iproute2. There is root access required for this.

`ip addr add dev enp1s0 192.168.3.1/24`	set ip/subnet of bond device
`ip link set enp1s0 up`	bring bond device up
`ip link set enp1s0 mtu 9000`	set mtu size

For persistent connection you can use the graphical or command line interface of the Network Manager. Below is a sample configuration using the cli. There is no root access required for this.

`nmcli connection add type ethernet con-name mycon ifname enp1s0`	add connection to interface enp1s0
`nmcli connection mod mycon ipv4.addresses 192.168.10.65/24`	configure ip/subnet of connection
`nmcli connection mod mycon ipv4.method manual`	manual configured ip
`nmcli connection mod mycon 802-3-ethernet.mtu 9000`	set mtu size to 9000
`nmcli connection up mycon`	bring connection up

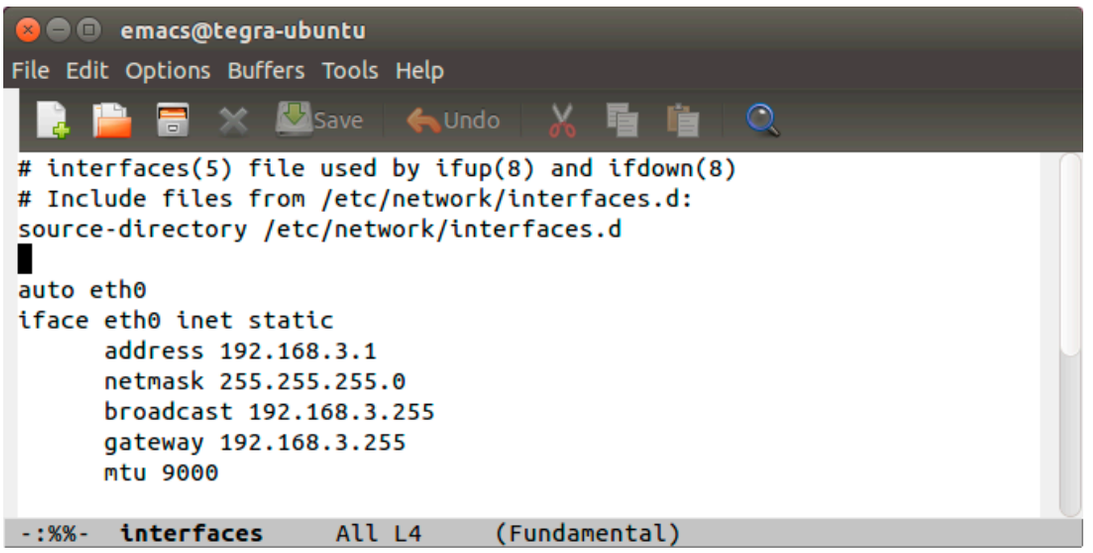
Method for Ubuntu ≤ 16.04:

To configure the network settings for the transfer of data between the camera and your PC adjust the settings in the file `interfaces`.

The interface file is located in the folder: `/etc/network`

Notice
To make changes in the interface file, you must first switch to Admin mode.

Add the following lines to configure eth0:



After that, a restart of the system is necessary.

You can check the configuration by entering the command:

```
# ifconfig
```

6.1.2 Configuring Dual-GigE Interface (Bonding)

Bonding allows you to group the two links of a Dual-GigE camera to form a “virtual” link, allowing the camera to treat the two bonded links as if they were a single link.

To connect a Dual-GigE camera to the host using “bonding”, you will require two host Ethernet adapter ports.

For a first test you can use iproute2 There is root access required for this.

`ip link add mybond type bond`	add bond device
`ip addr add dev mybond 192.168.3.1/24`	set ip/subnet of bond device
`ip link set mybond up`	bring bond device up
`ip link set enp1s0 down`	disable device
`ip link set enp1s0 master mybond`	assign device to master
`ip link set enp4s0 down`	disable device
`ip link set enp4s0 master mybond`	assign device to master
`ip link set mybond mtu 9000`	set mtu size

For persistent connection you can use the graphical or command line interface of the Network Manager. Below is a sample configuration using the cli. There is no root access required for this.

`nmcli connection add type bond con-name bondcon ifname mybond`	**create bond device**
`nmcli connection mod bondcon ipv4.addresses 192.168.3.1/24`	**assign ip and subnet to bond device**
`nmcli connection mod bondcon ipv6.method ignore`	**no ipv6 support**
`nmcli connection mod bondcon ipv4.method manual`	
`nmcli connection add type bond-slave ifname enp1s0 master mybond`	**set device enp1s0 as slave of mybond**
`nmcli connection add type bond-slave ifname enp4s0 master mybond`	**set device enp4s0 as slave of mybond**
`nmcli connection mod bondcon +bond.options mii=100`	**set time interval for checking the link status (e.g. 100 ms)**
`nmcli connection modify bondcon 802-3-ethernet.mtu 9000`	**set mtu size to 9000**
`nmcli connection up bond-slave-enp1s0`	**bring first interface up**
`nmcli connection up bond-slave-enp4s0`	**bring second interface up**
`nmcli connection up bondcon`	**bring bond device up**

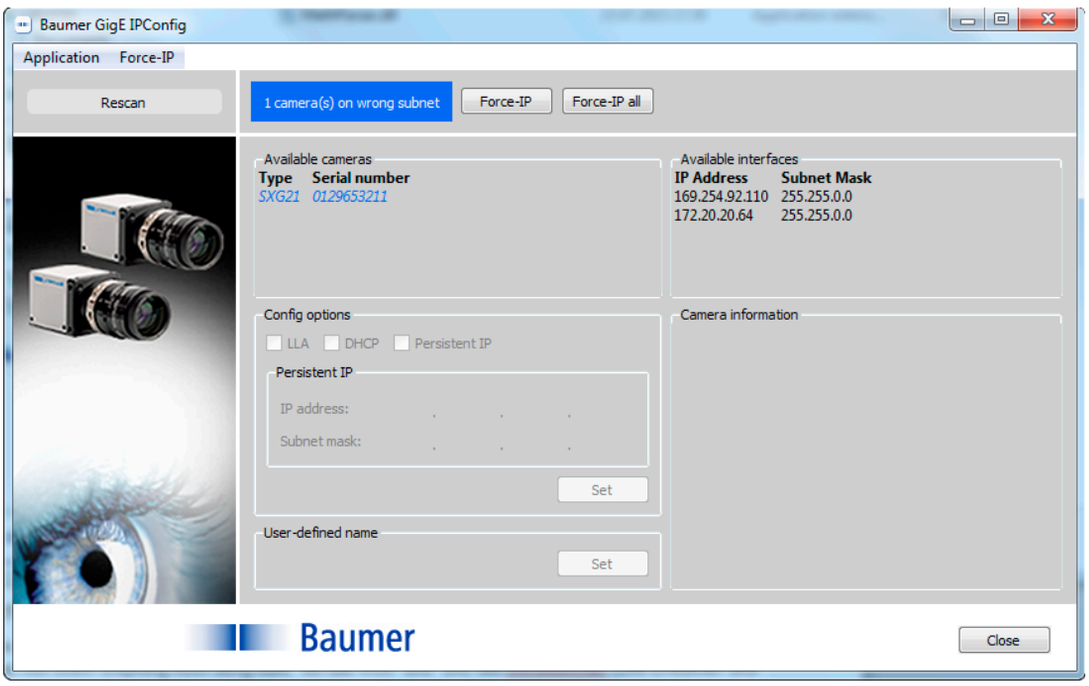
6.1.3 Change the IP address of your Camera

If the IP address of the camera is not in the same address range as the network interface it is necessary to change the IP address of your camera.

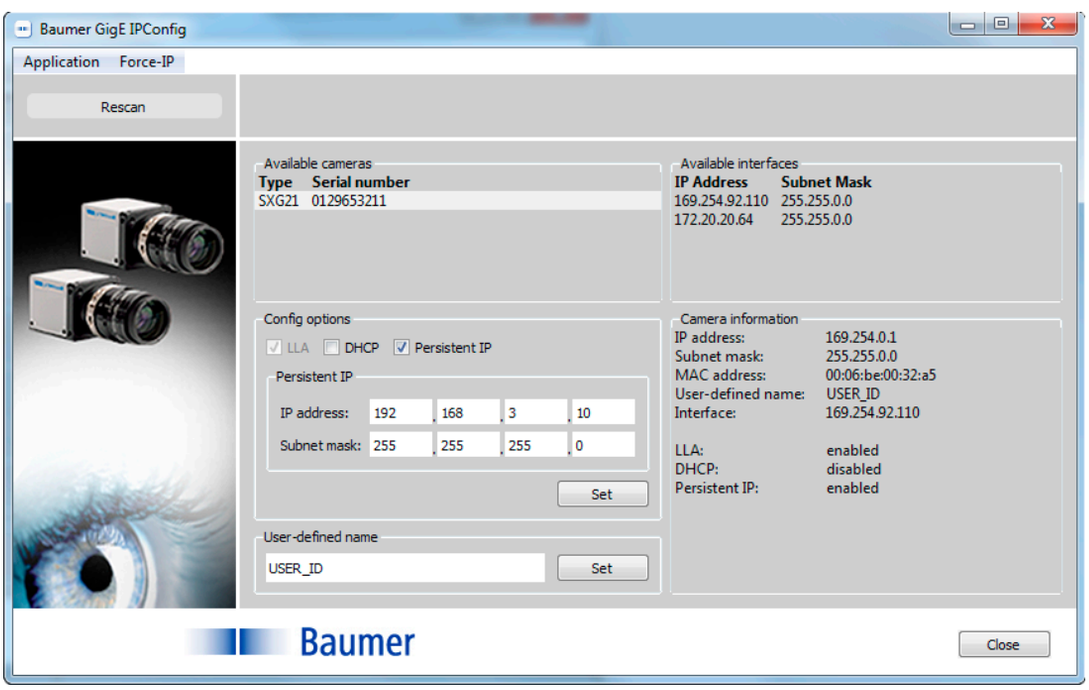
Start the IPConfigTool

Input via the console [Terminal Program]:

```
sudo IpConfigTool
```



The figure shows the startup screen of the Baumer GigE IP ConfigTool with one connected Baumer Industrial Camera. Select the camera and press button “Force-IP” to change the camera’s IP address.



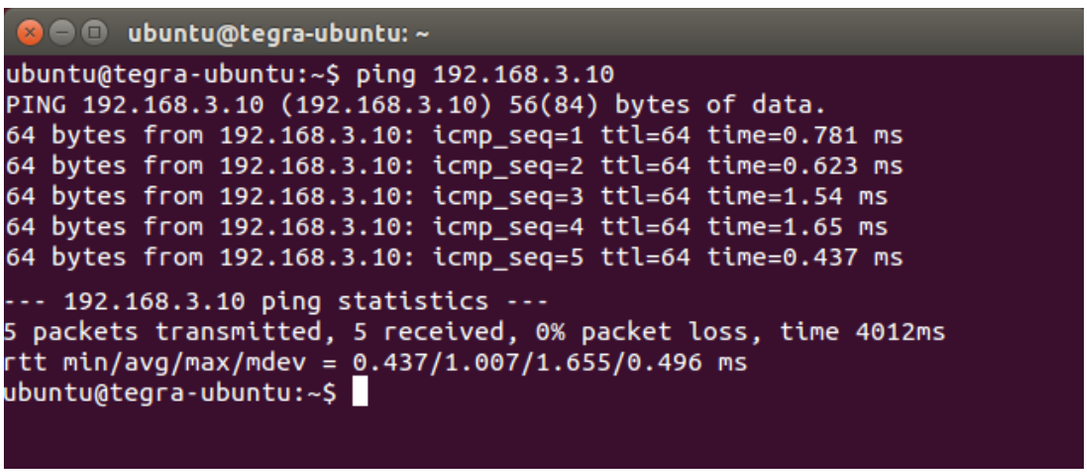
We recommend giving your camera a static IP address. Be sure to enter the correct combination of the address

and the subnet mask.

The camera uses the assigned IP address after a restart or a new network connection.

6.1.4 Check Connection

You can check the connection to the camera by using the “ping” command:



7. USB Cameras

Due to plug and play USB cameras are easy to install. To use USB cameras in applications that are launched with non admin rights you have to add udev rules for your cameras. An udev-rule for all Baumer Cameras was installed with Baumer GAPI SDK in `/etc/udev/rules.d/`. This file contains a line looking similar to the following:

```
SUBSYSTEM==”usb”, ATTRS{idVendor}==”2825”, ATTRS{idProduct}==”*”, MODE=”0666”,
GROUP=”users”
```

To add a new camera you can use this file as template. Copy the Baumer udev file and change the attributes idVendor and idProduct to fit to the new camera. To get the new Id’s of your camera you can use the command line tool lsusb. lsusb return all found USB Devices and show also the Id’s. For example lsusb returning the following entry: `Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub`

Now you have to change the idVendor value to 1d6b and the idProduct to 0003. You can also use an “*” to apply the rule to all devices of the Id-Type.

After changing or adding a rule you have to restart the whole system or at least udev. To restart only udev use the following command:

```
# sudo /etc/init.d/udev restart.
```

Notice

The USB module of the Linux® kernel features a memory limit of 16 MB, which will lead to restrictions in the use of USB multi camera systems.

Also observe the notes in the Application Note: *Baumer-GAPI-Multi-USB-Camera-systems-on-Linux.pdf* to prevent these restrictions.

8. Get the first Picture

The Camera Explorer can be used to easily test the functionality of your cameras. If you start the application while a camera is connected, it will show the recorded pictures right after start. Otherwise your camera will show up in the window. Start the image view by double-clicking the camera icon. Start the tool by Linux® terminal with the following command:

```
# bexplorer
```

On the Unity desktop environment, it is also possible to start the tool by using the launcher. The application is called “bexplorer”.

Depending on the CPU usage it could be necessary to reduce frame rates. This can be done by using the trigger mode or set an acquisition frame rate. For this you can also use the Baumer Camera Explorer.

8.1 Build an Application

To show you how to program the access to camera features, the Baumer GAPI SDK includes different examples. These are called SDK examples and will be stored in `/usr/local/src/baumer/sdk_examples/C++` by installing the Baumer GAPI SDK. All source files are written in C++ and can be found in the `src` subdirectory.

To build the SDK examples you need the following additional software packages installed on the computer:

Software Package	Installation Command	Notes
g++	`sudo apt-get install g++-4.8`	Command installs version 4.8.4 with what the build was tested
CMake	`sudo apt-get install cmake`	
build-essential	`sudo apt-get install build-essential`	

Notice

To install these Packages the board must be connected to the internet.

Due to the SDK examples are installed in the implied directory you may need to be root to perform the following steps.

After all necessary software packages have been installed, start the script file `install_example_linux.sh` which is included in the SDK examples directory.

Execute it by the following command:

```
# ./install_example_linux.sh
```

The script creates four different build directories:

- `build_linux_debug`
- `build_linux_release`
- `build_linux_eclipse_debug`
- `build_linux_eclipse_release`

The folders whose names ending with “debug” will contain the debug versions of the SDK examples after they have been built. The folders with “eclipse” in their names containing project files which can be used with the Eclipse IDE.

To build the SDK examples change into the respective directory (e.g. build_linux_release):

```
# cd build_linux_release/
```

Execute the following command in this directory:

```
# make
```

Then the executable files are built. Change into the source directory and the respective subdirectory to execute the SDK example you want.
For example:

```
# cd src/0_Common/001_ImageCaptureMode_Polling

# ./001_ImageCaptureMode_Polling
```

9. Support

In the event of any questions or for troubleshooting please contact our support team.

Worldwide

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