AVT GigE Cameras

Installation Manual

AVT GigE Vision Cameras

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Allied Vision Technologies GmbH
Taschenweg 2a
D-07646 Stadtroda, Germany

ALLIED Vision Technologies

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Managing Director: Mr. Frank Grube
Tax ID: DE 184383113

Headquarters:

Taschenweg 2a
D-07646 Stadtroda, Germany
Tel: +49 (0)36428 6770
Fax: +49 (0)36428 677-28
e-mail: info@alliedvisiontec.com

Contents

Contacting Allied Vision Technologies

Info

- **Technical information:**
  http://www.alliedvisiontec.com
- **Support:**
  support@alliedvisiontec.com

Allied Vision Technologies GmbH (Headquarters)
Taschenweg 2a
07646 Stadtroda, Germany
Tel: +49 36428-677-0
Fax: +49 36428-677-28
e-mail: info@alliedvisiontec.com

Allied Vision Technologies Canada Inc.
101-3750 North Fraser Way
Burnaby, BC, V5J 5E9, Canada
Tel: +1 604-875-8855
Fax: +1 604-875-8856
e-mail: info@alliedvisiontec.com

Allied Vision Technologies Inc.
38 Washington Street
Newburyport, MA 01950, USA
Toll Free number +1 877-USA-1394
Tel: +1 978-225-2030
Fax: +1 978-225-2029
e-mail: info@alliedvisiontec.com

Allied Vision Technologies Asia Pte. Ltd.
82 Playfair Road
#07-02 D'Lithium, Singapore 368001
Tel: +65 6634-9027
Fax: +65 6634-9029
e-mail: info@alliedvisiontec.com

Allied Vision Technologies (Shanghai) Co. Ltd.
2-2109 Hongwell International Plaza
1602# ZhongShanXi Road, Shanghai 200235, China
Tel: +86 21-64861133
Fax: +86 21-54233670
e-mail: info@alliedvisiontec.com

Introduction

This **AVT GigE Installation Manual** provides instructions for first time use of AVT GigE Vision cameras. Powering up the camera, installing AVT drivers and related software, and enabling users to get the camera up and running are the focus of this document.

For information on camera dimensions, feature overview, I/O definition, trigger timing waveforms, frame rate performance, and camera cleaning instructions please refer to the **AVT Technical Manuals** unique for each camera family.

For detailed information on camera features and controls specific to the AVT GigE cameras refer to the **AVT GigE Camera and Driver Attributes** and **AVT GigE Camera and Driver Features** documents.

WWW

AVT product literature:
http://www.alliedvisiontec.com/us/support/downloads/product-literature.html

Document history

Version	Date	Remarks
V1.0.0	2013-Jul-04	New Manual – RELEASE Status
V1.0.1	2013-Oct-02	• Added information on how to minimize/eliminate dropped packets on page 50 • Removed camera cleaning section from the manual • Updated links for PvAPI SDK and Gigabit Ethernet cameras home page throughout the manual
V1.1.0	2014-Jul-22	• Added Goldeye G • Updated Index

Table 1: Document history

Conventions used in this manual

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

Styles

Style	Function	Example
Bold	Programs, inputs, or highlighting important information	**bold**
Courier	Code listings etc.	`Input`
Upper case	Register	REGISTER
Italics	Modes, fields	*Mode*
Parentheses and/or blue	Links	(Link)

Table 2: Styles

Symbols

Note

This symbol highlights important information.

Caution

This symbol highlights important instructions. You have to follow these instructions to avoid malfunctions.

www

This symbol highlights URLs for further information. The URL itself is shown in blue.

Example:

http://www.alliedvisiontec.com

Additional information

This section provides information on **AVT accessories** and available **AVT software** for AVT GigE Vision cameras.

AVT accessories

Note

Allied Vision Technologies offers a wide range of **accessories** for the use of AVT GigE cameras and the easy integration in already existing applications.

- **Gigabit Ethernet** accessories including standard GigE components as well as PoE capable GigE components.
- **Lenses** for corresponding sensor sizes and resolutions. (Contact AVT Support for further information.)

www

To **order accessories online** (by clicking the article and sending an inquiry) visit:

http://www.alliedvisiontec.com/emea/products/accessories.html

For more information on third-party hardware components tested with AVT GigE cameras, read:

Application Note: Hardware Selection for AVT GigE Cameras:

http://www.alliedvisiontec.com/fileadmin/content/PDF/Support/Application_Notes/Hardware_Selection_for_AVT_GigE_Cameras.pdf

For **more information on lenses** go to:

http://www.alliedvisiontec.com/emea/products/accessories/lenses.html

AVT software

All software packages provided by AVT are **free of charge** and contain the following components:

- Drivers
- Software Development Kit (SDK) for camera control and image acquisition
- Examples based on the provided APIs of the SDK
- Documentation and release notes
- Viewer application to operate/configure the cameras

www

All **software packages** (including **documentation** and **release notes**) provided by AVT can be downloaded at:

http://www.alliedvisiontec.com/emea/support/downloads/software.html

Third-party software

In addition to the software provided by AVT, there are numerous GigE Vision Standard compliant third-party software options available. In general, third-party software provides increased functionality such as image processing and video recording.

www

For a list of compliant third-party software see:

http://www.alliedvisiontec.com/emea/products/software/third-party-software.html

Safety instructions

This chapter describes safety instructions/cautions valid for AVT GigE cameras and special safety instructions/cautions depending on the camera model used.

General safety instructions

Note

- There are no switches or parts inside the camera that require adjustment. The guarantee becomes void upon opening the camera casing.
- If the product is disassembled, reworked or repaired by anyone other than a recommended service person, AVT or its suppliers are not responsible for the subsequent performance or quality of the camera.
- The camera does **not** generate dangerous voltages internally.

Note

IR cut filters for visible light cameras:

All **color models** are equipped with an **optical filter** to eliminate the influence of infrared light hitting the sensor. Please be advised that, as a side effect, this filter reduces sensitivity in the visible spectrum. See camera technical manual for the location of IR cut filter.

Sensor safety instructions

Caution

Sensor may be damaged

Light intensity or exposure time exceeding the saturation of the sensor may damage the sensor irreparably.

This may occur in the following situations:

- Laser light hitting the sensor directly
- Bright light sources (e.g. sunlight) hitting the sensor directly
- Camera is exposed to X-rays

Damages may be caused by:

- Overheating of color filters, microlenses or pixel structures
- Accelerated aging of color filters or pixel structures

Caution

To avoid sensor damage

- Use light source with lower intensity
- Use external shutter
- Use optical filters
- Use lens cap (when camera not in use)
- Vary local light spot / laser spot on sensor
- X-rays:
  - Keep camera out of X-ray path. Guide light source via mirrors to the sensor
  - Use lead glass to protect lens and sensor
  - Use lead jacket for the body of the camera

The warranty does not cover damaged cameras caused by X-ray applications or too much light/laser light.

Changing filters safety instructions

Caution

- Mount/dismount lenses and filters in a **dust-free environment**, and **do not** use compressed air (which can push dust into cameras and lenses).
- Use only **optical quality tissue/cloth** if you must clean a lens or filter.

Ask your dealer if you are not familiar with these procedures.

Safety instructions for board level cameras (only Manta and Prosilica GB)

Note

Read the Manta / Prosilica GB Technical Manual and these safety instructions before use.

Abuse or misapplication of the camera may result in limited warranty or cancellation of warranty.

Caution-ESD

Board level cameras: ESD warnings

- Board level cameras are delivered without housing. Handle the sensor board and main board with care. Do not bend the boards. Do not touch the components or contacts on a board. Hold a board by its edges.
- Sensor board and main board are sensitive to electrostatic discharge. To avoid possible damage, handle all static-sensitive boards and components in a static-safe work area. Follow the procedures below.
- ESD (electrostatic discharge): Static electricity can damage the sensor board or the main board of your board level cameras. To prevent static damage, discharge static electricity from your body before you touch any of your broad level camera's electronic components, such as sensor board or main board. To do so, use a static-safe work area with static-dissipative mat and wear a static-dissipative wrist strap. Do not hold any components of your board level cameras against your clothing. Even if you are wearing a wrist strap, your body is grounded but your clothes are not.
- Do not remove the sensor board and main board from its anti-static packaging unless your body is grounded.
- **ESD shielding**: To protect the boards from radiation of other modules or devices use a special ESD protective housing.

Caution **Board level cameras: General warnings**

- Be sure that all power to your board level camera is switched off before mounting the sensor board or making connections to the camera.
- Do not connect or disconnect any cables during an electrical storm.
- Do not use your board level cameras during an electrical storm.
- To help avoid possible damage to the sensor board or main board, wait 5 seconds after power is switched off, before connecting or disconnecting any cable to the board level cameras.
- Keep your board level cameras away from radiators and heat sources.
- Avoid contact of board level cameras with liquids.

Caution **Board level cameras: Loading**

- Avoid any mechanical forces to the board level cameras, the boards and its components, especially torsional, tensile and compressive forces.
- To avoid damages of the boards, provide cables with an external pull relief so that no force is applied to the connectors itself.

Caution **Board level cameras: Dirty environments**

- Always use clean boards.
- To protect the board level cameras from debris always use in a clean environment or a protective housing.

Getting started

This chapter describes the components required for your camera system:

GigE Vision camera

AVT offers the following GigE Vision camera families:

- Bigeye G
- Goldeye G
- Mako
- Manta
- Prosilica GB
- Prosilica GC
- Prosilica GE
- Prosilica GS
- Prosilica GT
- Prosilica GX

This guide can be applied to all of these families. Follow the links below to learn more about GigE Vision cameras from AVT.

www Follow this link to learn about GigE Vision cameras from AVT.

http://www.alliedvisiontec.com/emea/products/cameras/gigabit-ethernet/manta.html

Optics

AVT GigE cameras offer various mechanical interfaces for installing a lens including C-Mount, CS-Mount, F-Mount, M12-Mount, M42-Mount, M58-Mount, and Canon EF-Mount. Lenses can be purchased directly from AVT or from an AVT distributor. Users need to select the desired focal length and appropriate optical format for the target camera model.

www See **AVT Modular Concept** for more information on mechanical interface options for specific AVT GigE cameras:

http://www.alliedvisiontec.com/us/support/downloads/product-literature/avt-modular-concept.html

www AVT offers a number of lenses to choose from:

http://www.alliedvisiontec.com/us/products/accessories/lenses.html

For assistance in choosing a suitable lens for your AVT GigE camera, please contact support@alliedvisiontec.com.

GigE Vision software

AVT provides several software packages that support AVT GigE Vision cameras. User can target the following operating systems and a variety of CPU architectures:

- Windows, Linux (supported by both AVT VIMBA and PvAPI SDKs)
- QNX or OSX (supported by PvAPI SDK only)

www

VIMBA is AVT's future-proof SDK for all current and upcoming AVT cameras with GigE Vision, FireWire (IEEE 1394) and USB Vision interfaces. Visit the link below for more information.

http://www.alliedvisiontec.com/us/products/software/vimba-sdk.html

www

AVT PvAPI SDK supports all GigE Vision cameras from AVT on various operating systems, including Windows, Linux, OSX and QNX. Visit the link below for more information.

http://www.alliedvisiontec.com/emea/products/legacy.html

AVT GigE Vision cameras are GigE Vision v1.2 compliant. This means they are compatible with third-party software which offers a GigE Vision driver.

www

For a list of compliant third-party software see:

http://www.alliedvisiontec.com/emea/products/software/third-party-software.html

Overview of installation

This is an overview of the installation process: follow the hyperlinks to read the step-by-step instructions.

- Install Gigabit Ethernet network card and configure network card (Jumbo Frames, Receive Descriptors, Performance Options and IP address settings):
  See chapter Installing hardware on page 16.
- Install **AVT SDKs** plus corresponding **Viewers**:
  See chapter Installing camera software on page 22.
- Connect camera to PC or laptop and ensure that the camera is powered:
  See chapter Starting the camera on page 25.
- Acquiring your first image with **VIMBA Viewer** and **GigE Sample Viewer**:
  Read chapter Using the AVT viewer applications on page 26.

Installing hardware

This chapter describes the hardware installation and configuration of Gigabit Ethernet network cards (PC or laptop) for optimum system performance when using a GigE Vision camera.

Installing Gigabit Ethernet network card

GigE Vision cameras can operate on 10/100, or Gigabit speed Ethernet adapters. In order to take advantage of maximum camera frame rates, a Gigabit speed adapter is required.

If your host computer has an available Ethernet port, this can be used with AVT GigE Vision cameras. We recommend that your camera system uses a dedicated Ethernet port not shared with internet or local area networks. If more ports are needed, or your existing Ethernet adapter is unable to operate at Gigabit Ethernet speeds, installing additional hardware may be required.

For desktop systems Use a PCI Express bus Ethernet adapter.

For laptops Use an expansion slot via an ExpressCard.

Note

Verify that there is an available and compatible interface slot on the host computer before purchasing the desired Ethernet adapter card.

www

For a list of Ethernet adapters available for purchase From AVT refer to:

http://www.alliedvisiontec.com/us/products/accessories/gige-accessories.html

www

A list of AVT recommended Ethernet adapters is available on the AVT website.

http://www.alliedvisiontec.com/fileadmin/content/PDF/Support/Application_Notes/Hardware_Selection_for_AVT_GigE_Cameras.pdf

Caution

AVT recommends Category 6 or higher rated Ethernet cables. A different rating may not sustain peak interface bandwidth; leading to lost connectivity or image data coming from the camera.

Ethernet adapter configuration

1. **PC:** Install the (second) Gigabit Ethernet network card in your host computer according to the instructions you got from your network card manufacturer.
   Laptop: Insert the Gigabit Ethernet ExpressCard into your laptop.
2. Cancel the **Found new Hardware Wizard** window that may appear when Windows detects your network card.

Installation of Ethernet adapter driver

3. Install the network card driver from your network card manufacturer. This manual references the Intel Gigabit CT series, an equivalent can be found from other manufacturers.

www

Follow the link below to download the latest drivers for Intel adapters.

http://www.intel.com/p/en_US/support/detect

Run installation application provided by driver manufacturer. If no installation application is provided, update the driver manually:

[Windows 7]

- **Start**
- **Control Panel**
- **Hardware and Sound**
- **Device Manager**
- Expand **Network Adapter**
- Right-click Adapter device name
- **Properties**
- **Driver** tab
- **Update driver**
- **Install from specific location** (identify installation directory)

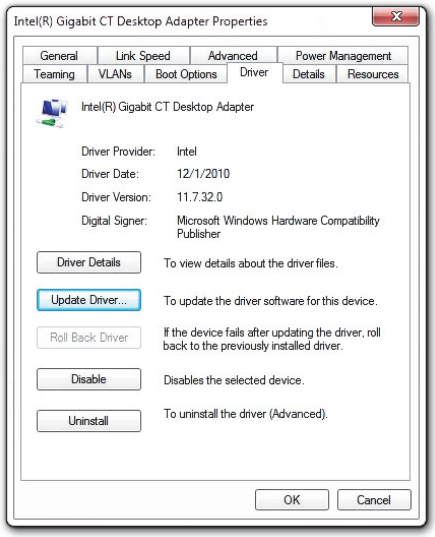

Figure 1: Adapter properties, driver tab, Windows 7

Modify Ethernet adapter IP address

4. After initial Ethernet adapter hardware installation, connect the Ethernet adapter directly to the camera. The default configuration assigns an IP address automatically using the Link-Local Address range of 169.254.xxx.xxx or an address defined the by the DHCP server, if present.

Users can fix the adapter address to minimize the time required for a camera to be recognized by the host application. Systems that employ multiple Ethernet adapters connected to multiple cameras will also be required to fix the address of the Ethernet adapter.

[Windows 7]

- **Start**, **Control Panel**
- **Network and Internet**
- **View network status and tasks**
- **Change adapter settings**
- Right-click Network Connection
- **Properties**
- Select **Internet Protocol Version 4** and click **Properties**
- Select **Use the following IP address:**

  IP Address: 169.254.100.1
  Subnet mask: 255.255.0.0
  Default gateway: blank

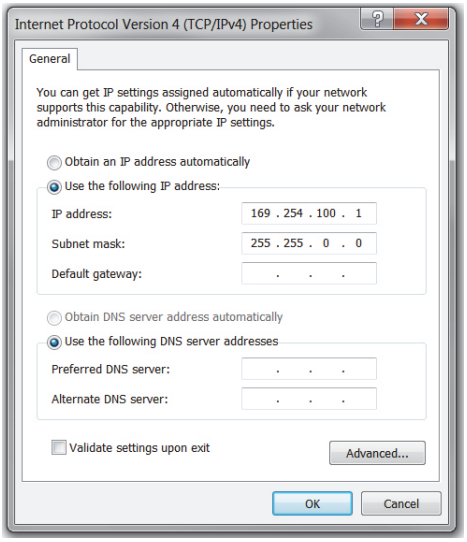

Figure 2: Windows - Fixed IP address, Auto IP range

[Linux]

- **Terminal:** ifconfig
- Note eth# of NIC connected to camera
- **Terminal:** sudo gedit /etc/network/interfaces
- **Add/edit:**

```
auto eth6
iface eth6 inet static
address 169.254.100.1
netmask 255.255.0.0
```

  Where, `eth6` is name of NIC connected to camera.

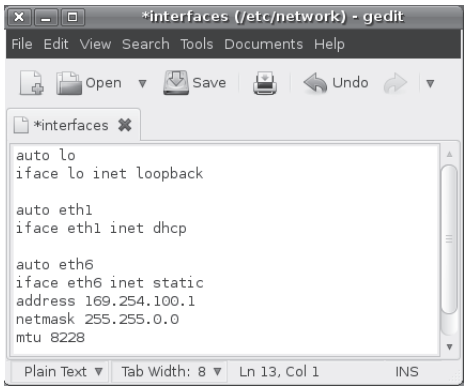

Figure 3: Interfaces file for static IP, Linux Ubuntu 10.04

[OSX] (PvAPI only)

- **System Preferences**
- **Network**
- Select **Ethernet**, click **Advanced**
- **TCP/IP** tab:

  Configure IPv4: Manually
  IPv4 Address: 169.254.100.1
  Subnet Mask: 255.255.0.0
  Router: Blank

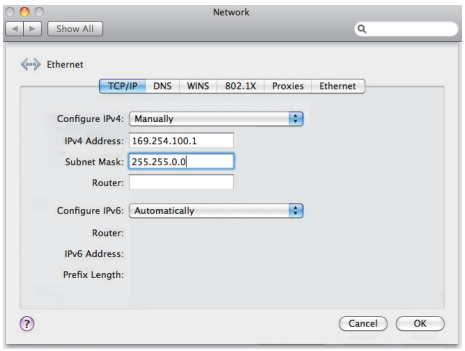

Figure 4: Interfaces file for static IP, Linux Ubuntu 10.04

Ethernet adapter optimization

5. The Ethernet adapter should be adjusted to improve system performance when using a GigE Vision camera. This performance is related to minimizing CPU usage and dropped or resent packets.

   Edit the Ethernet adapter driver properties according to the values in the table below. The names and availability of the properties listed may vary depending on adapter manufacturer and model.

Properties	Value
Packet size (MTU)	8228 or larger
Interrupt Moderation Rate	Extreme
Transmit buffers	256 bytes
Receive buffers	Max setting available

Table 3: Ethernet adapter performance settings

Default AVT GigE Vision camera factory settings configure the camera packet size to 8228. The host adapter needs to support a packet size of equal or larger size to stream from the camera.

Note

If adapter packet size support is limited to 1500 bytes, as on 10/100 speed NICs, the camera packet size can be reduced using VIMBA Viewer / GigE Sample Viewer and saved to an on board camera power up config file.

PvAPI users: See *ConfigFile* in the AVT GigE Camera and Driver Attributes document.

VIMBA users: See *SavedUserSets* in the AVT GigE Camera and Driver Features document.

Adjust camera packet size

[Windows 7, Intel Gigabit CT]

- **Start**, **Control Panel**
- **Hardware and Sound**
- **Device Manager**
- **Network Adapter**
- Right-click Adapter device name
- **Properties**
- **Advanced** tab
- **Settings:** Jumbo Packet - **Value:** 9014 Bytes

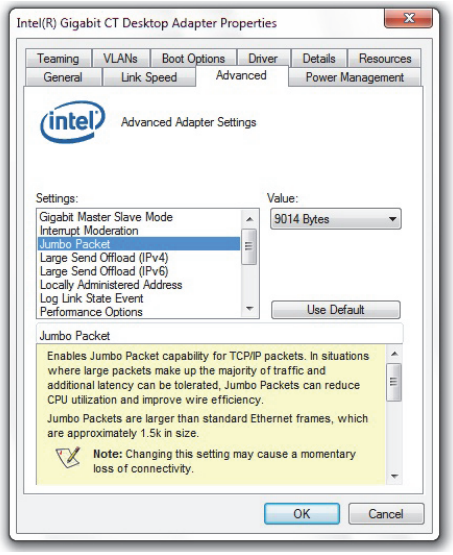

Figure 5: Setting jumbo packets

Note

The settings list in the advanced adapter settings may be different between different types/brands of Gigabit Ethernet network cards. Common expressions are **Jumbo Frames** or **Jumbo Packet**.

If **Jumbo Frames** or **Jumbo Packet** does not appear in this list, your network card may not support it. Without this capability, you may not be able to achieve the full performance of the camera.

[Linux]

- **Terminal**: *sudo gedit /etc/network/interfaces*
- **Add**: *mtu 8228* to appropriate interface.
- Or, to temporarily increase packet size:

  Terminal: *sudo ifconfig eth0 mtu 8228,* where eth0 is the camera NIC.

[OSX] (PvAPI only)

- **System Preferences**
- **Network**
- Select **Ethernet**, click **Advanced**
- **Ethernet** tab:

  Configure: Manually
  Speed: 1000baseT
  Duplex: full-duplex
  MTU: Jumbo (9000)

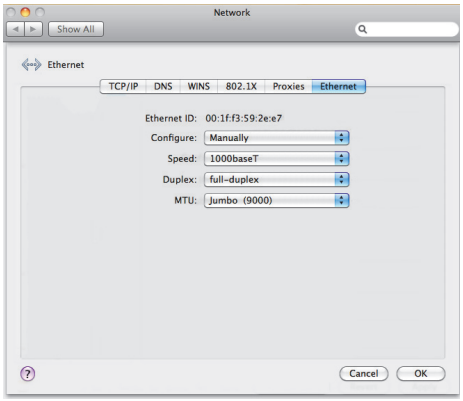

Figure 6: Ethernet settings OSX Snow Leopard

Adjust buffers and moderation rate

[Windows 7, Intel Gigabit CT]

- **Start**, **Control Panel**
- **Hardware and Sound**
- **Device Manager**
- **Network Adapter**
- Right-click Adapter device name
- **Properties**
- **Advanced** tab
- **Performance Options**
- **Settings**: Interrupt Moderation Rate
  Value: Extreme
- **Settings**: Transmit Buffers
  Value: 256 bytes
- **Settings**: Receive Buffers
  Value: Max allowable

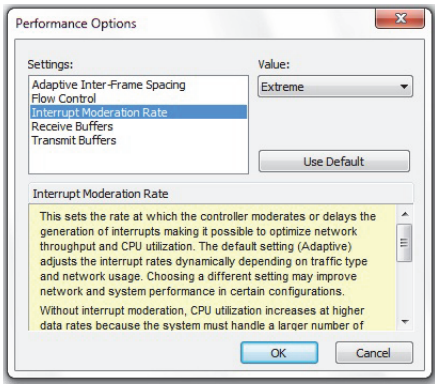

Figure 7: Intel adapter performance options. Windows 7, Intel Gigabit CT

[Linux, QNX, OSX]

Support for buffer size control and moderation rate settings varies greatly between network card driver providers.

www

Follow the link below for a detailed guide to using the Linux e1000 Base Driver for the Intel PRO/1000 family of adapters:

http://www.intel.com/support/network/adapter/pro100/sb/CS-032516.htm?wapkw=e1000+linux+base+driver+for+the+intel+pro%2f1000

Installing camera software

This chapter presents instructions for software installation specific to Windows 7. AVT GigE Vision cameras can be operated under earlier versions of Windows including XP. Suggestions specific to Linux, QNX and OSX are also offered when applicable. AVT offers two main SDKs for its GigE Vision cameras—VIMBA and PvAPI.

Overview of software installation

This is an overview for the software installation: follow the hyperlinks to read the step-by-step instructions.

- Install **AVT VIMBA SDK** plus corresponding **VIMBA Viewer**:
  Read Install VIMBA Viewer on page 23.
- Install **AVT PvAPI SDK** and corresponding **GigE Sample Viewer**:
  Read Install GigE Sample Viewer on page 24.

Download camera drivers

AVT GigE cameras work with any or all of the following software options:

www

AVT VIMBA Viewer or VIMBA SDK:

http://www.alliedvisiontec.com/us/products/software/vimba-sdk.html

www

GigE Sample Viewer or PvAPI SDK:

http://www.alliedvisiontec.com/emea/products/legacy.html

www

Recommended third-party GigE Vision compliant software packages:

http://www.alliedvisiontec.com/us/products/software/3rd-party-solutions.html

Install VIMBA Viewer

[Windows 7]

- Go to install directory.
- Click **AVTVimba.exe**.
- Select an installation level suitable for your needs. For first time users, installation level **Camera Demonstration** is recommended.
- Click **Start**.

[Linux]

Necessary runtime libraries for executing VIMBA Viewer are available with AVT VIMBA SDK package.

- AVT VIMBA ships as a tarball. Uncompress the archive with the command *tar -xf ./AVTVimba.tgz* to a directory you have writing privileges for. This creates a directory named *AVTVimba*.
- Navigate to *AVTVimba/AVTGigETL* and execute the shell script *Install.sh* with root privileges (e.g. *sudo ./Install.sh*).
- VIMBA Viewer is now ready to use and it can be found in *Vimba/Viewer/Bin*.

Note

VIMBA Viewer must be run with root privileges (e.g. *sudo -E ./VimbaViewer)* if you want to change the IP configuration of a camera in a foreign subnet. Running it as root user instead of using *sudo -E* requires you to set the environment variables manually.

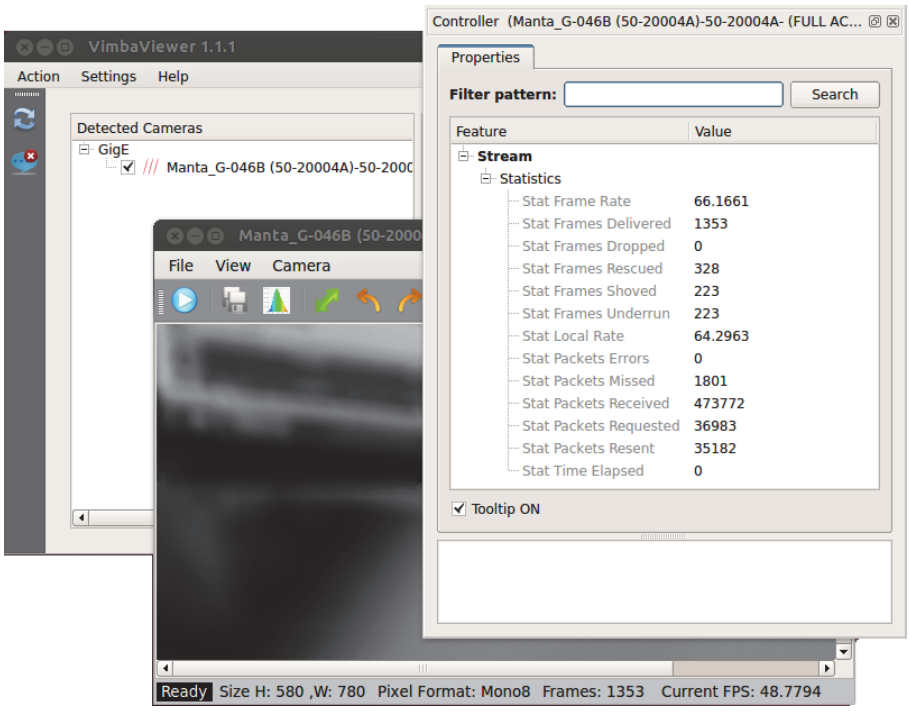

Figure 8: VIMBA Viewer, Linux Ubuntu 12.04

Install GigE Sample Viewer

First time users may want to install the GigE Sample Viewer which offers an excellent introduction to using the camera. Advanced users wishing to develop their own software should download PvAPI SDK. Source code for the GigE Sample Viewer is provided in the examples directory. A filter driver installation executable is also provided with the SDK.

[Windows 7]

- Go to install directory.
- Click **Allied_Vision_Technologies_GigE_Viewer_Installer.exe**.
- A message appears indicating the publisher could not be verified, select **Run to continue**.
- Follow the prompts as requested, when asked "Would you like to install the Filter driver?" select **Yes**.

Note

The AVT Filter miniport driver works alongside the native Ethernet adapter driver to optimize CPU usage, and minimize dropped packets. It is available only on Windows.

[Linux]

- Precompiled versions of GigE Sample Viewer are available in the *AVT GigE 'SDK/bin-pc* directory.
- Run as root, e.g. "*sudo ./SampleViewer*", allowing the OS to boost the priority of the AVT driver thread, the driver to bind directly to the NIC adapter, and minimize dropped packets. Users who feel running as root compromises their system security may find the following implementation satisfactory:
  - Set the executable owner as root.
  - Set the "setuid" permission bit on the executable.
  - In code, when application starts, use capset() to release all but these privileges: CAP_SYS_NICE, CAP_NET_ADMIN, CAP_NET_BROADCAST, CAP_NET_RAW.

The application starts with all root privileges, but it drops them immediately after startup.

Starting the camera

Power up

A camera power adapter for each GigE camera is available from AVT. Please consult the camera technical manual for connector definition and voltage specifications

www **AVT Product literature**

http://www.alliedvisiontec.com/us/support/downloads/product-literature.html

Caution **For AVT Goldeye G, Prosilica, Mako, and Manta cameras:**

- Use only DC power supplies with insulated cases.
- For all power connections use only shielded cables to avoid electromagnetic interferences.
- Goldeye G, Mako, Manta, and Prosilica GT PoE models can source power from:
  - 802.3af (100 MBit/s and 1000 MBit/s), and
  - 802.3at compliant PSE devices (Power Sourcing Equipment): such as switches injectors or NICs

Caution **Bigeye G cameras**

Operate Bigeye G cameras at **12 V (+ 5 %)**. The current is limited to **max. 3.0 A**. Operating Bigeye G cameras **outside these specifications may cause damage**.

Connect to host application

Use a Category 6 or higher rated Ethernet cable to connect the camera to the host adapter. Crossover cabling is not required, but works—the camera has circuitry to determine if a crossover cable is being used.

www For **more information on accessories** go to:

http://www.alliedvisiontec.com/emea/products/accessories.html

Using the AVT viewer applications

This chapter describes the use of two viewer applications offered by AVT—VIMBA Viewer and GigE Sample Viewer. The viewer applications are used to stream live view images from the camera, adjust the camera parameters and test functionality.

www The AVT VIMBA Viewer can be downloaded from the AVT website:

http://www.alliedvisiontec.com/us/products/software/vimba-sdk.html

www The GigE Sample Viewer can be downloaded from the AVT website:

http://www.alliedvisiontec.com/emea/products/legacy.html

Using VIMBA Viewer

This section describes main features of the VIMBA Viewer.

Launch the application

1. Launch the VIMBA Viewer application. Wait for the camera to appear in the “Detected Cameras” list. This may take up to one minute in network card “Obtain an IP address automatically” mode.

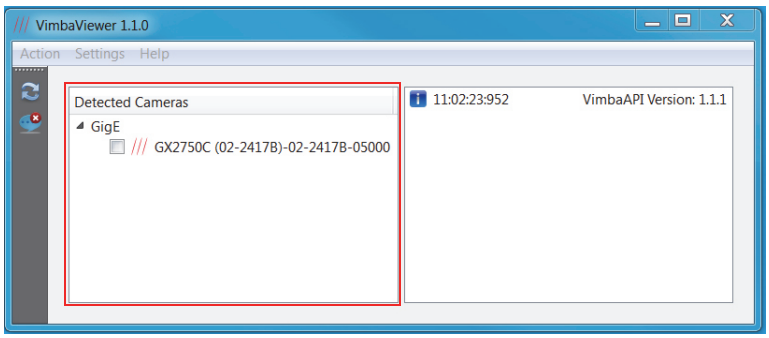

Figure 9: VIMBA Viewer window

If a camera does not appear after some time, try the following:

- Confirm the camera is powered.
- Confirm the Ethernet cable is connected to the host PC.

- Confirm that camera IP and Ethernet adapter are on the same subnet. For more information refer to Modifying camera IP address on page 35.

2. Select the desired camera from “Detected Cameras” list.
3. A new camera window appears, as shown in figure 10. This camera window consists of the following components:
   - Viewer toolbar: controls to customize the live camera view
   - Controller window: shows camera controls
   - Information window: displays camera and event information
   - Histogram window

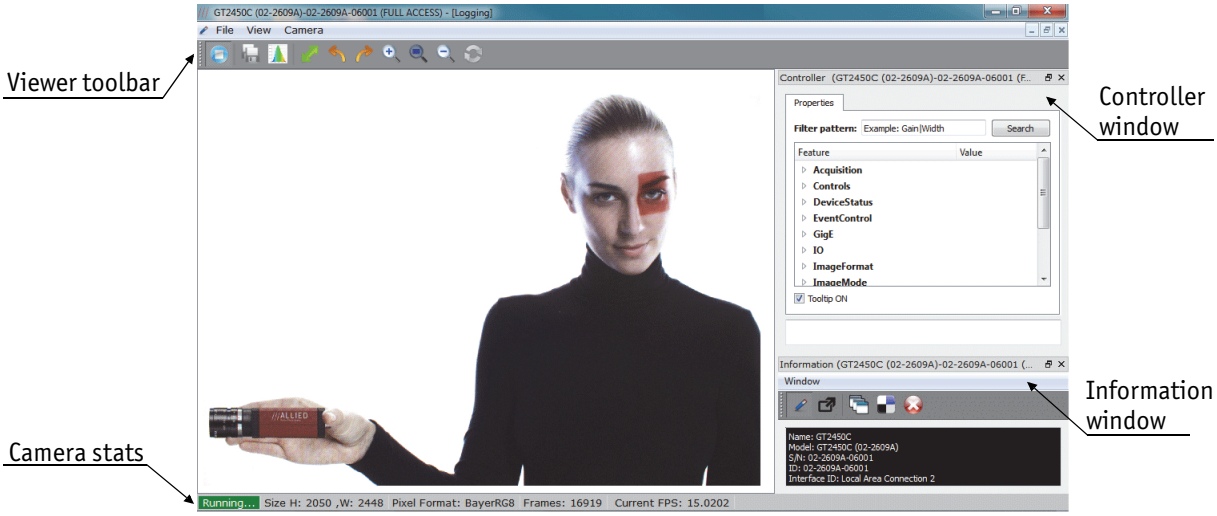

Figure 10: Camera window in VIMBA Viewer

The camera window supports a fully dockable layout that allows user to customize their workspace.

Note

If any of the above components of the camera window is missing, then:

- Right-click on menu or toolbar
- Select the missing component

Open live view: Viewer toolbar

Press freerun button in the viewer toolbar, shown left. This starts continuous acquisition from the camera using default camera settings. It can be confirmed by stats at the bottom of camera window, as shown in figure 10. “Running” means continuous acquisition, whereas, “Ready” means camera is ready to acquire images. The freerun button is used to start/stop the live view.

If the images are too dark, point the camera directly at a light source to ensure images are not being dropped. If no images appear proceed to chapter Trouble-shooting on page 47.

Adjust camera controls: Controller window

The controller window, as shown in figure 10, is used to configure the camera frame rate, exposure time, color balance, imaging mode, strobe functionality, pixel format, and much more.

www

A detailed explanation of camera controls can be found in **AVT GigE Camera and Driver Features** document:

http://www.alliedvisiontec.com/fileadmin/content/PDF/Software/Prosilica_software/Prosilica_firmware/AVT_GigE_Camera_and_Driver_Features.pdf

Camera information: Information window

The information window, as shown in figure 11, consists of the following functionalities.

Click the logging icon, shown left. The logging window opens. It provides camera identifying information including the serial and ID number.

Click the event viewer icon, shown left. The events viewer window opens. This is a tool used to monitor in-camera events such as *EventAcquisitionEnd*, *EventAcquisitionStart*, *EventExposureEnd*, etc. The factory default settings disable all event notifications. Use the camera controls to select which events to monitor.

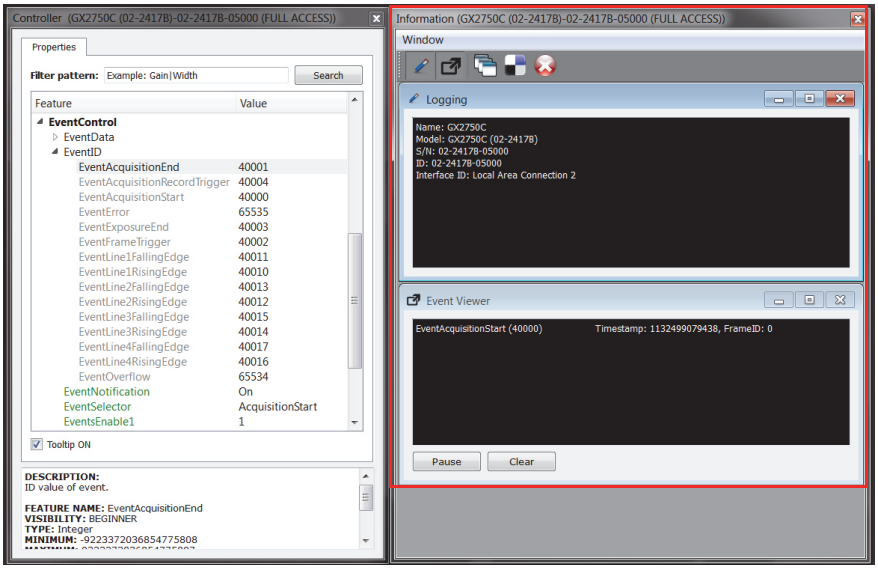

Figure 11: VIMBA Viewer events and controls

Live histogram

Start live view from the camera by selecting freerun button. Click the histogram icon in the viewer toolbar, shown left. This launches a live histogram. A histogram graphs number of pixels on the vertical axis and digital number value on the horizontal axis.

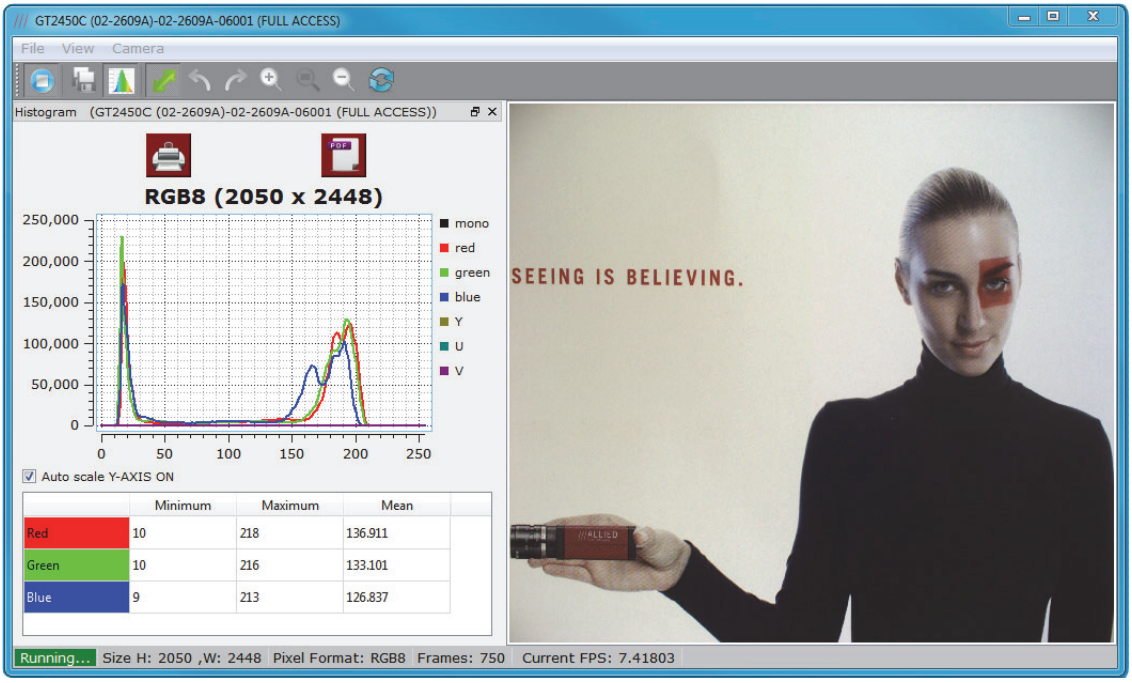

Figure 12: Live histogram in VIMBA Viewer

Note

Histogram is **ONLY** supported for the following pixel formats:

- Mono8
- RGB8
- BGR8
- YUV444
- BayerRG12Packed

Using the GigE Sample Viewer

This section describes main features of GigE Sample Viewer.

Launch the application

Start the GigE Sample Viewer application. Wait for the camera to appear under Host.

If a camera does not appear after some time, try the following:

- Confirm the camera is powered.
- Confirm the Ethernet cable is connected to the host PC.
- Modify the Ethernet adapter and/or Camera IP such that they are on the same subnet. For more information refer to Modifying camera IP address on page 35.

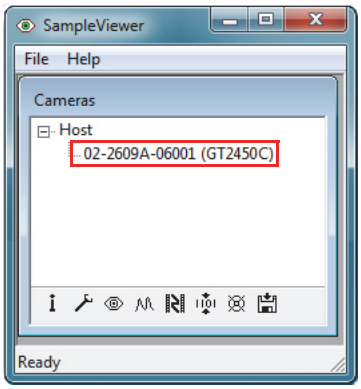

Figure 13: camera window

If the camera still does not appear, proceed to chapter Troubleshooting on page 47.

Open live view

Select the desired camera from the cameras window of the GigE Sample Viewer. Click the eyeball icon. This opens a new view window. Using default camera settings, this starts continuous acquisition from the camera using freerun trigger mode.

If the images are too dark, point the camera directly at a light source to ensure images are not being dropped. If no images appear proceed to Troubleshooting on page 47.

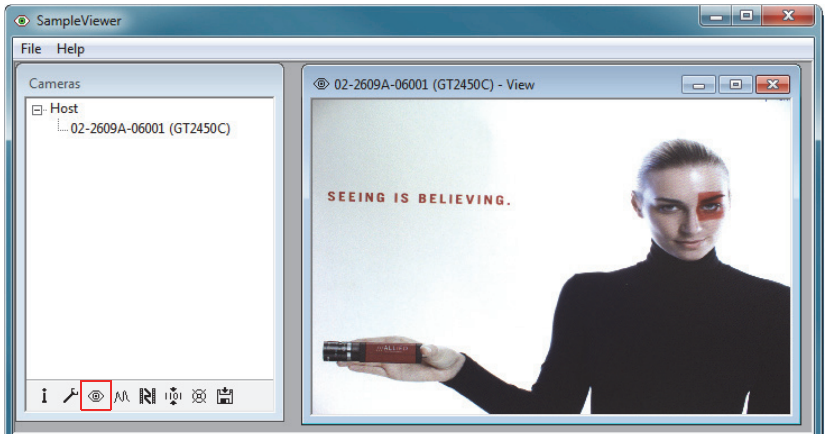

Figure 14: GigE Sample Viewer live view

Adjust camera controls

Select the desired camera from the cameras window of the GigE Sample Viewer. Click the wrench icon to open controls window. The controls window is used to configure the camera frame rate, exposure time, color balance, imaging mode, strobe functionality, pixel format, and much more.

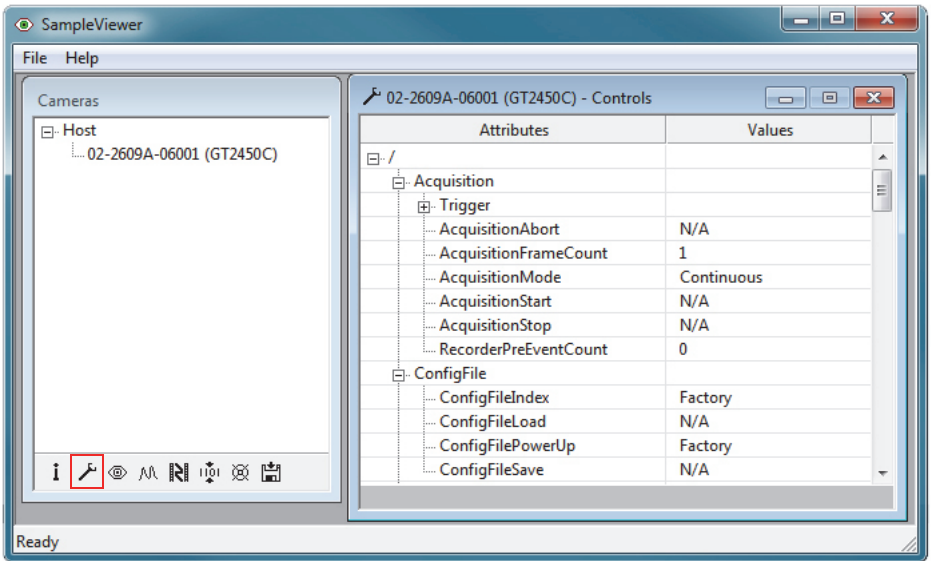

Figure 15: GigE Sample Viewer controls window

A detailed explanation of camera controls can be found in the AVT GigE Camera and Driver Attributes document.

www

AVT GigE Camera and Driver Attributes download link:

http://www.alliedvisiontec.com/fileadmin/content/PDF/Software/Prosilica_software/Prosilica_firmware/AVT_Camera_and_Driver_Attributes.pdf

Live histogram

Start live view from the camera by selecting the eyeball icon. Click the histogram icon, shown left. This launches an 8-bit live histogram. A histogram graphs number of pixels on the vertical axis and digital number value on the horizontal axis.

Camera information

Select the desired camera from the cameras window of the GigE Sample Viewer. Click the information icon, shown left. The information window provides camera identify information including the serial number and part number.

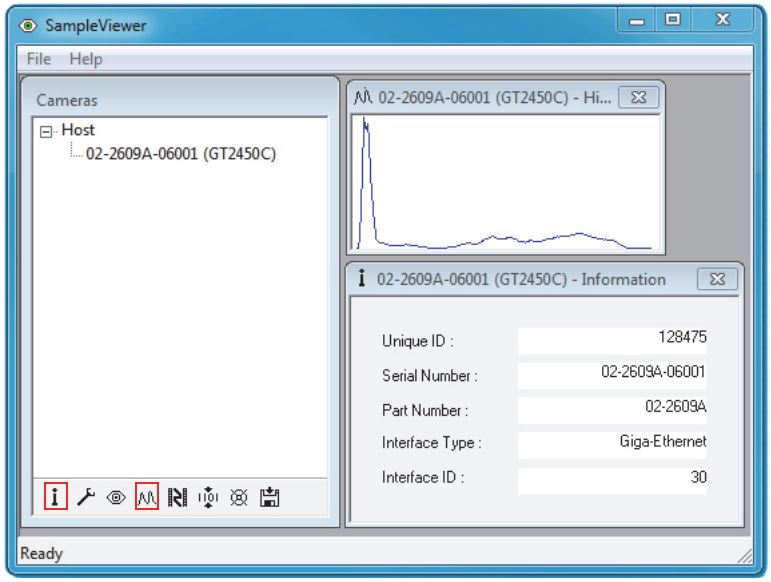

Figure 16: GigE Sample Viewer information and histogram windows

Event channel

Select the desired camera from the cameras window of the GigE Sample Viewer. Click the film icon, shown left, to open the events window. This is a tool used to monitor in-camera events such as *AcquisitionEnd*, *ExposureStart*, *ExposureEnd*, etc. The factory default settings disable all event notifications. Use the camera controls to select which events to monitor. View the *EventID* to understand the display format in the Events window.

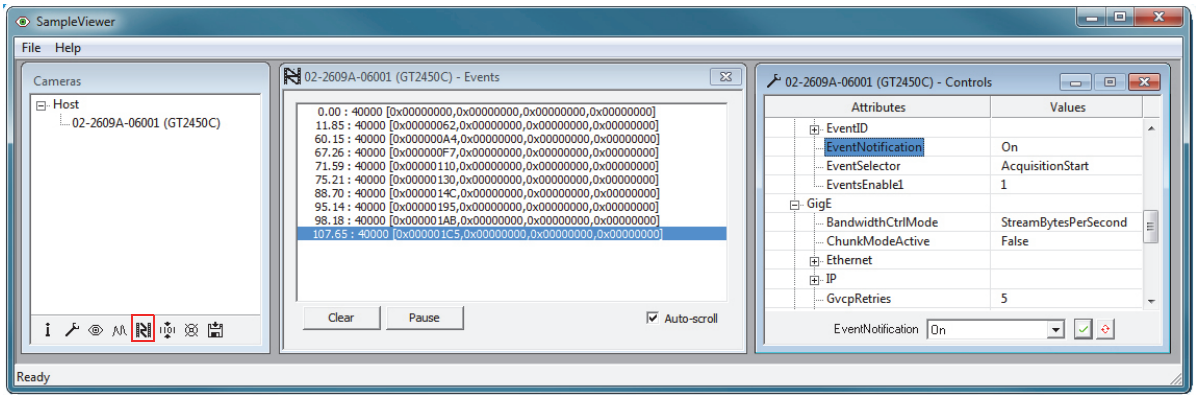

Figure 17: GigE Sample Viewer events and controls

RS232 serial interface

Select the desired camera from the cameras window of the GigE Sample Viewer. Click the serial icon, shown left, to open the serialIO window. This tool controls the camera's RS232 port which communicates across the RXD and TXD pins on the camera IO port. All AVT GigE Vision cameras except Mako offer an RS232 port.

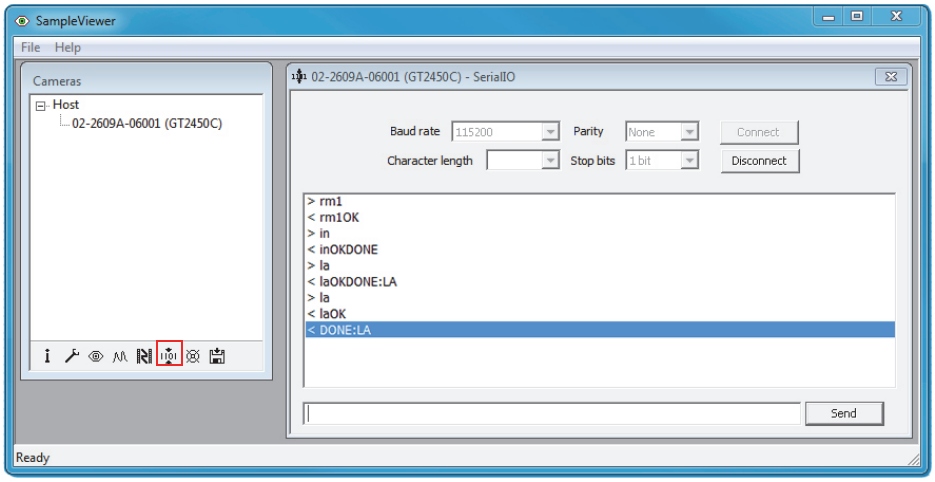

Figure 18: GigE Sample Viewer serialIO window

RS232 communication can be used for interfacing the camera to motorized lenses, temperature and pressure sensors, camera position motors, and other applications.

Seek camera

Select the desired camera from the cameras window of the GigE Sample Viewer. Click the seek icon, shown left. The seek camera window appears. This is used when camera UDP discover broadcast packets are either disabled, or blocked by hardware or network administrator preventing the camera from being recognized by the GigE Sample Viewer. Enter the camera's IP address into the window shown below.

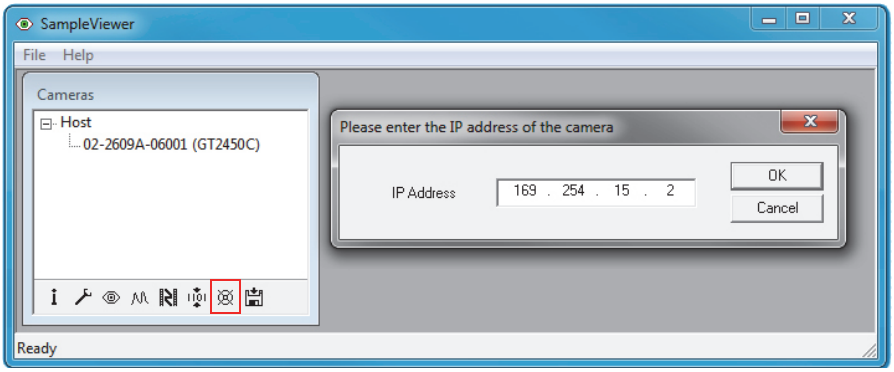

Figure 19: GigE Sample Viewer seek camera

Export camera settings

Select the desired camera from the cameras window of the GigE Sample Viewer. Click the floppy disk icon, shown left.

A file explorer window appears requesting a download location for the camera setup file. This file captures the current camera settings and creates a simple text file. This file can be uploaded to other cameras allowing both units to utilize the same camera settings.

www

Load camera settings to other cameras using the CamSetup example code found in PvAPI SDK from AVT. See the application note:

http://www.alliedvisiontec.com/fileadmin/content/PDF/Support/Application_Notes/AppNote_-_PvAPI_-_Saving_and_Loading_Camera_Attributes_with_Text_File.pdf

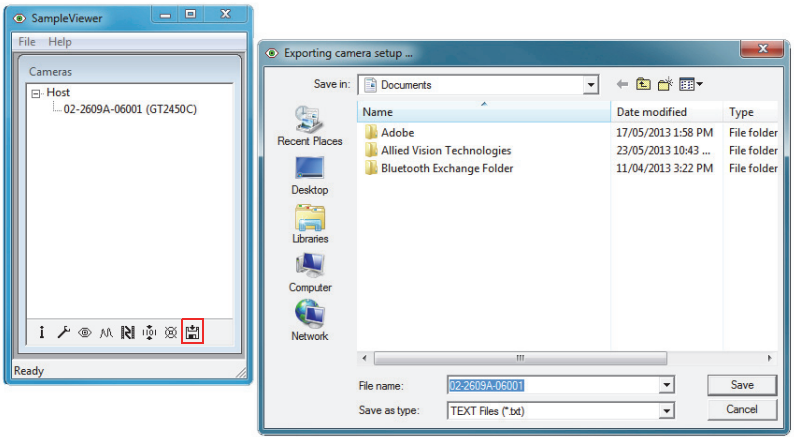

Figure 20: GigE Sample Viewer exporting camera setup

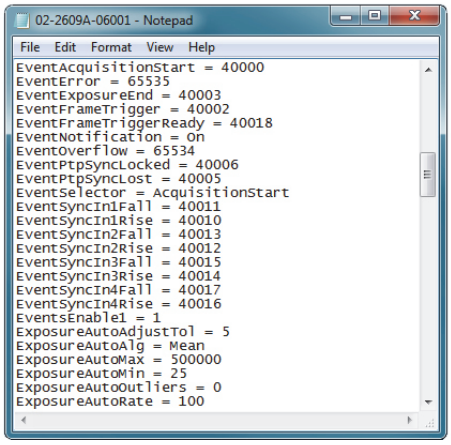

Figure 21: Camera settings text file exported from the camera

Modifying camera IP address

AVT GigE Vision cameras support a number of IP addressing modes. Cameras shipped from the factory are configured to DHCP. If a DHCP server is not present, the camera uses the LLL / Auto IP configuration mode.

Configuration Mode	Description
VIMBA: DHCP **PvAPI**: DHCP	Obtain an IP address automatically using DHCP (Fallback to LLL/Auto IP)
VIMBA: LLL **PvAPI**: Auto IP	Obtain an IP address automatically (169.254.xxx.xxx)
VIMBA: Persistent **PvAPI**: Fixed	IP address is assigned by the user

Table 4: Camera IP configuration modes

The camera IP address can be fixed by changing the configuration mode and defining the desired address.

For VIMBA users

The camera may not be detected by the viewer if the IP address of the adapter is not on the same subnet as the camera. In this case, start by configuring the adapter to Auto IP mode.

1. Ensuring that the adapter is in Auto IP configuration, launch the VIMBA Viewer application.
2. Wait for the camera to be listed in the “Detected Cameras” list.
3. Right-click the desired camera and select **Open CONFIG**.

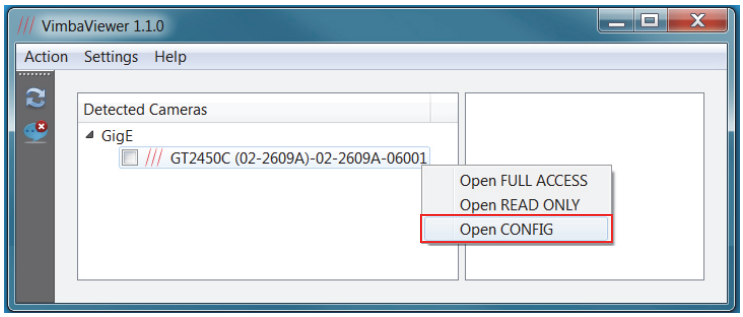

Figure 22: Example - Opening camera in configuration mode using VIMBA Viewer (Windows OS)

4. A new window opens. In the controller window, go to *GigE/Persistent* and provide the desired values.
5. Go to *GigE/Configuration/IP Configuration Mode*. Set *IP Configuration Mode* = Persistent; and execute *IP Configuration Apply* command.

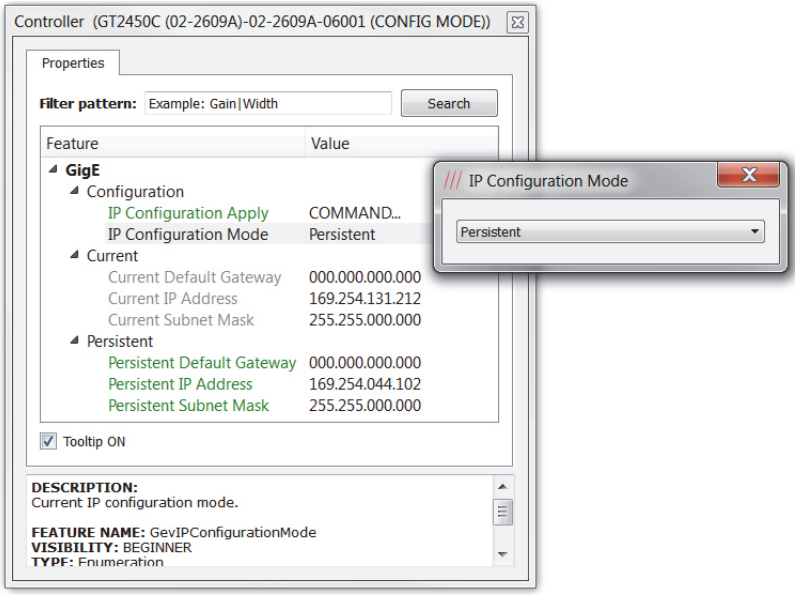

Figure 23: Example - Setting fixed camera IP address in VIMBA Viewer (Windows OS)

For PvAPI users

[Windows 7]

With the camera(s) connected to the host, run the **IPConfig** program. This application is packaged with the GigE Sample Viewer download.

- Select the camera(s) you wish to alter, select **Change**.
- Select **Use the following IP address**.
- Enter desired IP address, subnet mask, and gateway.

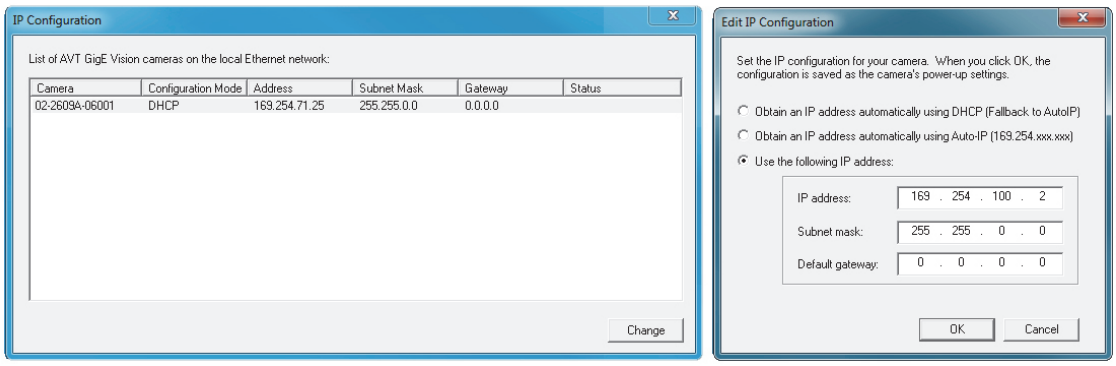

Figure 24: Setting fixed camera IP address using AVT **IPConfig** application

[Linux, OSX, QNX]

With the camera(s) connect to the host, run the **CLipConfig** program included in the AVT GigE SDK/bin-pc directory. Source code is included in the examples.

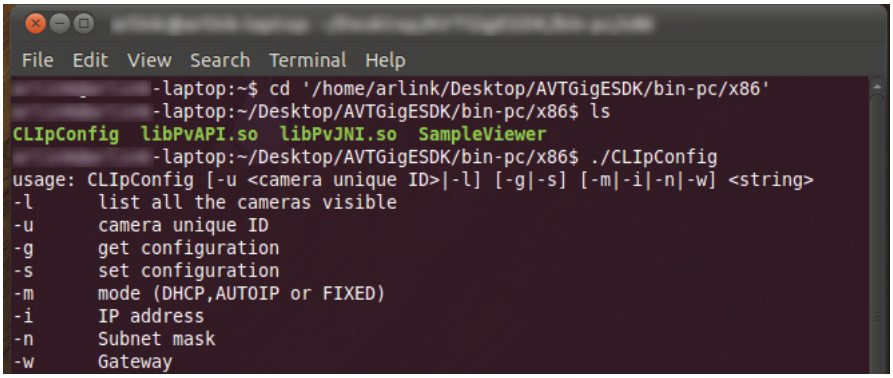

Figure 25: AVT **CLipConfig** application command line options

Using multiple cameras

There is a number of different methods for configuring a multiple camera system. Most of these can be differentiated into two architectures: Single Ethernet port and Multiple Ethernet port. In order to determine which architecture is needed, start by calculating the amount of bandwidth required from the cameras based on the desired resolution, pixel format, frame rate and number of cameras.

Bandwidth = Width x Height x Bytes Per Pixel x Frame Rate x Number of Cameras

= Value in MBps (Megabytes per second)

Example 1:

Three GC1020 cameras, full resolution, Mono8 pixel format (1 byte per pixel), at 30 fps.

Bandwidth usage = 1024 x 768 x 1 x 30 x 3 = 70.8 MBps

Percentage of single port GigE bandwidth = 57%. Single port architecture is sufficient.

Example 2:

Three GC650 cameras, full resolution, Mono16 pixel format (2 bytes per pixel), at 90 fps.

Bandwidth usage = 659 x 493 x 2 x 90 x 3= 175.4 MBps

Percentage of single port GigE bandwidth =140%. Multiple port architecture is needed.

Example 3:

Three GC1380C cameras, full resolution, Bayer16 pixel format (2 bytes per pixel), 20 fps.

Bandwidth usage = 1360 x 1024 x 2 x 20 x 3 = 167.1 MBps

Percentage of single port GigE bandwidth = 134%. Multiple port architecture is needed.

Gigabit Ethernet bandwidth is 1 Gbps (Gigabit per second) ~ 125 MBps (Megabytes per second). Example 1 can be accommodated using a single Ethernet port, whereas, example 2 and 3 require multiple Ethernet ports in order to increase the available bandwidth.

www

For more information on *StreamBytesPerSecond* and camera pixel format, see:

PvAPI users: AVT GigE Camera and Driver Attributes document

VIMBA users: AVT GigE Camera and Driver Features document

Single Ethernet port

Multiple cameras are connected to a switch. The switch is connected to a single Ethernet port. This is the simplest multiple camera installation. The cameras can be managed using Auto IP, no additional configuration on the switch is necessary.

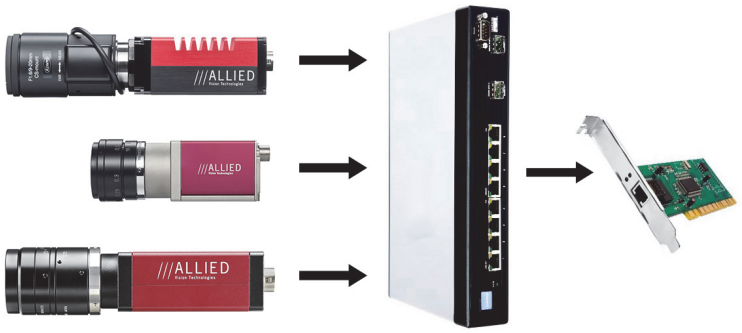

Figure 26: Multi-camera network configuration using a switch and single Ethernet port

This architecture combines bandwidth coming from each camera onto a single cable connected to the host. To prevent packet collision, resulting in dropped packets, the user is required the reduce *StreamBytesPerSecond* feature on each camera, such that the sum doesn't exceed 125,000,000 Bps.

Example:

Camera 1: GE1900, full resolution, Mono8 pixel format, at 15 fps
Bandwidth usage = 1920 x 1080 x 1 x 15 = 31,104,000 Bps
Set *StreamBytesPerSecond* = 31,104,000 Bps.

Camera 2: GE1650C, full resolution, Bayer GB8 / Bayer 8 pixel format, at 5 fps
Bandwidth usage = 1600 x 1200 x 1 x 5 = 9,600,000 Bps
Set *StreamBytesPerSecond* = 9,600,000 Bps.

Camera 3: GC2450, full resolution, Mono8 pixel format, at 5 fps
Bandwidth usage = 2448 x 2050 x 1 x 5 = 25,092,000 Bps
Set *StreamBytesPerSecond* = 25,092,000 Bps.

Total bandwidth consumed = 31,104,000 + 9,600,000 + 25,092,000 = 65,796,000 Bps

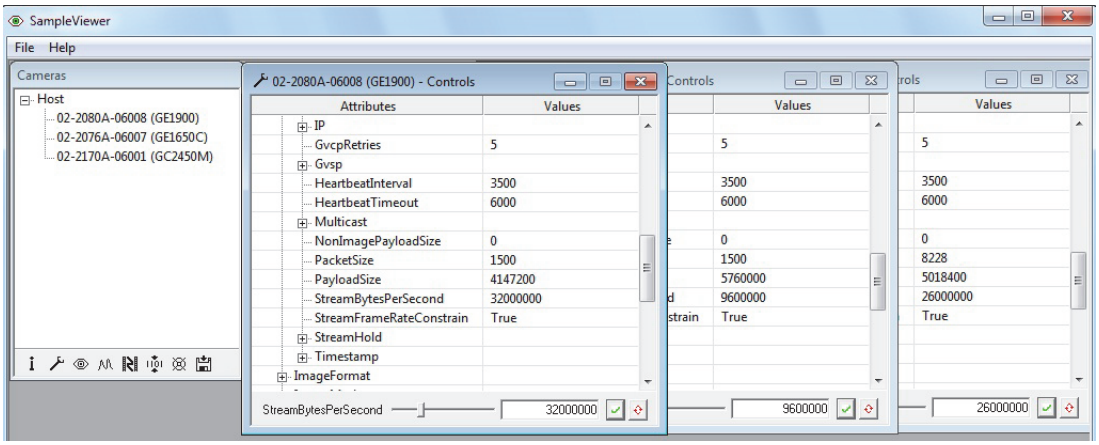

Figure 27: GigE Sample Viewer window, controls window showing *StreamBytesPerSecond* feature

Multiple Ethernet ports

Each camera is connected directly to an Ethernet port. No switch is used. This configuration is more complex and requires the user to manage host and camera IP addressing; however, it allows each camera to use the entire Gigabit interface bandwidth.

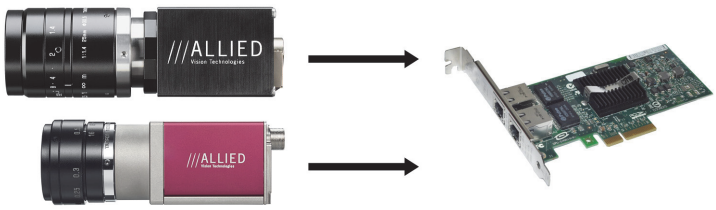

Figure 28: Multi-camera network configuration using multiple Ethernet ports

Camera and adapter IP addresses are managed with fixed IP addressing, as the IP address of each adapter needs to be on a unique subnet. A subnet is that part of the IP address that overlaps with the binary 1's (decimal 255 in following example) of the subnet mask.

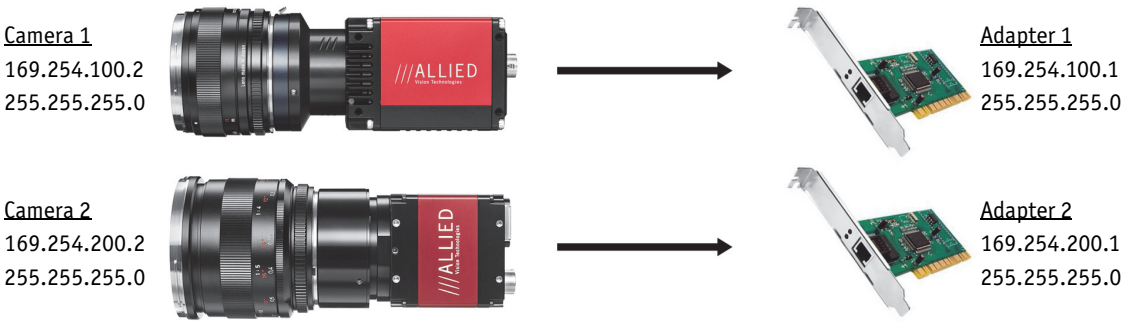

Figure 29: Camera and adapter IP address example

The following steps are required to configure a multiple Ethernet port camera system:

- Fix host adapter IP address
- Fix camera IP address

Note

The host can be configured using multiple single port adapter cards, multiple dual port, quad port and so on. The same IP addressing model can be scaled to larger network configurations.

Fix host adapter IP address

– Refer to Modify Ethernet adapter IP address on page 17.

– Select **Use the following IP address**:

Adapter1 IP Address: 169.254.100.1
Subnet mask: 255.255.255.0

Adapter2 IP Address: 169.254.200.1
Subnet mask: 255.255.255.0

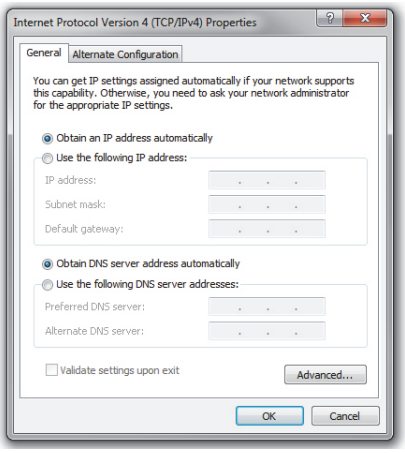

Figure 30: IP configuration window for Adapter 1

Fix camera IP address

– Refer to Modifying camera IP address on page 35.

– Set the following IP addresses:

Camera1 IP Address: 169.254.100.2
Subnet mask: 255.255.255.0

Adapter1 IP Address: 169.254.200.2
Subnet mask: 255.255.255.0

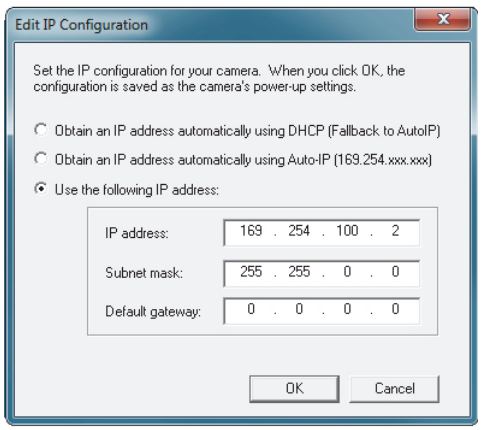

Figure 31: AVT IPConfig camera IP address configuration window

Implementing link aggregation

The Prosilica GX series cameras offer two Gigabit Ethernet ports for image data transfer and control. Users can connect one or both ports on the Prosilica GX to Ethernet adapter ports on a host computer. The dual port approach requires the host computer to configure a Link Aggregate Group (LAG). A LAG configuration combines multiple Ethernet ports into a single data channel.

Figure 32: Prosilica GX camera network configuration using multiple Ethernet ports

When is LAG needed?

Connecting both ports increases the available bandwidth to 240 MB/sec. This is beneficial for the following cases.

- Need to use high(> 8 bits) bit depth pixel formats.
- Highest frame rate is needed.

www See AVT Prosilica GX Technical Manual for resolution and ROI frame rate performance.

http://www.alliedvisiontec.com/us/support/downloads/product-literature/prosilica-gx.html

www For more information on camera pixel format, see:

PvAPI users: AVT GigE Camera and Driver Attributes document

VIMBA users: AVT GigE Camera and Driver Features document

The following examples show how to determine bandwidth consumption. If the value is greater than 125 MB, LAG is required.

Example 1:

GX1050 camera using Mono8 pixel format and outputting 100 fps

Bandwidth usage = Resolution x Pixel format x Frame rate
= 1024 x 1024 x 1 (1 byte for Mono8) x 100
~ 105 MBps

Percentage of single port GigE bandwidth ~ 84%, LAG is not required to operate the GX1050 camera at 100 fps in Mono8.

Example 2:

GX1050C using YUV422 pixel format and outputting 100 fps

Bandwidth usage = 1024 x 1024 x 2 (2 byte for YUV422) x 100

~ 210 MBps

Percentage of single port GigE bandwidth ~ 168%, LAG is required to operate the GX1050C at 100 fps using YUV422.

Configuring Link Aggregation

The GX camera connected to host using LAG requires two host Ethernet adapter ports. Configure and optimize each Ethernet adapter port using steps outlined in Ethernet adapter configuration on page 17. The following steps describe the setup of a link aggregate group.

[Windows 7, Intel PT]

- **Start**, **Control Panel**
- **Hardware and Sound**
- **Device Manager**
- **Network Adapter**
- Right-click Adapter device name
- **Properties**
- **Teaming** tab
- Select **Team the adapter with other adapters**
- Click **New Team**
- The New Team Wizard window opens, choose a team name and click **Next**
- Select the desired adapters corresponding to the ports to be used by the Prosilica GX camera, click **Next**

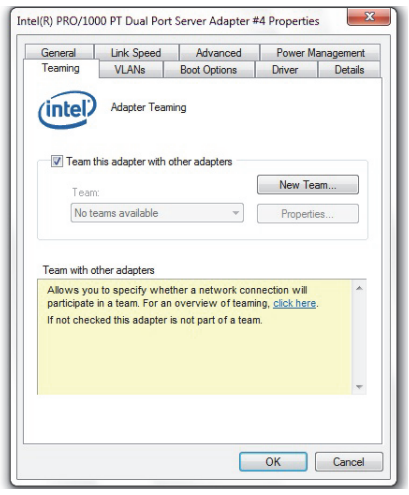

Figure 33: Intel adapter properties teaming tab

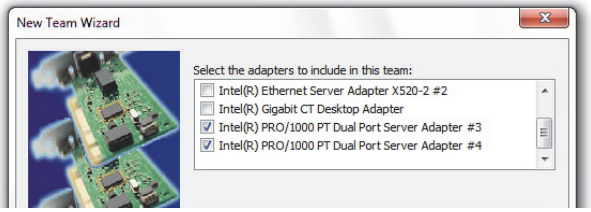

Figure 34: Team wizard adapter selection

– **Select team type**: Static Link Aggregation
click **Next**

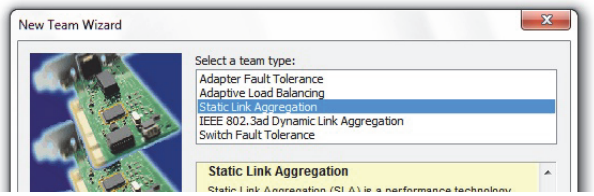

Figure 35: Team wizard team type selection

This configures the team and a new adapter appears in the Network Connections window.

Note

The newly formed team adapter can be managed using automatic IP configuration or fixed IP using instructions provided in Modify Ethernet adapter IP address on page 17.

[Linux]

Link Aggregation is referred to as bonding in Linux. The following instructions are for Ubuntu Linux 10.04 or newer.

www

For full installation instructions on Ubuntu, see:

https://help.ubuntu.com/community/UbuntuBonding
https://help.ubuntu.com/community/LinkAggregation

– Download ifenslave module
– **Terminal**: sudo apt-get install ifenslave
– **Terminal**: ifconfig
– Note eth#'s of NICs to be bonded
– **Terminal**:
sudo gedit /etc/network/interfaces
– **Add/edit**:

```
auto bond0
iface bond0 inet static
address 169.254.100.101
netmask 255.255.0.0
bond-slaves eth6 eth7
bond_mode 0
mtu 8228
```

where, `eth6` and `eth7` are the NICs to be bonded.

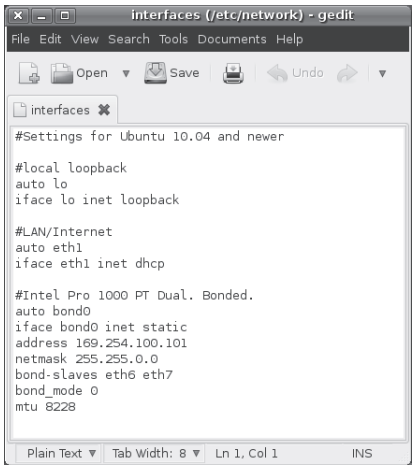

Figure 36: Interfaces file for bonding

[OSX] (PvAPI only)

www

For full installation instructions on OSX, see:

http://docs.info.apple.com/article.html?path=ServerAdmin/10.6/en/asa7873dc0.html

Note

These instructions are for OSX server, but apply to OSX also.

- **System Preferences**
- **Network**
- Select **Ethernet**, click **gear** icon, **Manage Virtual Interfaces**
- Click the Add (**+**) button, and select **New Link Aggregate**
- Select the ports to bond from the list, click **Create**, **Done**.

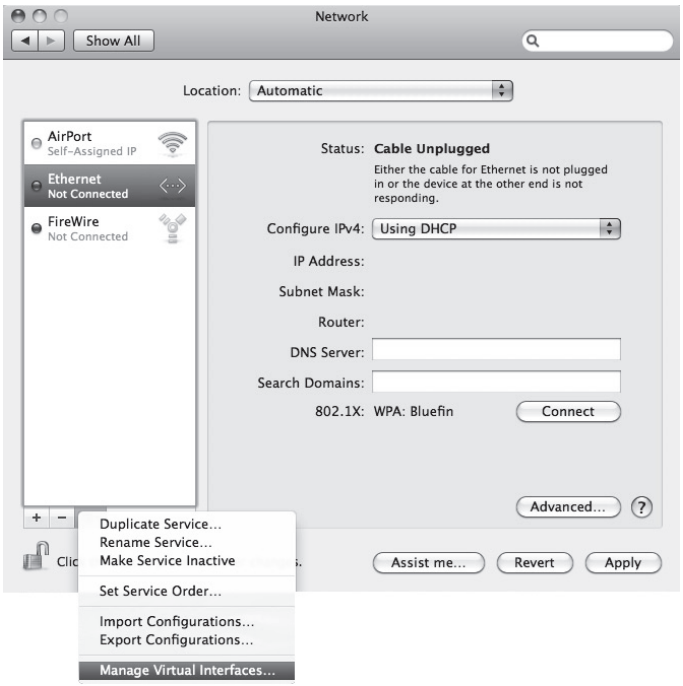

Figure 37: Manage Virtual Interfaces. OSX

Multicasting configuration

Multicasting allows multiple hosts on the same network to receive camera image data. One host acts as master/controller, and the others act as monitor. Most network hardware only supports multicasting at maximum packet size 1500.

www

For enabling/disabling multicasting, see:

PvAPI users: AVT GigE Camera and Driver Attributes document

VIMBA users: AVT GigE Camera and Driver Features document

[Windows]

Ensure camera packet size is 1500. No additional setup is required.

[Linux]

Multicasting only works if the application is run as root. Additionally, you may have to add manually a route:

```
> sudo route -n add -net 224.0.0.0 netmask 240.0.0.0 dev eth0
```

where, `eth0` is the adapter used for camera.

[OSX] (PvAPI only)

Multicasting is not supported on Mac OS X.

Troubleshooting

Is the camera getting power?

The RJ45 Ethernet connector on the back for the camera contains LEDs, one of which illuminates when the camera is powered. If unlit, check the power adapter. If possible, test the adapter with a working camera to verify its operation. If using a custom power adapter, be sure the adapter and wire gauge is rated to 200–500 mA.

Is the camera powered, but not detected in viewer?

Damaged or poor quality Ethernet cabling can result in no cameras found, dropped packets, decreased bandwidth, and other problems. Use Category 6 or better rated Ethernet cabling.

Return to Modify Ethernet adapter IP address on page 17, which describes how to adjust the IP address of the host adapter. There should be no gateway on your NIC. Connect a single camera directly to your NIC, no hub/switch.

Ensure that IP address of the adapter is on the same subnet as the camera. If not, return the adapter address to the Auto IP configuration. A sample IP configuration for the camera and adapter is shown below.

	Adapter	Camera
IP address:	169.254.23.2	169.254.43.3
Subnet Mask:	255.255.0.0	255.255.0.0

PvAPI users only **[Windows 7]**

Run the IpConfig application installed with the GigE Sample Viewer. You may need to wait up to one minute for the camera to appear.

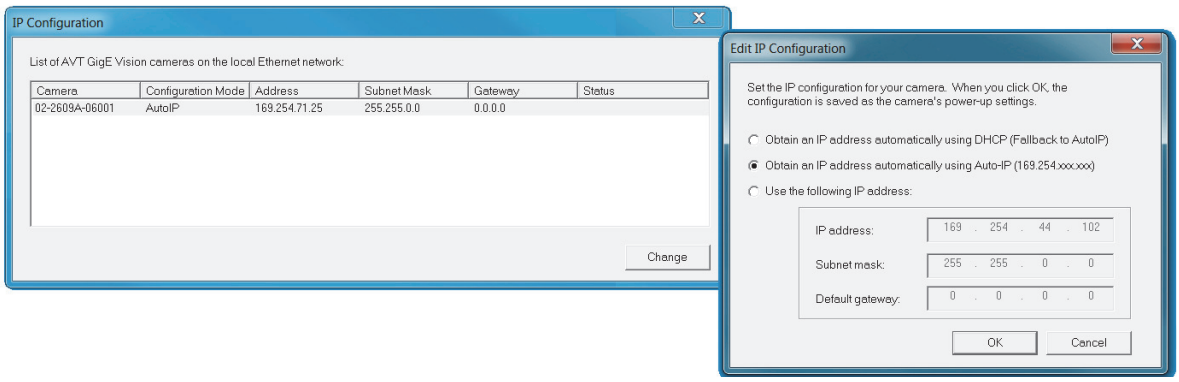

Figure 38: GigEIpConfig

[Linux, OSX, QNX]

In AVT GigE SDK/bin-pc/<correct architecture>/ directory:

Terminal: sudo ./CLiPConfig -l

If you are still having problems, type: ipconfig /all in a command prompt [windows]; ifconfig -a in terminal [Linux, OSX, QNX]. Send resulting screenshot to support@alliedvisiontec.com.

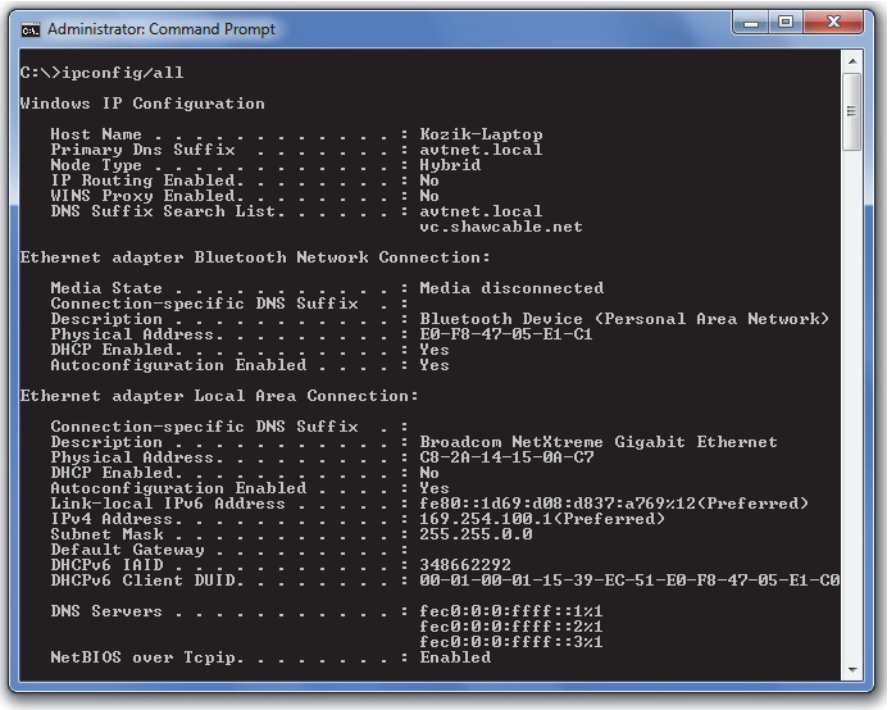

Figure 39: ipconfig /all. Windows

Is the camera listed in Viewer but can't acquire images?

Reset your camera settings to factory default.

VIMBA Viewer In controller window, set *UserSetDefaultSelector* = Default, and click the *UserSetLoad* button.

GigE Sample Viewer In controls window, set *ConfigFileIndex* = Factory, click *ConfigFileLoad* button. While streaming, check the camera Stats.

StatFramesDelivered / StatPacketsReceived = 0

- Likely a firewall is blocking incoming traffic. Disable your firewall on Ethernet adapter connected to camera. Ensure that:
  - **For VIMBA Viewer**: *TriggerSelector* = FrameStart *TriggerSource* = Freerun or FixedRate
  - **For GigE Sample Viewer**: *FrameStartTriggerMode* = Freerun or FixedRate.

  Other trigger modes require a trigger event to capture frames.

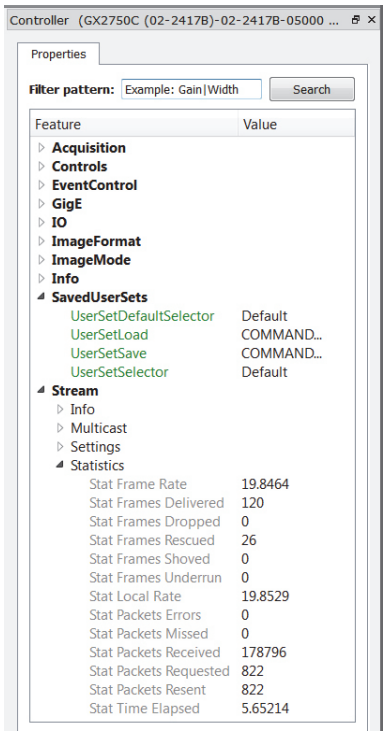

Figure 40: VIMBA Viewer - Stats

StatFramesDropped ≠ 0

- Packets are incoming, but all dropping. Be sure you have jumbo frames enabled on your adapter, see Ethernet adapter optimization on page 19. Alternatively, reduce camera packet size value to 1500 using the viewer.

StatFramesDelivered is increasing but black image

- Be sure your scene is sufficiently lit.
- Increase exposure value.
  - **For VIMBA Viewer**: *ExposureTimeAbs*
  - **For GigE Sample Viewer**: *ExposureValue*
- Ensure the camera lens is properly installed and the lens cap has been removed.

Note

If you are still having problems, email to support@alliedvisiontec.com.

How to minimize/eliminate dropped packets?

- Check the Gigabit Ethernet cable. A damaged cable often causes the host to switch to 10/100 speed mode.
- Use one of the NICs recommended in our hardware selection guide.

www

A list of AVT recommended Ethernet adapters is available on the AVT website.

http://www.alliedvisiontec.com/fileadmin/content/PDF/Support/Application_Notes/Hardware_Selection_for_AVT_GigE_Cameras.pdf

- Use the latest NIC driver from the NIC manufacturer.
- Enable jumbo frames/packets on NIC. Typical maximum supported packet sizes are 9014 and 16000. Camera is set to packet size8228. Larger packets result in less overhead on the host CPU.

  However, not all network hardware may support maximum packet size. For example, if using a switch and seeing *StatPacketsResent* in the viewer, decrease packet size until resends stop.
  - **VIMBA Viewer**: decrease *GevSCPSPacketSize*
  - **GigE Sample Viewer**: decrease *PacketSize*

  This is an indication of buffer overflow on the switch. More frequently, smaller sized packets resolve this.
- Set NIC Interrupt Moderation Rate = Extreme. Receive Buffers = Max allowable.
- Use PvAPI ≥ v1.26 with filter driver (filter is Windows only) ≥ v1.22 enabled on NIC.

www

To download latest PvAPI SDK, visit:

http://www.alliedvisiontec.com/emea/products/legacy.html

- Disable the firewall if no filter driver is used.
- Use a dedicated LAN/NIC/Switch for the camera(s). Do not share camera networks with internet, company LAN, etc. If using multiple cameras on a single port NIC through a switch, be sure the sum of *StreamBytesPerSecond* on all cameras doesn't exceed available bandwidth (124,000,000 MBps).
- **GX Only**: With LAG, you may need to increase *GvspLookbackWindow*/*GVSPMaxLookBack*.

www

For more information on *GvspLookbackWindow*/*GVSPMaxLookBack*, see:

PvAPI users: AVT GigE Camera and Driver Attributes

VIMBA users: AVT GigE Camera and Driver Features

- **Linux only**: Run as root, allowing the OS to boost the priority of the AVT driver thread, and the driver to bind directly to the NIC adapter. Users who feel running as root compromises their system security may find the following implementation satisfactory:
  - Set the executable owner as root
  - Set the “setuid” permission bit on the executable
  - In code, when application starts use capset() to release all but these privileges: CAP_SYS_NICE, CAP_NET_ADMIN, CAP_NET_BROADCAST, CAP_NET_RAW. The application will start with all root privileges, but it will drop them immediately after startup

Troubleshooting for Bigeye G cameras only (IOD mode)

If the camera can be detected but no images can be grabbed:

Verify the camera operation mode: Make sure the camera operates in continuous mode, and not in IOD mode.

General description:

- Continuous mode: The camera generates the images with a constant exposure time autonomously.
- Image on Demand (IOD): the camera produces no image until a trigger impulse is generated.

Controls ⇨ IODMode	Controls ⇨ Exposure ⇨ ExposureAuto/ExposureMode	Trigger mode	Description
Continuous	Off/Manual	Freerun	Camera generates images with a constant exposure time autonomously. The exposure time cannot be adjusted.
Continuous	Off/Manual	LineX/SyncInX	Camera waits for an impulse at the selected trigger input pin to start a continuous image output.
IOD	Off/Manual	Freerun	Camera produces images autonomously. The exposure time can be adjusted.
IOD	Off/Manual	LineX/SyncInX	Camera produces a single image for every impulse at the selected trigger input pin. The exposure time is defined by *ExposureTimeAbs/ExposureValue*.
IOD	Other/External	LineX/SyncInX	Camera produces a single image for every impulse at the selected trigger input pin. The pulse width defines the exposure time.

Table 5: Comparison of IOD modes and trigger modes

Additional references

Product webpage

http://www.alliedvisiontec.com/us/products/cameras/gigabit-ethernet/manta.html

Product manuals and CAD models

http://www.alliedvisiontec.com/us/support/downloads/product-literature.html

AVT VIMBA SDK

http://www.alliedvisiontec.com/us/products/software/vimba-sdk.html

AVT GigE PvAPI SDK

http://www.alliedvisiontec.com/emea/products/legacy.html

Knowledge base

http://www.alliedvisiontec.com/us/support/knowledge-base.html

Case studies

http://www.alliedvisiontec.com/us/products/applications/industrial-inspection.html

Firmware

http://www.alliedvisiontec.com/us/support/downloads/firmware.html

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