Sapera LT™ 8.60

Getting Started Manual
for GigE Vision® Cameras & 3D Sensors

sensors | cameras | frame grabbers | processors | **software** | vision solutions

TELEDYNE DALSA
Everywhere**you**look™

NOTICE

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About This Manual

This manual exists in Windows Help, and Adobe Acrobat® (PDF) formats (printed manuals are available as special orders). The Help and PDF formats make full use of hypertext cross-references. The Teledyne DALSA home page on the Internet, located at http://www.teledynedalsa.com/imaging, contains documents, software updates, demos, errata, utilities, and more.

About Teledyne DALSA

Teledyne DALSA, a business unit of Teledyne Digital Imaging Inc., is an international high-performance semiconductor and electronics company that designs, develops, manufactures, and markets digital imaging products and solutions, in addition to providing wafer foundry services.

Teledyne Digital Imaging offers the widest range of machine vision components in the world. From industry-leading image sensors through powerful and sophisticated cameras, frame grabbers, vision processors and software to easy-to-use vision appliances and custom vision modules.

Contents

Sapera LT with GigE Vision Cameras and 3D Sensors

Teledyne DALSA GigE Vision® cameras and 3D sensors provide image acquisition using standard Gigabit Ethernet network adapters and Ethernet cables without the need for frame grabber hardware and are suitable for a variety of applications.

GigE Vision® cameras and 3D sensors rely on GenICam™ to describe the features supported by the camera, providing a user-friendly common interface to control camera functionality across platforms. An XML file, stored on the device, describes the camera features, which are standardized. These features are then exposed through the Sapera API.

All devices that are GenICam compliant use the same feature names (established by the Standard Feature Naming Convention (SNFC)) to control the camera, though manufacturers can use camera specific features that are not part of this standard.

The Sapera LT SDK includes the Network Imaging package which provides support for devices that use the GigE Vision standard. The GigE Vision Module software provides all components required to control GigE Vision devices.

GigE Vision cameras require a Gigabit Network Interface adapter. Refer to the camera or 3D sensor documentation for more information.

Supported Industry Standards

	GigE Vision devices that are compliant with the GigE Vision 1.0 specification which defines the communication interface protocol used by any GigE Vision device. The device description and capabilities are contained in an XML file. For more information see: https://www.visiononline.org/

Introduction to Sapera LT

Sapera™ LT is a software API for controlling image acquisition devices such as GigE Vision cameras and 3D sensors. Sapera LT libraries support Teledyne DALSA cameras and frame grabbers as well as hundreds of 3rd party camera models across all common interface formats like GigE Vision®, Camera Link®, as well as emerging new image acquisition standards such as CLHS.

> If your application requires image processing or GPU optimization, Sapera Essential, a full-featured image processing library, is available as a separate software package. For more information see www.teledynedalsa.com/imaging/products/software/.

This manual introduces the Sapera LT API and is designed to help programmer's with installation, and quickly perform hardware setup and validation.

Sapera LT Licensing

Sapera LT is available free of charge, both SDK and runtime versions, when used with Teledyne DALSA frame grabber or camera products. However, if Sapera LT is used with 3rd party GigE cameras, a license must be purchased to activate the Sapera Network Imaging Package; refer to the section Using Sapera LT with 3rd Party GigE Cameras.

The Sapera LT APIs

Sapera LT includes everything you need to acquire and display images, using one of its 3 application programming interfaces (API):

- Sapera LT++ classes (based on C++ language)
- Sapera LT .NET classes (based on .NET languages)
- Sapera LT Standard API (based on C language)

It is targeted at developers that have their own image processing libraries and want to interface those libraries to a Sapera LT compatible device. Sapera LT includes tools such as CamExpert to speed up application development.

Hardware independent classes allow one application to control different Teledyne DALSA devices through the same API. It also guarantees seamless migration to any future Teledyne DALSA hardware product supported by Sapera LT.

If you are using Sapera LT with a GigE Vision camera, the Sapera Network Imaging Package is also provided to communicate with and control devices using the GigE Vision protocol.

Sapera Tools and Utilities

The Sapera LT SDK and runtime installations include the following a set of tools and utilities:

- Sapera Explorer: provides quick access to all tools, demos, examples and source code
- CamExpert: acquisition and device configuration, including image display
- Z-Expert: For 3D sensors; acquisition and device configuration, including image display
- Sapera Monitor: real-time event viewing of applications.
- Sapera Log Viewer: error and other message log for applications and hardware
- Network Configuration Tool: network configuration
- Sapera Configuration Utility: memory resource configuration and multi-threading optimization

Sapera LT Manual Descriptions

Sapera LT is supported by the following manuals in PDF, and compiled HTML help formats.

API/Topic	Title	Description
General	**Sapera LT Getting Started Manual for Frame Grabbers**	Provides a general overview of the Sapera LT APIs with frame grabbers, possible hardware configurations and a quick overview of Sapera programming.
General	**Sapera LT Getting Started Manual for GigE Vision Cameras and 3D Sensors**	Provides a general overview of the Sapera LT APIs with GigE Vision cameras and 3D sensors, a quick overview of Sapera programming as well as troubleshooting guidelines.
General	**Sapera LT Getting Started Manual for USB3 Vision Cameras**	Provides a general overview of the Sapera LT APIs with USB3 Vision cameras, a quick overview of Sapera programming as well as troubleshooting guidelines.
General	**Sapera LT User's Manual**	Introduces Sapera LT ++ API and Sapera .NET API programming procedures, including sample code for typical operations in C++, C# and VB .NET.
GigE Vision	**Network Imaging Package for Sapera LT Optimization Guide**	Network setup and optimization guide for GigE Vision cameras.
.NET	**Sapera LT .NET Programmer's Manual**	Provides a complete reference of the Sapera .NET Framework for Visual Studio. Sapera .NET reflects the underlying low-level Sapera LT architecture.
C++	**Sapera LT ++ Programmer's Manual**	Provides a complete reference of all the Sapera LT ++ classes. Sapera LT ++ is based on the C++ language.
C++	**Sapera LT GUI Classes Reference Manual**	Describes the C++ GUI (graphical user interface) helper classes used to create common application dialogs. These classes are used in the Sapera demo programs and are provided to help users with applications that require a GUI.
C++	**Sapera LT Legacy Classes Reference Manual**	Describes the obsolete C++ classes that continue to be supported but have been replaced or retired.
C	**Sapera LT Acquisition Parameters Reference Manual**	Describes the Sapera LT low level acquisition parameters and capabilities (based on the C language).
C	**Sapera LT Basic Modules Reference Manual**	Lists in detail the Sapera LT low-level module functions as well as data definitions, file formats, and macros (based on the C language).

Supported Operating Systems

- Windows 7 SP1 with security update KB3033929 (SHA-2 Code Signing Support) or Windows 10 (32-bit or 64-bit versions)

Supported Sapera LT Development Environments

- C/C++ and .NET language compilers, for both 32-bit and 64-bit development:
    - Microsoft Visual Studio 2010
    - Microsoft Visual Studio 2012
    - Microsoft Visual Studio 2013
    - Microsoft Visual Studio 2015
    - Microsoft Visual Studio 2017

Installation Types

When installing Sapera LT, you are provided with a choice of different setup types, each with its own dedicated installation program.

The full SDK (software development kit) installation provides access to all available Sapera LT functions, tools, and utilities, such as CamExpert, for 32 or 64-bit application development, and the GigE Vision module (required when using GigE cameras).

Installation Type	Notes
Sapera LT Full SDK	Full installation of the software development kit, including all tools and utilities. Installation options allow you to install components for frame grabbers only, for GigE Vision cameras (includes the Sapera Network Imaging Package) only, 3D sensors or USB3 Vision cameras.
Sapera LT Runtime (32 or 64-bit)	Runtime installation for application deployment, including all tools and utilities, and optionally the GigE Vision module (if required).
Sapera LT Runtime WoW64 (32-bit application for 64-bit OS)	
CamExpert	Installation of CamExpert only (includes GigE Vision module).
CamExpert WoW (32-bit application for 64-bit OS)	
Sapera LT Camera SDK	Installation of Sapera LT Camera SDK for Gen CP CameraLink cameras. Feature control only.
Sapera LT Camera SDK Runtime	Runtime installation for application deployment of Sapera LT Camera SDK for GenCP CameraLink cameras. Feature control only.

These executable files are available for download directly from the Teledyne DALSA website:

http://teledynedalsa.com/imaging/support/downloads/sdks/

> ⚠️ Warning: The Sapera LT GigE Vision driver requires Sapera LT 8.11 (or greater) for support under WoW64 runtime environments.

> ℹ️ Note: The Sapera LT Camera SDK is also available for use when using Teledyne DALSA Camera Link cameras with third party frame grabbers only. It is provided as part of the Teledyne DALSA camera installation.

Installing Sapera LT for use with GigE Vision

To install the Sapera Network Imaging Package, it is recommended that the installation be started locally instead of from a network location.

During the installation process, you are prompted to choose the Sapera LT acquisition components to install. Select the **GigE Vision cameras** and/or **Teledyne DALSA 3D profile sensors** options. This will install the GigE Vision Network Imaging Package on your system.
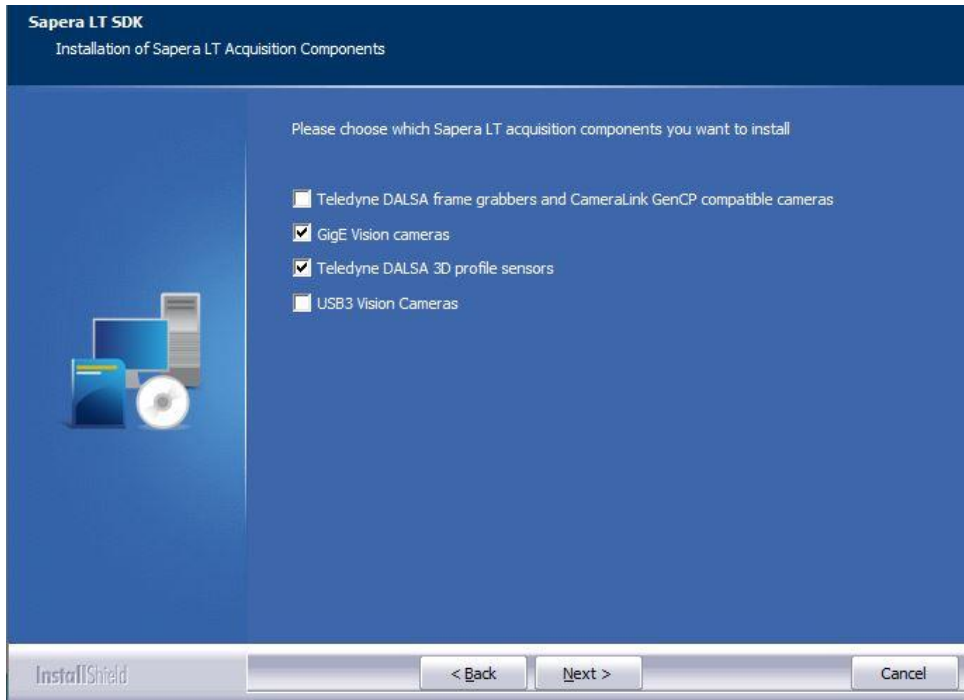
Upgrading Previous Versions of Sapera LT

Sapera LT 7.30 and Higher

When upgrading from Sapera LT version 7.30 or higher, uninstalling is not required; proceed directly to installation of Sapera LT 8.60.

	Note: The installation option is persistent. When upgrading to a newer version of Sapera LT, the previously chosen option (frame grabbers only/GigE Vision cameras only/All components) is used. If you want to change option, you must uninstall Sapera LT first.

To verify the current installation option, check the Sapera LT SDK entry in the **Windows Settings > Apps and features** section.

For example, if the **GigE Vision cameras** option was selected, it is indicated as follows:
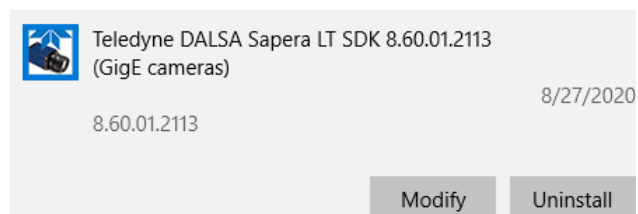
If the **Teledyne DALSA 3D profile sensors** option was selected, it is indicated as follows:
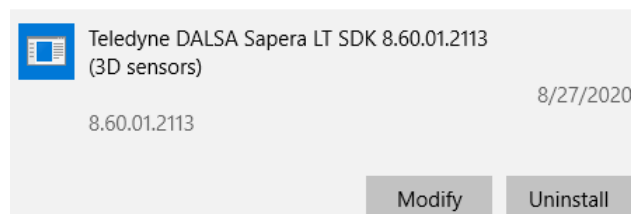
If more than one option was selected (for example, GigE cameras and 3D sensors), they are indicated as follows:
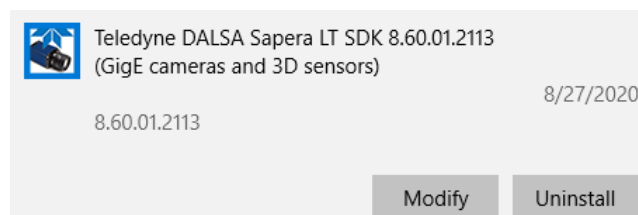
Sapera LT 7.20 and Lower

Before installing Sapera LT 8.60, uninstall Sapera LT from the Windows **Control Panel > Programs and Features**.

Start Menu Shortcuts

For Windows 7, Start menu shortcuts for Sapera LT are available under **All Programs > Teledyne DALSA > Sapera LT** and **>Sapera Network Imaging Package.** For Windows 10, similar shortcuts are available from the Start menu.

The following screenshots display the menus for the full Sapera LT SDK.
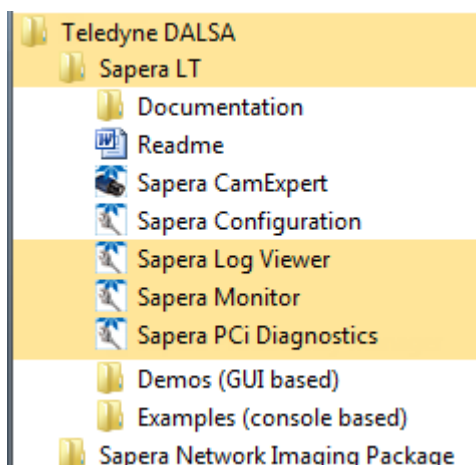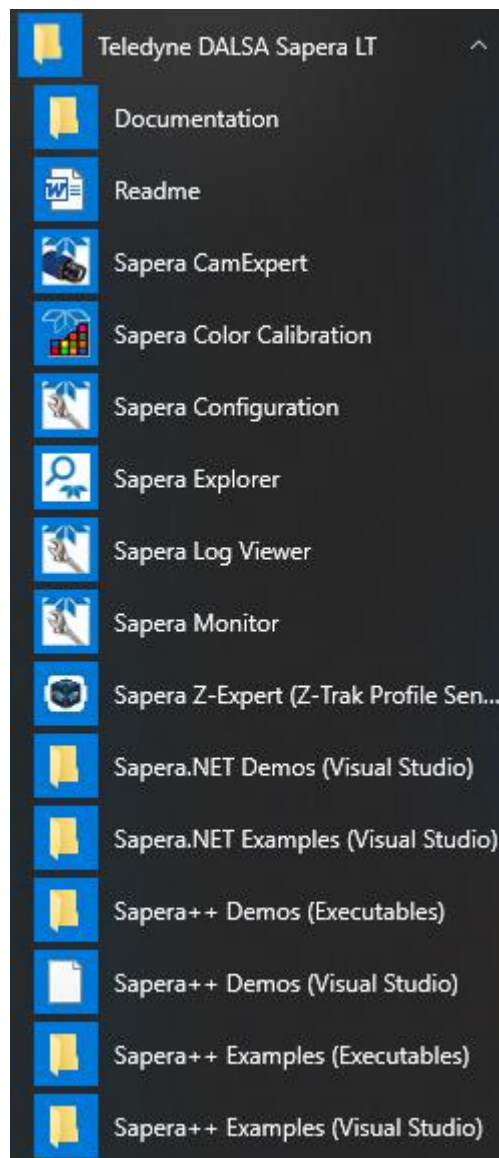
Windows 7	Windows 10

See Appendix A: File Locations for a complete description of directory contents.

Sapera Explorer

The Sapera Explorer application provides quick access to the Sapera LT tools documentation, demos, examples and source code, grouped by category. Select a category to view available applications. To run the selected application, click the active tile.
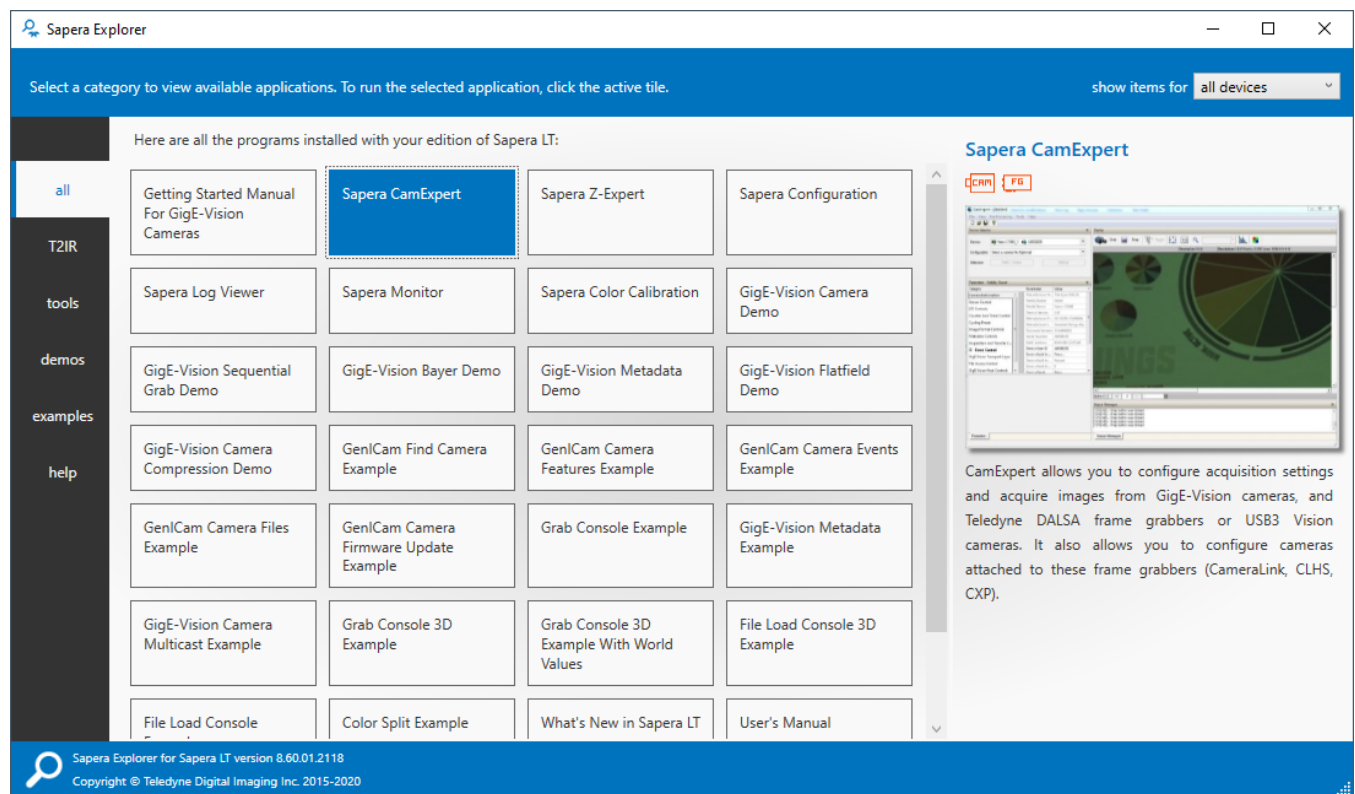
Items can be filtered using the **show items for** drop-down list:
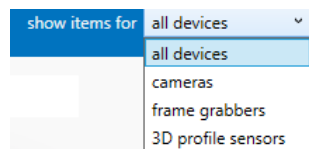
For Demos and Examples, click **Browse code for Sapera ++** or **Browse code for Sapera .NET** to open the source code directory.
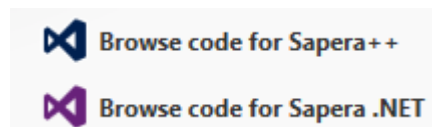
The CAM, FG and 3D icons indicate whether the demo or example is supported by cameras, frame grabbers or 3D sensors.

Sapera LT Architecture Overview

The following section describes application architecture, related terms, and illustrates Sapera LT's library architecture.

Application Architecture

Whichever API is used (Sapera LT ++, Sapera LT .NET, or Standard C), the Sapera LT modular architecture allows applications to be distributed on different Sapera LT servers. Each server can run either on the host computer or on a Teledyne DALSA device. Sapera LT calls are routed to different servers via the Sapera LT messaging layer in a fashion completely independent of the underlying hardware.
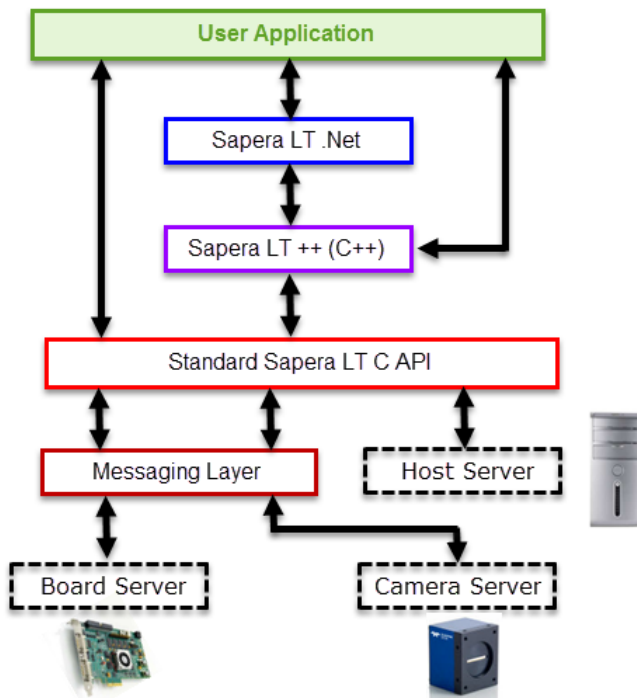
What is a server?

A Sapera Server is an abstract representation of a physical device like a frame grabber, a camera or 3D sensor, or a desktop PC. In general, a Teledyne DALSA board is a server. Some processing boards, however, may contain several servers; this is true when using multi-processor boards.

A server allows Sapera applications to interact with the server's resources. The server name consists of the product model name and an index. For example, the Genie Nano M1940 camera has a server name "Nano-M1940_1". If more than one camera of the same type is available, the index differentiates the cameras.

Library Architecture

The typical machine vision application requires configuration of acquisition resources, image capture and transfer to memory buffers. These image buffers can then be processed or displayed, analyzed, with results determining subsequent processes. Events can also be monitored to trigger appropriate responses. The Sapera LT library architecture is organized around these basic machine vision functional blocks.

Vision applications developed with Sapera LT are typically programmed in either the Sapera LT++ API (Application Programming Interface) or the Sapera LT .NET API. In general, both APIs use similar classes and naming conventions.

Sapera LT Standard C API is available for programmers who prefer working with the underlying Sapera LT C layer or who are maintaining legacy code. It provides access most of the same functionality as the higher level, object-oriented programming C++ and .NET APIs (for example, it does not support flat field calibration and software correction). For more information refer to the Sapera LT Basic Modules Reference Manual and the Sapera LT Acquisition Parameters Reference Manual.

The following block diagram, while not exhaustive of all the classes available in Sapera LT, illustrates the major functional blocks with the corresponding classes.
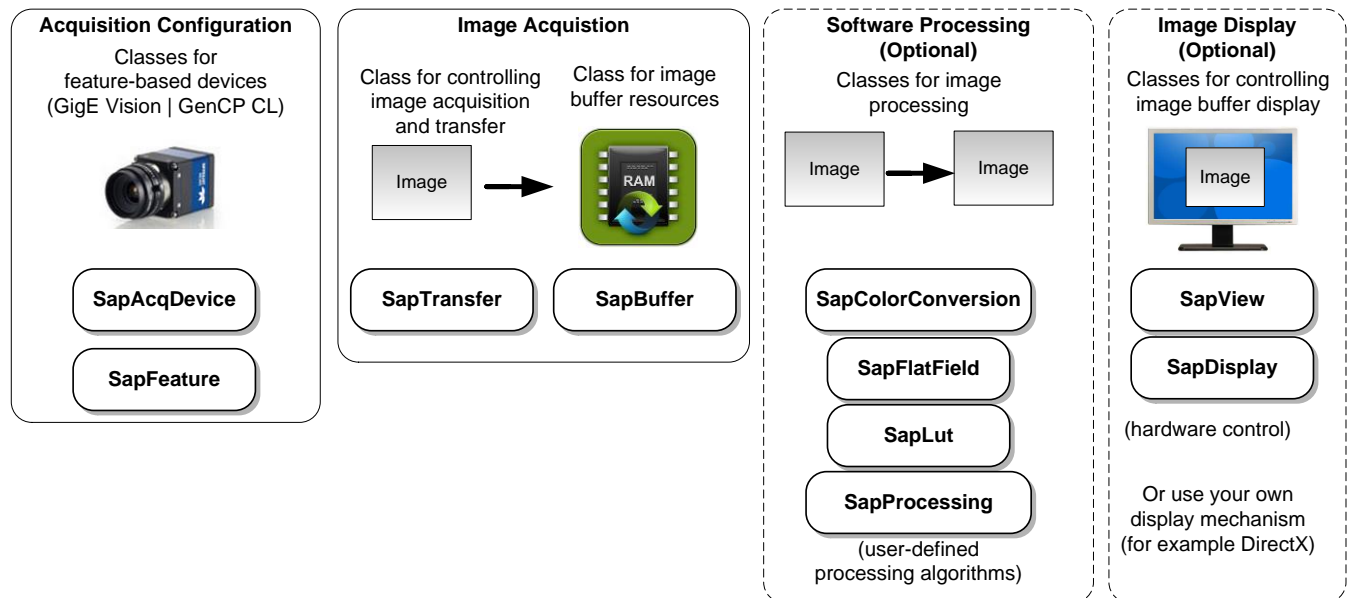
For the complete reference to the Sapera LT APIs refer to the **Sapera LT ++ Programmer's Manual** or **Sapera LT**.**NET Programmer's Manual**.

In addition, the **Sapera LT User's Manual** provides explanations and multiple code snippets, in both C++ and .NET languages, for typical application operations.

> It is always recommended to use the source code provided with the demos and examples as both a learning tool and a starting point for your applications. For a complete list and description of the demos and examples for GigE cameras included with Sapera LT see Demos and Examples.

Configuration Files

Most GigE cameras support saving a user-defined set of parameter settings that can be loaded instead of the factory defaults on power-up.

If the camera supports file access, the feature parameter settings can be downloaded from the camera and saved to a file. This file can then be uploaded to a camera to use these feature settings and saved as a user set. This can be useful if you want to use the same settings for multiple cameras.

If the camera does not support file access Sapera LT applications can load an acquisition configuration file before acquiring images from a camera. The camera configuration file has the extension **.ccf**.

Use CamExpert to generate a *.ccf* file for cameras with parameters as required by your imaging project.

The SapAcqDevice constructor, for GeniCam-compliant cameras, have prototypes that use *.ccf* files. For cameras, if no *.ccf* file is available, the camera default parameters are used.

GigE Vision XML Files for Host and Device Controls

The GigE Vision XML device description file is retrieved from devices such as the Teledyne DALSA GigE products, allowing GigE Vision Compliant applications to retrieve the camera or 3D sensor capabilities. The Host Control XML file is provided with the GigE Vision Module.

GigE Vision Host Controls XML File

The GigE Vision Host Controls are independent of any GigE Vision device used with the Teledyne DALSA driver. The default parameter values are specified by an XML file installed by the Teledyne DALSA GigE Vision Module.

At application run time, the Host controls XML contents are merged with the GigE Vision device XML to define the total feature set of the vision system. See GigE Vision Host Controls for details about these Host controls.

- File location: \Teledyne DALSA\ Network Interface\hostfeatures.xml.
- User can change parameter default values if required.
- User should respect the specified minimum and maximum parameter range values to avoid problems.

Automatic Retrieval of Device XML Files

Device XML feature files are automatically retrieved from the device when first connected. By convention, the XML files will have unique names such that new versions for the device are easily identified.

- When connecting a device for the first time, its XML parameter file is copied to the host system (for example, in the <Install>\ProgramData\Teledyne DALSA\GenICam\download directory).
- When connecting the same device again, its XML file is not retrieved unless the file name is different than the one previously transferred to the host system.
- The Teledyne DALSA XML file naming convention for GigE Vision cameras includes the camera firmware version, for easy identification.

Sapera Support for Third Party GigE Vision Devices

Third party GigE Vision cameras are visible to the GigE Vision applications such as the Teledyne DALSA CamExpert tool when Sapera runtime is installed. Camera parameters can be controlled, as defined by the camera manufacturer.

What a Sapera runtime application cannot do is acquire from the third-party camera, unless a standard Sapera Processing license is purchased. With a Sapera license, GigE Vision Sapera applications are fully functional.

Sapera GigE Vision Camera Demo and Example Code

Program	**Teledyne DALSA●Sapera LT●Demos●Cameras●GigE Vision Camera Demo**
Program file	\…\…\Sapera\Demos\Classes\vc\GigeCameraDemo\Release\GigeCameraDemo.exe
Workspace	\…\…\Sapera\Demos\Classes\vc\SapDemos_2010.sln \…\…\Sapera\Demos\Classes\vc\SapDemos_2012.sln \…\…\Sapera\Demos\Classes\vc\SapDemos_2013.sln \…\…\Sapera\Demos\Classes\vc\SapDemos_2015.sln \…\…\Sapera\Demos\Classes\vc\SapDemos_2017.sln
Description	This program demonstrates the basic acquisition functions included in the Sapera library. The program allows you to acquire images, either in continuous or in one-shot mode. The program code may be extracted for use within your own application.
Remarks	The executable provided in the Sapera LT installation for this demo is built using Visual C++ 2013. It is based on Sapera C++ classes. See the Sapera User's and Reference manuals for more information.

Ethernet Switch Requirements

When there is more than one device on the same network or a camera-to-PC distance greater than 100 meters, an Ethernet switch is required. Since the GigE camera complies with the Internet Protocol, it should work with all standard Ethernet switches. However, switches offer a range of functions and performance grades, so care must be taken to choose the right switch for a particular application.

IEEE 802.3x Pause Frame Flow Control

Ethernet Switches supporting Full-duplex IEEE 802.3x Pause Frame Flow Control must be used in situations where multiple cameras may be triggered simultaneously. In such a case the host system NIC maximum bandwidth would be exceeded if there was no mechanism to temporarily hold back data from cameras. Teledyne DALSA GigE cameras support the IEEE 802.3x pause frame flow control protocol automatically so that images from many cameras can be transmitted through the NIC efficiently, without data loss.

The limiting condition is that the bandwidth sum from all cameras aggregated by the switch and then passed to the host NIC is within 1 gigabit/sec. A switch meeting the requirements will average out the simultaneous packets coming into its ports and will have enough buffer memory to support devices transmitting jumbo packets.

	Important: The maximum frame rate possible from a large number of cameras which are simultaneously triggered will depend on the camera model, frame size, and network details. Each imaging system should be tested for frame rate limits.
	If the host system NIC is close to its maximum bandwidth, the GigE camera feature InterPacketDelay can be used to insert time between camera data packets, to prevent packet resend conditions.
	Using PAUSE Frame will require the user to test various values of Jumbo Frames, to determine the best data throughput. Therefore, the downside to managed network traffic is that the Pause Frame control will reduce the absolute maximum transfer bandwidth possible on the network.

Ethernet to Fiber-Optic Interface Requirements

In cases of camera-to-PC distances of more than 100 meters but an Ethernet switch is not desired, a fiber-optic media converter can be used. The FlexPoint GX from Omnitron Systems converts GigE to fiber transmission and vice versa. It supports multimode (MM) fiber over distances of up to 220 m (720 ft.) and single-mode (SM) fiber up to 65 km (40 mi.) with SC, MT-RJ, or LC connector types.

	Important: The inclusion in this manual of GigE to fiber-optic converters does not guarantee they will meet specific application requirements or performance. The user must evaluate any supplemental Ethernet equipment.

Quick Start Guide

For Teledyne DALSA GigE Vision cameras, during installation, choose the option to install Sapera LT for GigE Vision cameras and/or Teledyne DALSA 3D profile sensors.
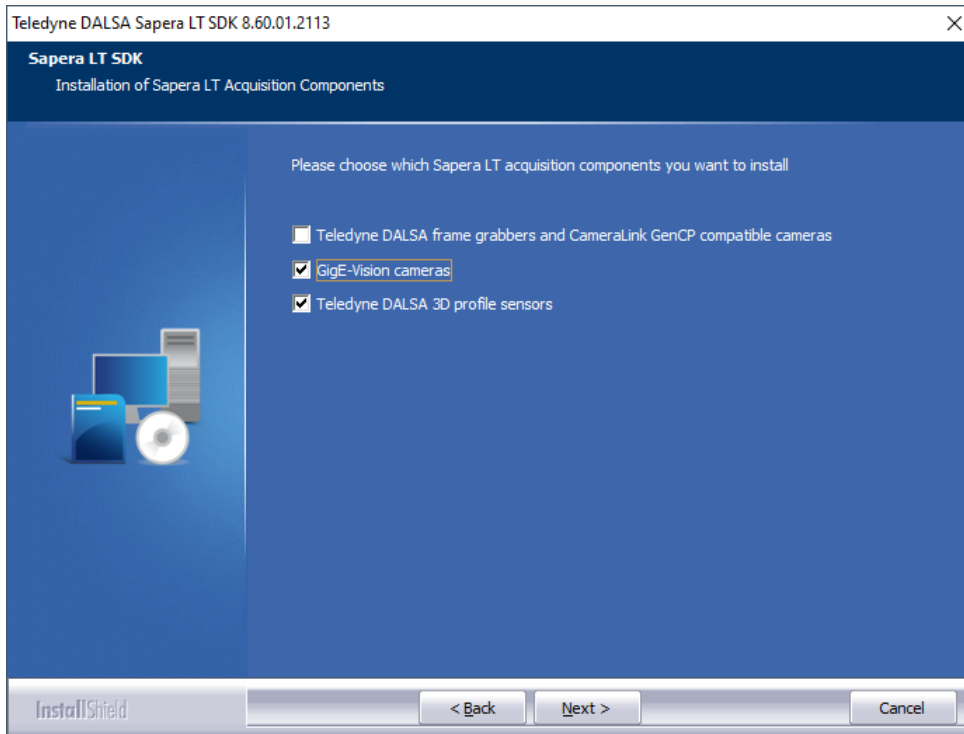
⚠️	Note that if you try to install Sapera LT from a network location you will not be able to install the Sapera Network Imaging Package; copy the installation executable locally.

Currently, Sapera LT supports GenICam GenCP CL and GigE Vision standards (including all mandatory feature requirements).

Connecting a Teledyne DALSA GigE Vision Camera

To configure a Teledyne DALSA GigE Vision Camera:

1. Refer to the camera user's manual and the Network Imaging Package for Sapera LT Optimization Guide.
2. Connect the camera to the GigE network card.
3. After the device has been detected. Click the icon on the system tray for more device information.
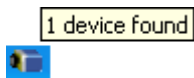
The Teledyne DALSA GigE Vision Device Status dialog displays information about all connected devices.

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
Teledyne DALSA	Genie TS-C1920	S0059974	00:01:0D:12:55:20	Available	169.254.2.70	169.254.159.248	Enable	0	19	CMOSIS colour	0001
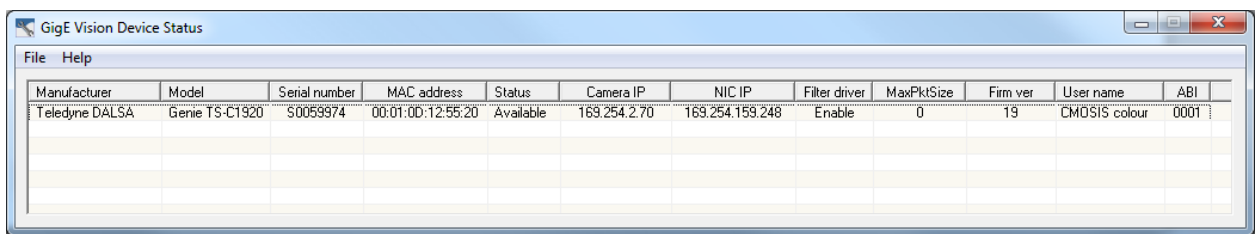
Note: if a properly powered and connected camera is not found, the Network Configuration Tool can be used to recovery a camera whose IP address is not correctly configured. Refer to the Recovering a Camera with an Invalid IP section.

4. For GigE Vision cameras, start the CamExpert application, select the camera to configure, and modify the camera parameter settings as required, and test the image acquisition by clicking the **Grab** button.
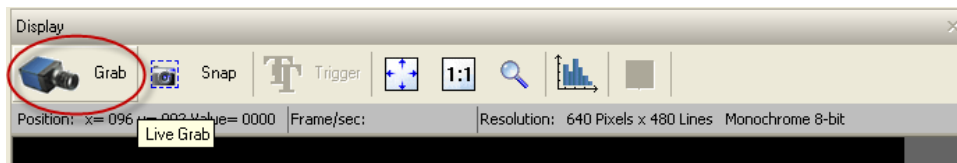
For 3D sensors, use the Z-Expert application.

Using Sapera LT with a Teledyne DALSA GigE Vision Device

Sapera LT Classes for GigE Vision Device Applications

The following diagram represents a typical application flow showing the Sapera LT object types associated with each component or stage.
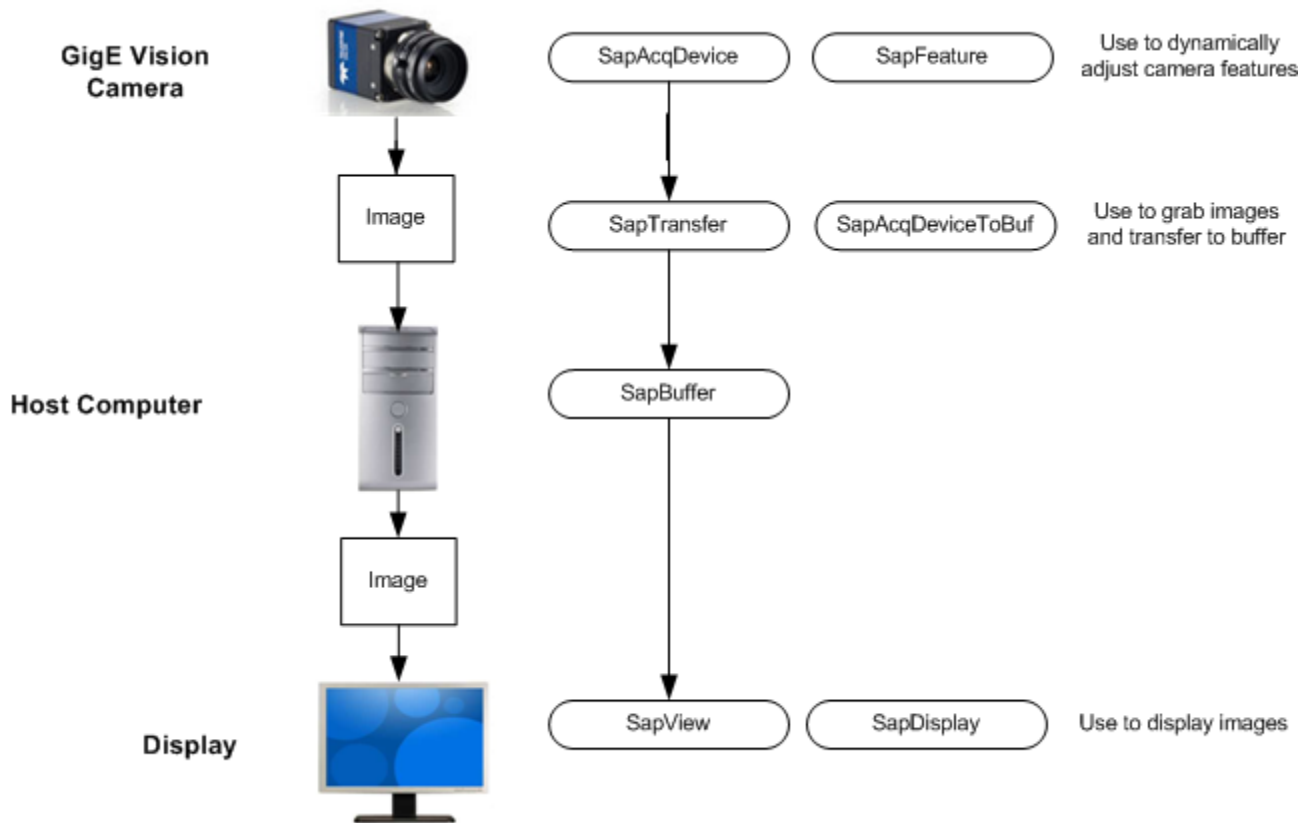
GigE Vision cameras require a Gigabit network connection on the host computer which is not used on a corporate network; refer to the Sapera Network Imaging Package documentation for installation requirements.

Using Sapera LT with 3ʳᵈ Party GigE Cameras

If you are using the Sapera LT SDK with 3ʳᵈ party GigE cameras only, a valid Sapera Processing license is required to activate the Teledyne DALSA GigE Vision Module. The Sapera License Manager Tool must be installed with Sapera LT to activate this license.

> Note: When using a Sapera LT application with 3ʳᵈ party USB3 Vision cameras without Sapera Processing or a Teledyne DALSA GigE Vision connected on the same system, a license is required to unlock the Sapera LT USB3 Vision Interface.
>
> For more information, contact your Teledyne DALSA sales representative.

To install the Sapera License Manager tool during the Sapera LT installation use the command line switch "-slm". The command line switch is required as the option is not available during standard installations.

For example, in the command terminal, use the following command:

```
SaperaLTSDKSetup.exe –slm
```

The Sapera License Manager executable file is available in the following directory:
<Install Directory>Program Files\Teledyne DALSA\Sapera License Manager\Bin\SvsLMgr.exe

The Sapera License Manager application can also be launched from the Windows Start menu:
Start > All Programs > Teledyne DALSA > Sapera License Manager > Sapera License Manager
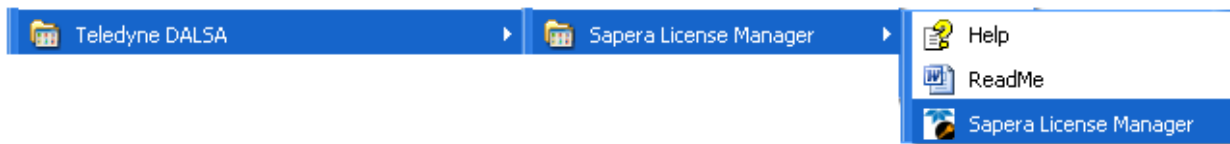
For more information on the Sapera License Manager tool, refer to the online help system available with the tool.

Sapera LT with Camera Sequencer (Cycling) Mode

For cameras that support a sequencer or cycling mode (used to change certain features dynamically during acquisition), the Sapera LT buffer allocated for images must be that of the largest image in the sequence if the image size changes during the acquisition cycle (for example, if a horizontal or vertical binning is enabled or disabled).

Using the CamExpert Tool

The CamExpert application uses various panels to simplify choosing and configuring camera files or acquisition parameters for the installed devices. Features include:

- Supports all Teledyne DALSA hardware currently supported by Sapera LT.
- Creates and modifies camera configuration (*.ccf* files).
- Supports Teledyne DALSA GigE Vision cameras, such as the Genie Nano series, by presenting the camera Features controls as defined by the camera's XML file.
- Groups acquisition parameters into related categories for easier access to any specific parameter.
- Intelligent editing of video timings through a locking mechanism that allows explicit modification of some values and automatic recalculation of the remaining ones.
- Live acquisition display window which allows immediate verification of timing or control parameters without the need to run a separate acquisition program
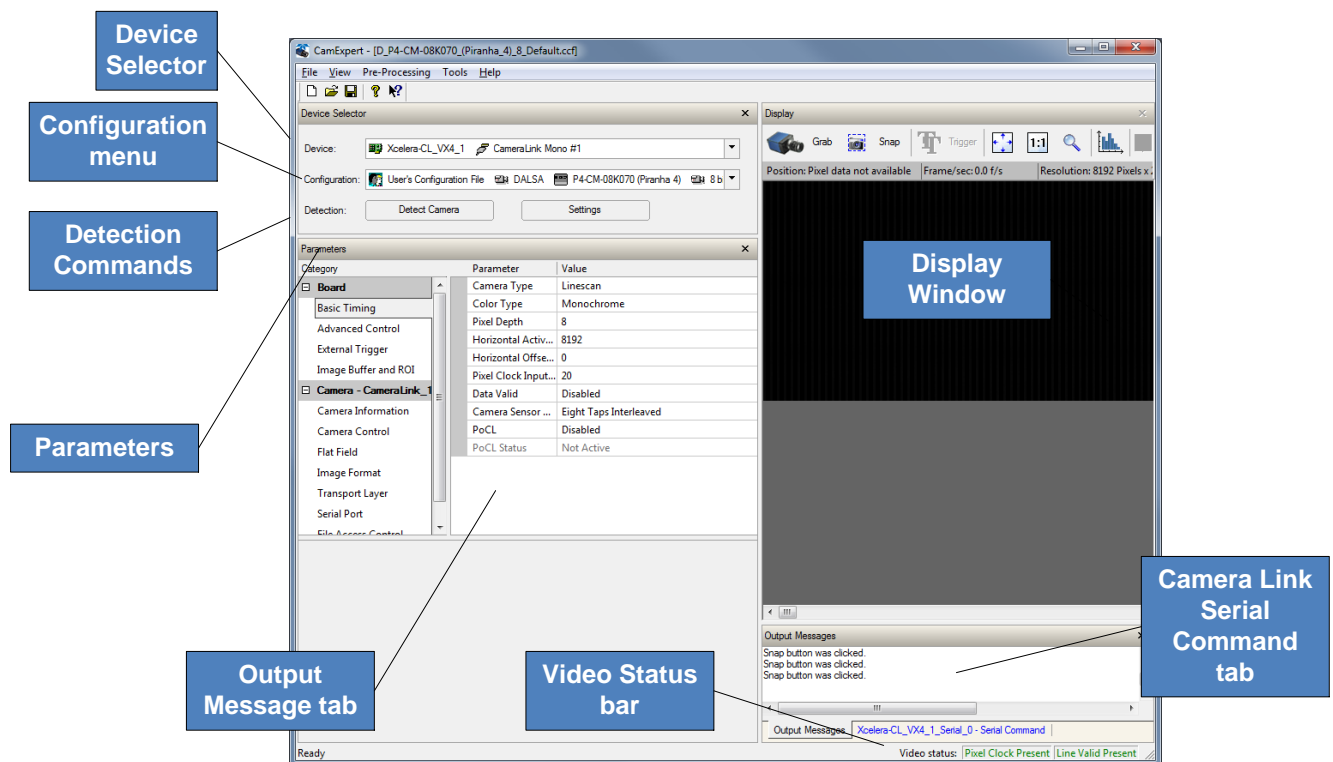
- **Device Selector**: The Device menu allows you to view and select from any installed Sapera acquisition device. After a device is selected, CamExpert only presents acquisition parameters applicable to that device.
  The Configuration menu allows selecting any camera file that is included with the Sapera installation. Only camera files supported by the selected acquisition device are displayed. When there is more than one acquisition server, such as monochrome and RGB, selecting an inappropriate camera file will produce a message prompting you to select the correct acquisition server.
  The Detection command buttons allow you to detect cameras that comply with the GenICam GenCP protocol or Teledyne DALSA cameras that use the three-letter protocol. Clicking the Settings button allows you to set the camera detection communication settings.

- **Parameters panel**: Allows viewing or changing all acquisition parameters supported by the acquisition device. CamExpert displays parameters only if those parameters are supported by the installed device. This avoids confusion by eliminating parameter choices when they do not apply to the hardware in use.
- **Display panel**: Provides a live or single frame acquisition display. Frame buffer parameters are shown in an information bar above the image window. The Display pane includes CamExpert control buttons. These are:

Grab / Freeze	**Acquisition control button:** Click once to start live grab, click again to stop.
Snap	**Single frame grab:** Click to acquire one frame from device.
T Trigger	**Software trigger button:** With the I/O control parameters set to Trigger Enabled / Software Trigger type, click to send a single software trigger command.
1:1	**CamExpert display controls:** (these do not modify the frame buffer data) Stretch image to fit, set image display to original size, or zoom the image to any size and ratio.
	Histogram / Profile tool: Select to view a histogram or line/column profile during live acquisition.

- **Output Messages Panel**: Displays messages from CamExpert or the device driver.
- **Camera Serial Link Command tab**: Use this to send ASCII commands from CamExpert to Teledyne DALSA CameraLink cameras.
- **Video Signal Status bar**: Located on the lower right of the CamExpert window, color coded camera signal status information is displayed. These are in green for valid signals detected, and in red for missing or incorrect signals. Video status items may differ with different devices.

Additional Information

See either the corresponding device user's manual or search within this manual for limitations applicable to specific Teledyne DALSA hardware.

GigE Vision Host Controls

The GigE Vision Host controls as shown by CamExpert, groups parameters used to configure the host computer system GigE Vision features, which are used for connected camera networking management. None of these features are stored in the connected camera – they remain as settings to the host system control software.

These features allow optimizing the network configuration for maximum camera bandwidth. Settings for these parameters are highly dependent on the number of cameras connected to a NIC, the data rate of each camera and the trigger modes used.

Parameters in gray are read only, either always or due to another parameter being disabled. Parameters in black are user set in CamExpert or programmable via an imaging application.

Parameters - Visibility: Guru		
Category	**Parameter**	**Value**
Readout Start Data	Inter-Packet Timeout	0.010
Readout End Data	Maximum Packet Resend	100
Event Overflow Data	Image Timeout	0.700
GigE Vision Transport Layer	System TransferStop Detection Method	Automatic
Serial Port Control	System TransferStop Time	76000
GigE Vision Host Controls	Command Timeout	200
File Access Control	Command Retry Count	3
	<< Less	

GigE Vision Host Control Feature Descriptions

Display Name	Feature	Description	View
Inter-Packet Timeout	InterPacketTimeout	Specifies the inter-packet timeout period used by the GigE server running on the host computer (in seconds). The inter-packet timeout is the amount of time the GigE server will wait between successive packets. If the inter-packet timeout expires, the GigE server will issue a packet resend request to the camera. The range of permitted values is 0.000000 to 0.65535. By default, this value is greater than and must be greater than the Inter-Packet Delay inserted by the GigE camera. Else the GigE server will force packet resends when none may be required. Increasing the timeout period is required when a NIC has several GigE cameras connected via an Ethernet switch, and packet resends can be avoided if the GigE server delays assuming data is lost.	Beginner
Maximum Packet Resend	packetResendMax	Maximum number of packet resend attempts when the Inter-packet Timeout is exceeded.	Guru
Image Timeout	ImageTimeout	Specifies the timeout period for an image acquisition used by the GigE server running on the host computer (in seconds – max=60). The Image timeout value is the amount of time the GigE server will wait for an image to be transferred from the camera to the host buffer memory. By default, this value is greater than (and must be greater than) the time required to receive a complete frame. The time required may depend on the number of GigE cameras connected to the NIC and whether they transmit frames simultaneously. If the timeout period is too short, data will be trashed, and packet resend commands will be issued. If the timeout period is too long, recovery from transmission errors may be too slow.	Beginner
System TransferStop Detection Method	systemTransferStopDetectionMethod	Specify if the systemTransferStopdetectionMethod feature is based on the GigE Vision driver or is controlled by the User, based on the SystemTransferStopTime feature. SystemTransferStopTime defines if a TransferStop is truly completed, if no data arrives from the device after the timer count is the last DATA trailer.	Guru
	Automatic	*The stream is considered stopped when it is idle for more than the current exposure time.*	
	Manual	*The transfer is considered stopped when it is idle for more than the feature systemTransferStopTime.*	
System Transfer Stop Time	systemTransferStopTime	When the feature systemTransferStopDetectionMethod is set to Manual, this is used to set the time a transfer can be inactive before been considered stopped. This time is only used by the CorXferStop and CorXferWait functions.	Guru

Command Timeout	CommandAcknowledgeTimeout	Specifies the time the host system controller will wait for a command acknowledgment from the connected GigE Vision device. Minimum and maximum values are dependent on the connected device (as defined in its XML file).	Beginner
Command Retry Count	CommandRetryCount	Specifies the number of retries for a command sent to a device.	Beginner
Transfer Stop Detection Method	transferStopDetectionMethod	The method used to detect the end of a transfer.	Invisible
Auto	*streamHidelTimeAuto*	In this mode a stream is considered stopped when it is idle for more than the current exposure time.	Invisible
Manual	*streamHidelTimeManual*	In this mode, a transfer is considered stopped when it is idle for more that the feature transferStopDetectionTime.	Invisible
Transfer Stop Detection Time	transferStopDetectionTime	This feature is used when the feature transferStopDetectionMethod is set to streamHidelTimeManual to configure the time a transfer can be inactive before been considered stopped. This time in only used by the CorXferStop and CorXferWait functions.	Invisible
Packet Resend Mode	packetResendMode	Control the method used to control the packet resend.	Invisible
Off	*Off*	*Do not allow host to request packet resend from the camera.*	
Window	*Window*	*This method is based on a window of opportunity. Packets can arrive out of order but within a window of opportunity.*	

Automatic Change for Inter-Packet Timeout with JPEG Designs

Genie TS models operating with the JPEG design firmware (GigE Vision 2.0) automatically increase the Inter-Packet Timeout feature value to 100ms from 10ms. This change is required due to the variable timing between packets from cameras performing on-board JPEG compression. Without this increased period, timeout events could occur for no valid reason – essentially false-positive timeout events.

	When Genie TS cameras with JPEG design firmware are used with third party GigE Vision Host software (not Teledyne DALSA Sapera software), the user must account for the variable time possible between packets. Increasing the Inter-packet timeout feature value, such as is done by the Sapera package, is required.

Z-Expert

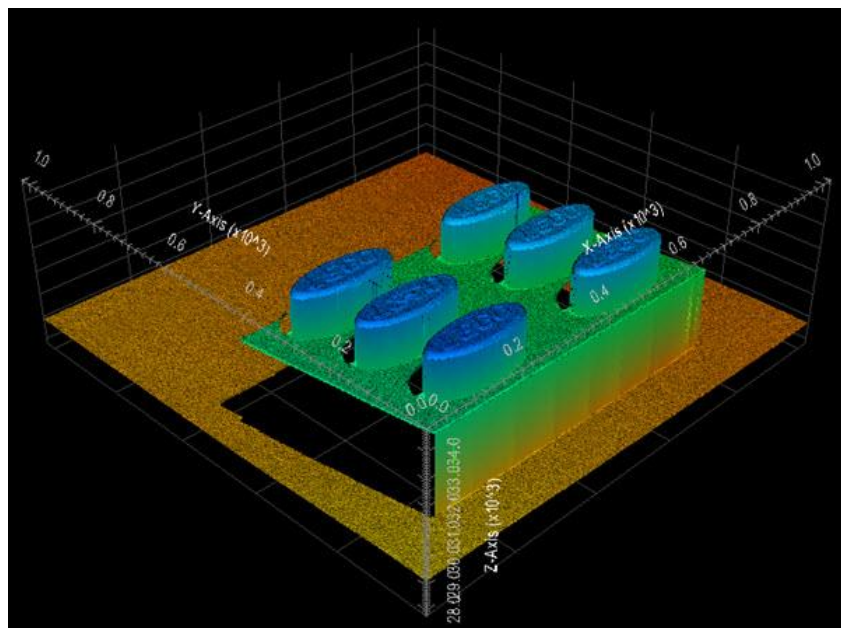The latest version of Sapera LT includes Z-Expert application for configuring Teledyne DALSA 3D sensors, such as the Z-Trak. It is built on a completely new platform than the original CamExpert.

Z-Expert includes display capabilities for rendering 3D images.

Z-Expert supports 3D sensors only (such as line profile acquisition devices). For more information, refer to the device documentation.

Networking Variations

Using GigE Vision Cameras with Ethernet Switches

Examples where a Gigabit Ethernet switch would be used are:

- Multiple cameras are controlled by one computer and a single NIC.
- Ethernet Switches supporting Full-duplex IEEE 802.3x Pause Frame Flow Control must be used in situations where multiple cameras may transfer data simultaneously, thus exceeding the link bandwidth. See IEEE 802.3x Pause Frame Flow Control for additional information.
- Multiple cameras are individually controlled by multiple computers, all located on the same subnet.

In these cases, the Ethernet switch is a transparent device. The device discovery process finds all GigE Vision cameras and presents them as ready to be controlled by an application.

Using GigE Vision Cameras with a VLAN Ethernet Switch

An Ethernet switch supporting VLAN (Virtual Local Area Network) allows multiple isolated subnets to exist on the same switch.

Within each VLAN group, the GigE Vision camera and controlling computer will behave identically as if connected to a simple Ethernet switch. But each VLAN group is isolated from each other, Therefore a camera in one VLAN group is never seen by a computer on a different VLAN group.

VLAN Ethernet Switches support configuration as Port-based or TAG VLAN groups. Port-based groups are typically easier to configure. Review your Ethernet switch manual for information on its factory default VLAN settings and configuration method.

IP Configuration Mode Details

The following descriptions provide more information on the IP configuration modes supported for GigE Vision cameras. In general, automatic IP configuration assignment (LLA/DHCP) is sufficient for most installations. For multiple NIC applications, use the Teledyne DALSA DHCP server since it is the easiest to manage.

Link-Local Address (LLA)

Note: that LLA mode limitations are avoided by enabling the recommended **Teledyne DALSA DHCP Server**.

- LLA is also known as Auto-IP. It is used for unmanaged networks including direct connections from a GigE Vision camera to a dedicated NIC.
- A subnet configured with LLA cannot send packets across routers but only via Ethernet switches.
- Ensure only one NIC is using LLA on your PC, otherwise IP conflicts will result.
- The NIC will automatically assign a random IP address within the 169.254.x.x subnet. The LLA protocol ensures there are no conflicts with other devices through an arbitration scheme.
- The Windows NIC configuration must be set to DHCP (the typical default case) and no DHCP server must be present on the network. Otherwise, an IP address gets assigned by the DHCP server. Windows will turn to LLA when no DHCP server answers requests coming from the NIC.

- If a DHCP server becomes available on the network, the NIC will get a DHCP assigned IP address for the connected device but connections on the LLA IP address will be lost. The Teledyne DALSA Network Configuration Tool can be used to enable the Teledyne DALSA DHCP server on the NIC used for the GigE Vision network. Refer to the Network Configuration Tool section.
- Important: If the host system has multiple NIC devices configured with LLA, then the communication stack cannot accurately resolve which NIC to forward an IP packet on the 169.254 segment. Limit the number of NIC configured using LLA to one interface. See the Warning Example 1a: IP error with multiple NICs section for additional information.

DHCP (Dynamic Host Configuration Protocol)

- This IP configuration mode requires a DHCP server (such as activating the Teledyne DALSA DHCP server) to allocate an IP address dynamically over the range of some predefined subnet. The GigE Vision camera must be configured to have DHCP enabled (this is the factory default setting required by the GigE Vision standard).
- The DHCP server is part of a managed network. Windows itself does not provide a DHCP server function therefore a dedicated DHCP server is required. The Teledyne DALSA Network Configuration Tool can activate the DHCP server on the NIC used for the GigE Vision network. Refer to the Network Configuration Tool section.
- The Teledyne DALSA DHCP server is always recommended where there are multiple NIC ports with multiple GigE Vision cameras attached. Each NIC ports must use a different subnet to avoid IP address conflicts (See Warning Example 1a: IP error with multiple NICs for additional information).
- Under Windows, a NIC is configured in DHCP mode by default. If no DHCP server is present on a given subnet, Windows will revert to LLA as explained in the section above.
- Subnet assignment will automatically be managed correctly when the Teledyne DALSA DHCP server is enabled on one or all subnets used for GigE Vision cameras. The graphic below illustrates a system with one NIC having the DHCP server enabled. Note that although the graphic shows one subnet using LLA mode, Teledyne DALSA strongly recommends using the Teledyne DALSA DHCP server for all subnets used for GigE Vision devices.
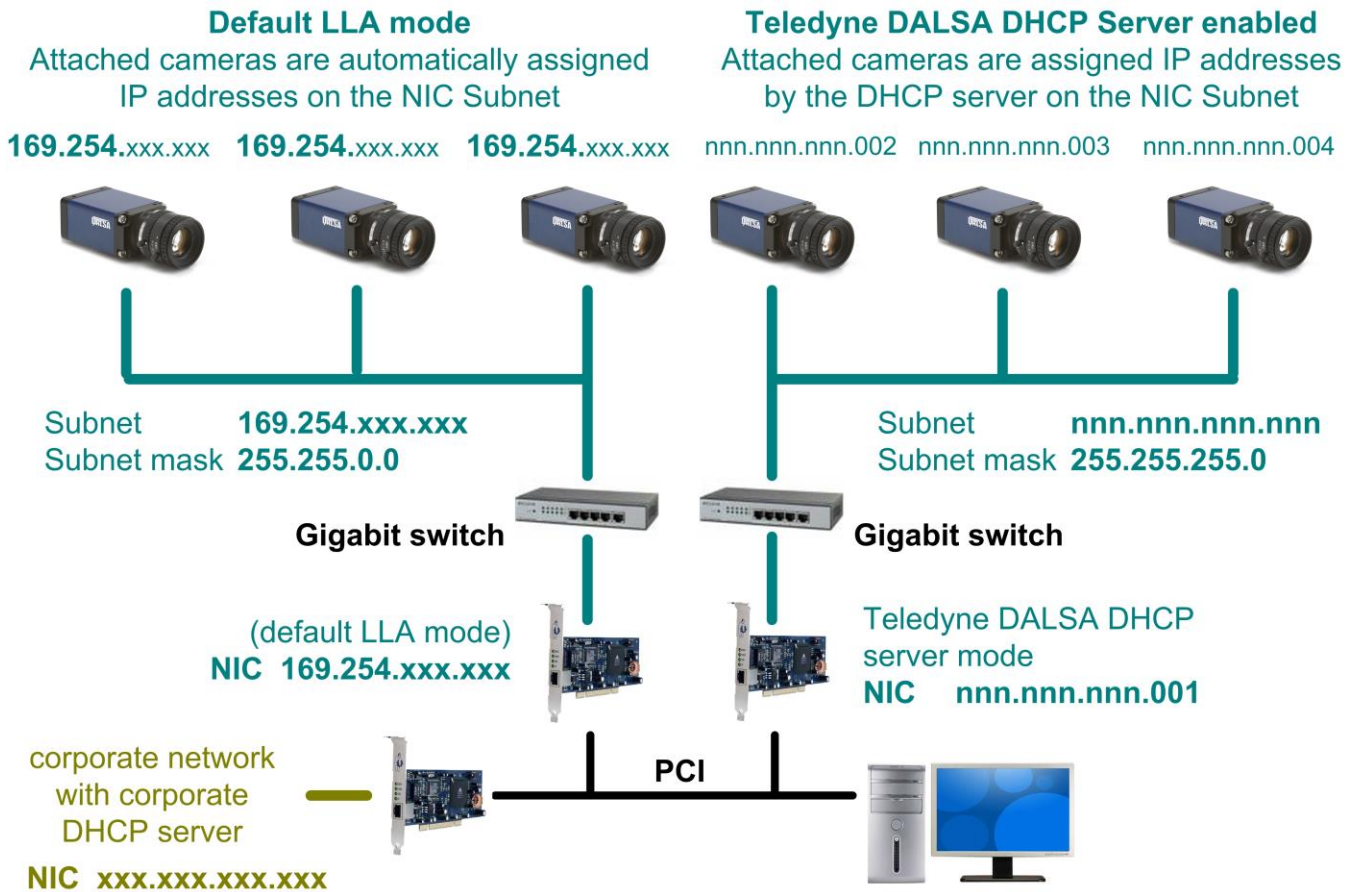
Persistent IP

- This protocol is only suggested if the user fully controls the assignment of IP addresses on the network and a GigE Vision camera is connected beyond routers.
- The GigE Vision camera is forced a static IP address. The NIC IP address must use the same subnet otherwise the camera is not accessible.
- If the camera is connected to a network with a different subnet, it cannot be accessed, unless the FORCEIP command is used.
- The Teledyne DALSA Network Configuration Tool is used to set a persistent IP address (refer to the Network Configuration Tool section).
- An example of a Persistent IP address assignment on a class C network:
    - NIC Subnet = 192.168.1.1
    - Subnet Mask = 255.255.255.0
    - Persistent IP = 192.168.1.2
    - Default Gateway = 0.0.0.0

⚠	**Warning**: an incorrect IP address assignment might make it impossible to connect to the GigE Vision camera. In such a case the Teledyne DALSA Network Configuration tool includes a function to recover a camera with an invalid persistent IP and set the camera to the factory default setting, i.e. DHCP/LLA mode. See the sections Recovering a Camera with an Invalid IP and Warning Example 2: Subnet Mask or IP error.

- For GigE Vision applications the FORCEIP command is used to force a new persistent IP or to change the IP configuration protocol.

- The following illustration shows a functional computer setup with three NIC ports, but no DHCP server. Two NIC ports are used for private GigE Vision networks. The first uses the default LLA mode for IP addresses, while the second NIC and the cameras connected to it are configured with persistent IP addresses. An application on the computer can control each camera, on each subnet, without conflict.
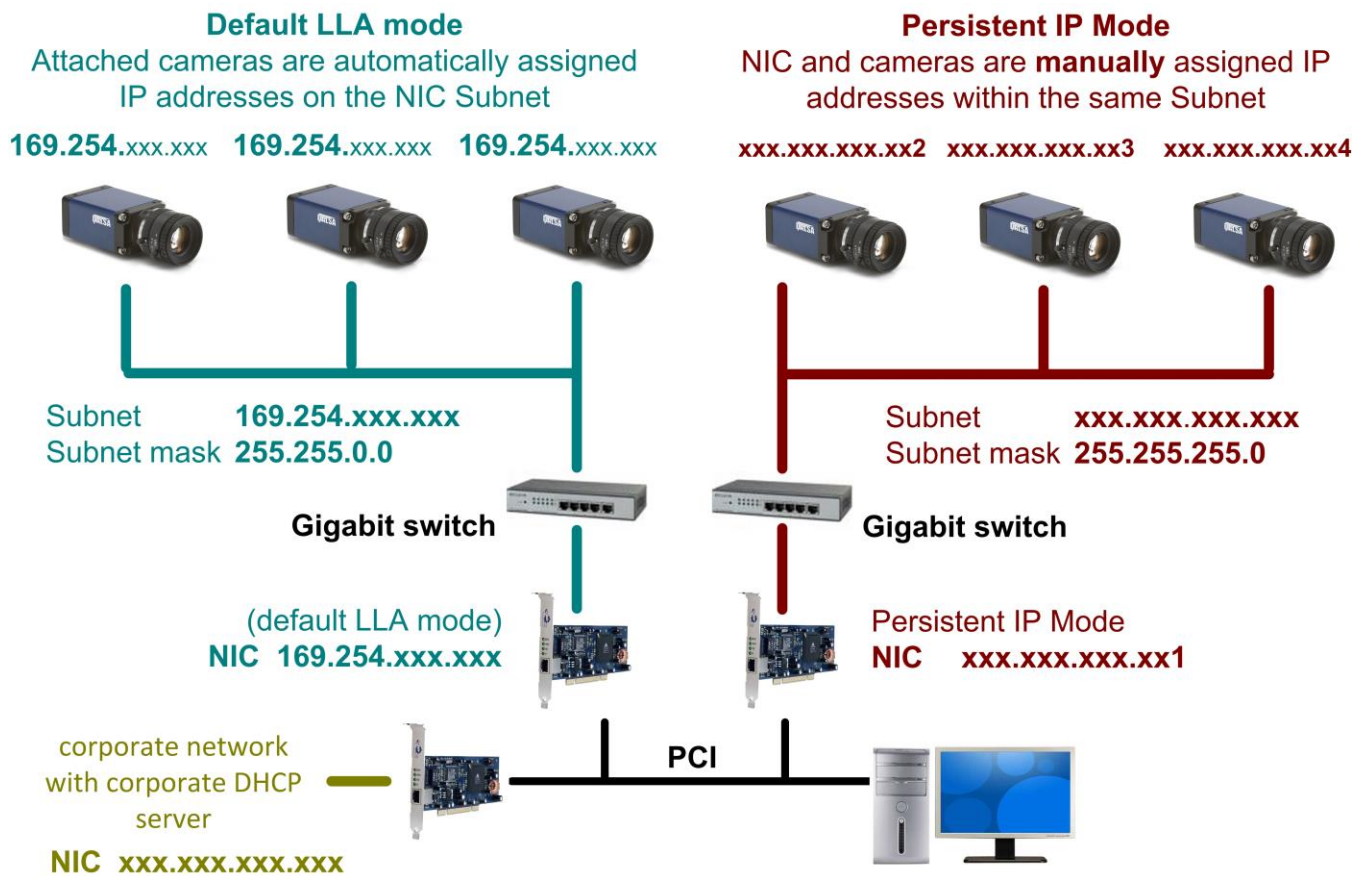
Sapera LT Utilities

Sapera LT includes the following utilities that can be used to monitor Sapera LT hardware and software events, error messages, as well as network configuration and diagnostics:

Sapera Monitor	Monitors user selected events generated by a Sapera LT application.
Sapera Log Viewer	Displays error and other messages generated by Sapera LT applications and Teledyne DALSA hardware.
Network Configuration Tool	The Network Configuration tool provides information and parameter adjustments for network adapters installed in the system and any connected GigE Vision camera without use of any Windows Control Panel application. It also allows recovery of incorrectly configured cameras.
Recover Camera Utility	Command line utility to recover incorrectly configured cameras using the MAC address. Can be used if the Network Configuration Tool recovery fails.

Sapera Monitor

As part of the Trigger-to-Image-Reliability (T2IR) framework, the Sapera Monitor tool allows users to view the acquisition and transfer events generated by an acquisition device in real-time. This is very useful since one can use the Sapera Monitor tool to debug application s and identify problems without having to code event handlers.

The key advantage to Sapera Monitor is that it can run concurrently with CamExpert or your own application. This can be useful for debugging applications and identifying problems without having to code event handlers.

To launch the Sapera Monitor use the **Start•All Programs•Teledyne DALSA•Sapera LT•Tools•Sapera Monitor** menu shortcut.

⚠️	Note: older driver versions of Teledyne DALSA devices may not support Sapera Monitor. Check the Teledyne DALSA website for updated drivers for your device that support Sapera Monitor. In addition, when using Teledyne DALSA GigE devices, you must start a Sapera application, such as CamExpert, that uses the device you want to monitor, before launching Sapera Monitor.

The Sapera Monitor Window

The Sapera Monitor Window is divided into three panes:
- Device directory tree: displays the available acquisition devices to monitor
- Event table: displays the available events to monitor for the selected device
- Output Messages pane: displays the messages generated by the selected monitored events.
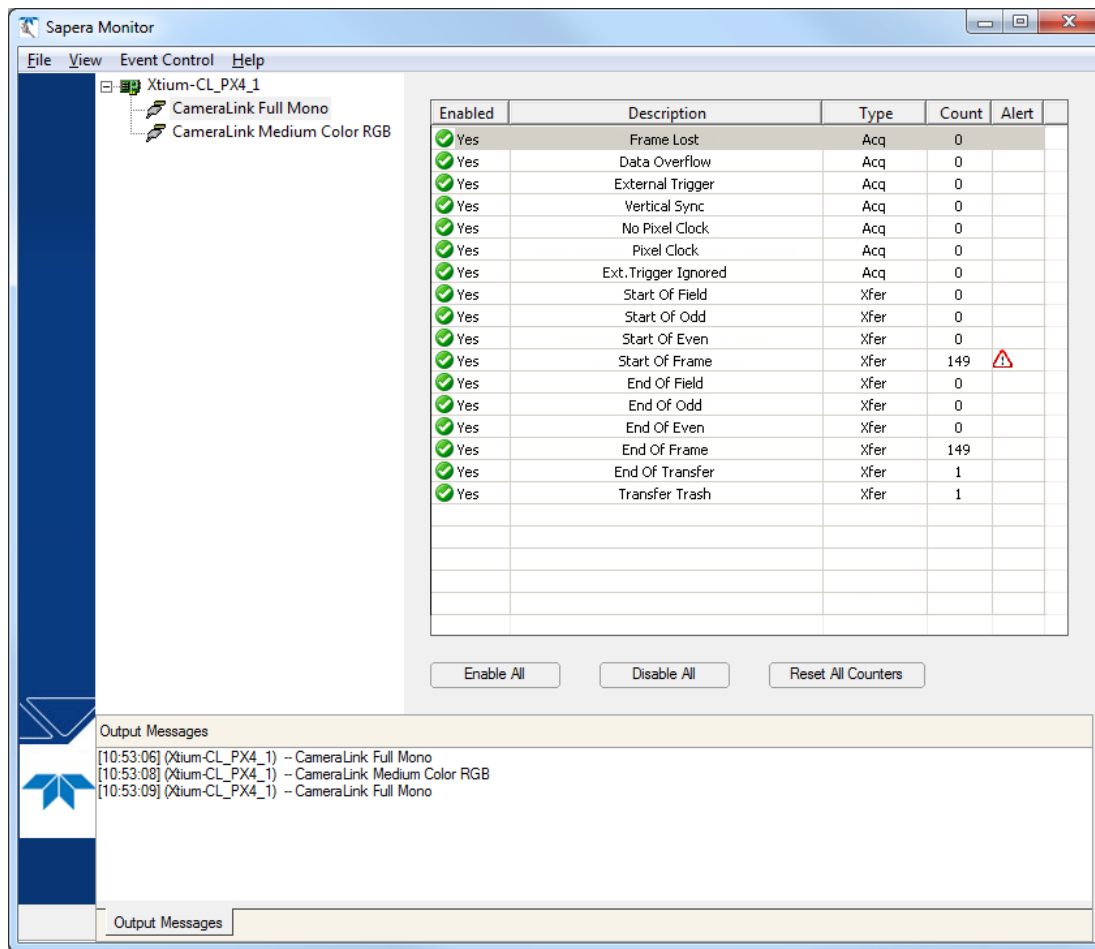
Statistic Tab

Clicking on the Statistic tab displays various real-time acquisition statistics, such as the Frame Rate.
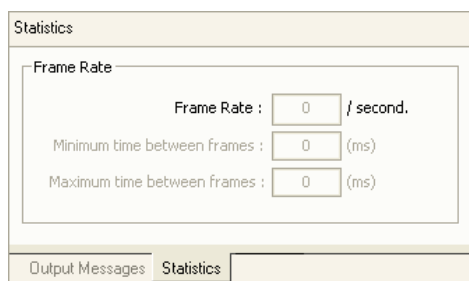
	Note that different devices can support different statistics and not all devices support all statistics. In addition, these real-time acquisition statistics are not included in generated reports. Thus, depending on the selected device, the Statistics tab may not be available.

Sapera Monitor Menu Commands

The Sapera Monitor menu provides access to File, View, and Event Control commands.

File Menu Commands

The **File•Generate Report** command generates a text file report that includes all event settings and messages included in the current Output Messages pane.

The **File•Clear Log Information** command clears the current Output Messages pane.
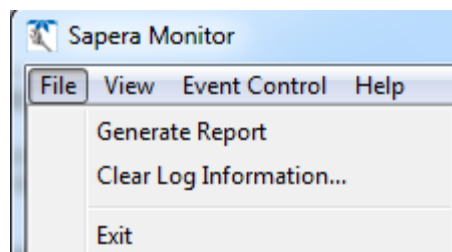
View Menu Commands

The **View•Always on Top** command displays the Sapera Monitor on top of any other windows that may be visible on the desktop.
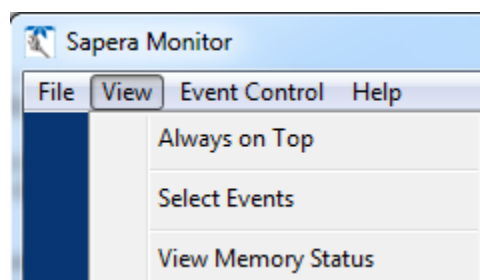
The **View•Select Events** command opens the Sapera Monitor Events Display Settings dialog which allows you to specify the events to display in the Event table.
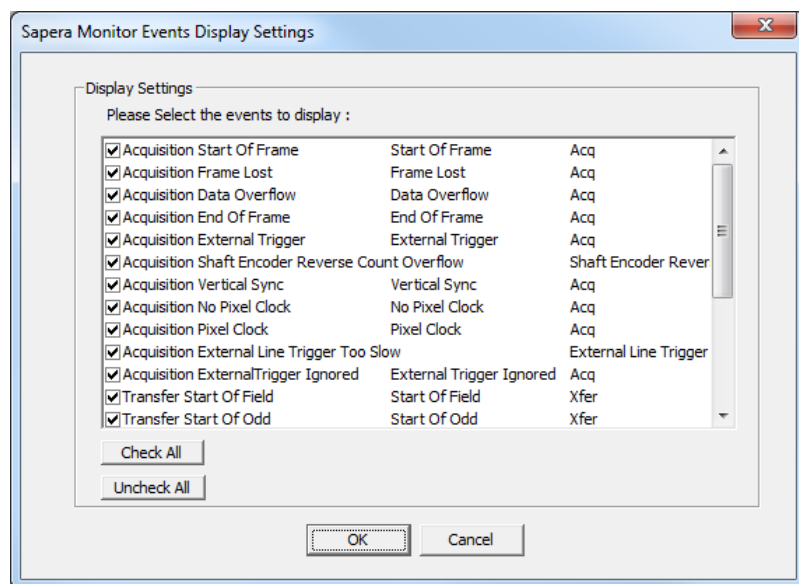
Event Control Menu Commands

The **Event Control•Enable** and **Disable** commands enable or disable the currently selected event in Event table.

The **Event Control•Reset event count** command returns the event counter to zero for the currently selected event in Event table.
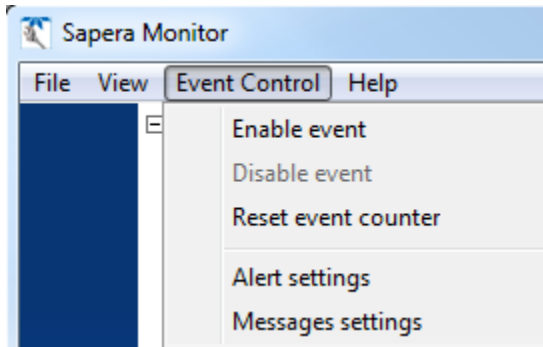
Alert Settings

You can specify the alert options for each available event using the Alert Settings command, available through the Event Control menu or by right-clicking on the selected event. The Alert Settings dialog allows you to enable or disable alerts for the event and to specify the number of events required to generate an alert.
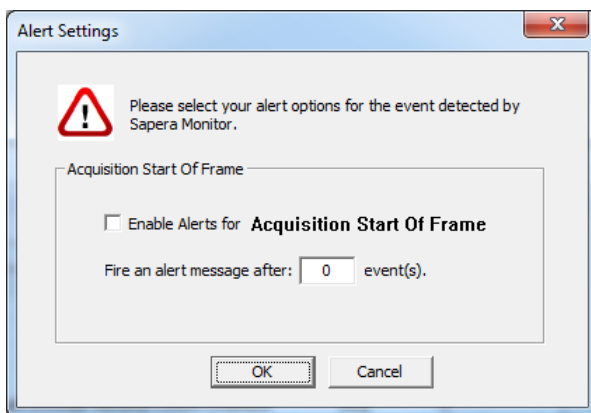
When an alert is generated, the Alert icon is displayed in the Alert column of the event.

Enabled	Description	Type	Count	Alert
✔ Yes	Start Of Frame	Xfer	146	⚠

An alert message, in red, also appears in the Output Messages Settings pane.

Output Messages

[17:45:42] (X64_1) INFO -- Xfer : End Of Frame has been detected. Number = 7
[17:45:42] (X64_1) INFO -- Xfer : Start Of Frame has been detected. Number = 8
[17:45:42] (X64_1) INFO -- Xfer : End Of Frame has been detected. Number = 8
[17:45:42] (X64_1) INFO -- Xfer : Start Of Frame has been detected. Number = 9
[17:45:42] (X64_1) INFO -- Xfer : End Of Frame has been detected. Number = 9
[17:45:42] (X64_1) ALERT -- Xfer : Start Of Frame has been detected. Number = 10
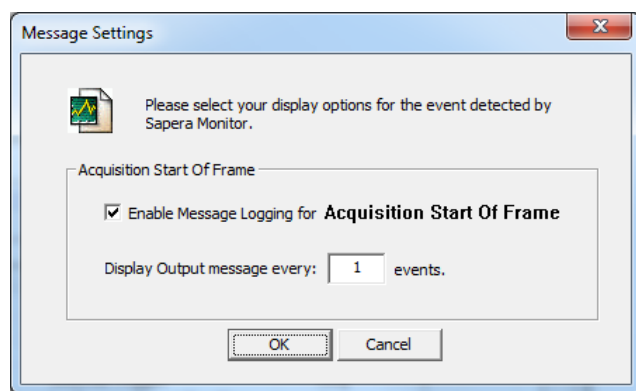[17:45:42] (X64_1) INFO -- Xfer : End Of Frame has been detected. Number = 10
[17:45:42] (X64_1) INFO -- Xfer : Start Of Frame has been detected. Number = 11

Message Settings

You can specify the events to enable message logging and the number of events required to generate a log message using the Message Settings command, available through the Event Control menu or by right-clicking on the selected event. The log messages appear in the Output Message pane.

Message Settings

Please select your display options for the event detected by Sapera Monitor.

Acquisition Start Of Frame

☑ Enable Message Logging for **Acquisition Start Of Frame**

Display Output message every: [1] events.

[OK]   [Cancel]

Using Sapera Monitor

To use the Sapera Monitor tool to monitor a device:

- Run a Sapera application, such as CamExpert, that uses the device.
- Launch the Sapera Monitor application
- In the Sapera Monitor Device directory tree, select the device.
- In the Sapera Monitor Event table, select the events to monitor. Double-clicking on the row containing the event toggles the Enabled status between ✔ Yes and ✘ No .
  Right-clicking on the event opens a context menu which provides easy access to commands to reset the event counter and modify the event Alert settings or Message settings.

Monitor
- Enable Event
- ✘ Disable Event
- ↻ Reset Event Counter
- ⚠ Alert settings
- Message settings

These commands are also available through the Event Control Menu.
Alternatively, you can use the Enable All and Disable All buttons to quickly clear or select events.

Sapera Log Viewer

The Sapera Log Viewer utility program included with Sapera LT provides an easy way to view error and other types of messages generated by Sapera LT applications and Teledyne DALSA hardware, such as cameras and frame grabbers. Typically, the Sapera Log Viewer application is used by technical support to troubleshoot software and hardware problems.

During development it is recommended to start the Sapera Log Viewer before your application and then let it run so it can be referred to any time a detailed error description is required. However, errors are also stored by a low-level service (running in the background), even if the utility is not running. Therefore, it is possible to run it only when a problem occurs with your application.

Refer to the utility's online help for more information on using the Sapera Log Viewer.
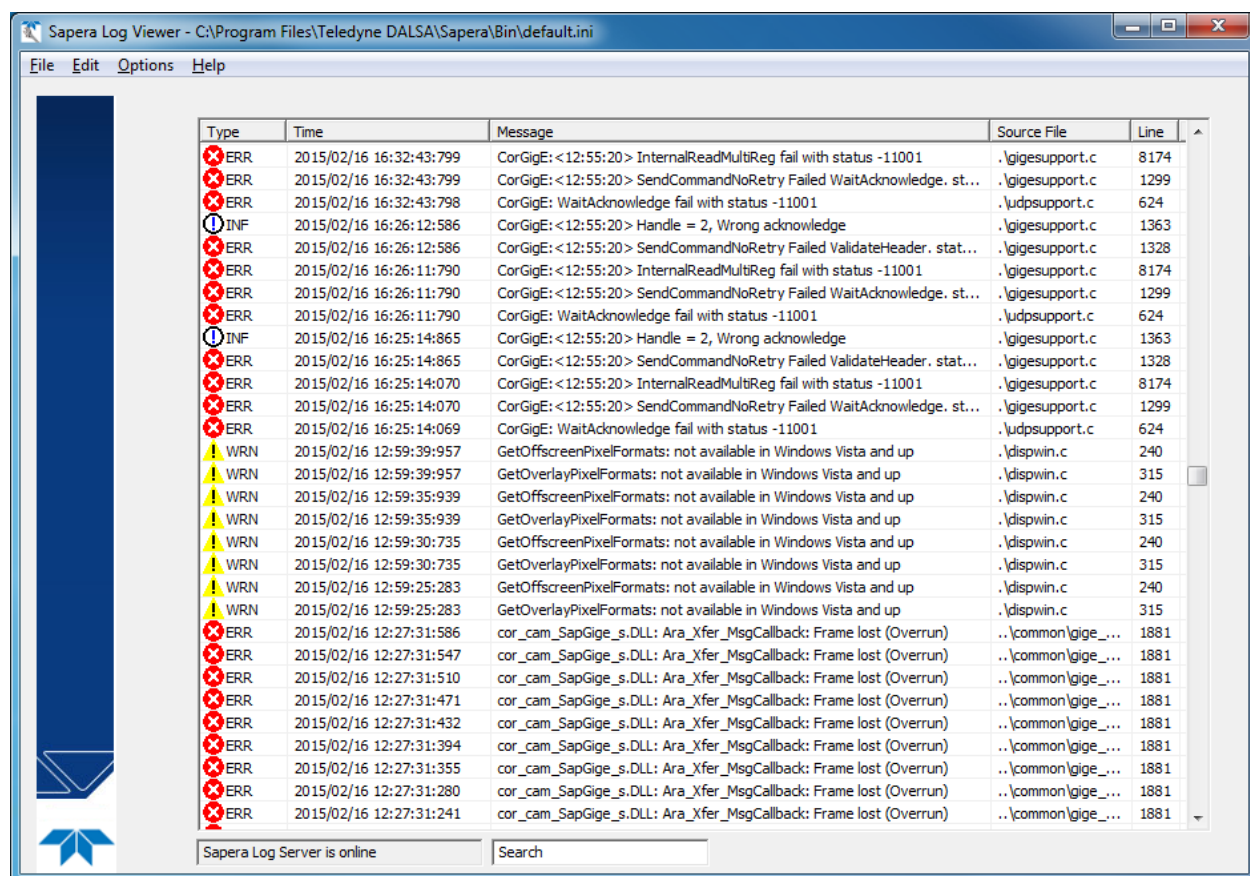
Network Configuration Tool

The Network Configuration tool provides information on all network adapters installed in the system and any connected GigE Vision devices. When using a GigE Vision camera, the tool allows a simple method to assign a User-Defined name and to set a Persistent IP address instead of the default DHCP/LLA assigned IP address. Using this tool, GigE Vision network configurations can be easily made without having to use any Windows Control Panel application.

This tool allows you to:
- Activate the Network Imaging driver used for image acquisition on any NIC.
- Disable the imaging driver for any NIC not used with a GigE Vision camera.
- Enable or Disable the Auto Discovery process.
- Change the Auto Discovery Interval from the default of 15 seconds.
- Add the DALSA GigE server to the Windows firewall exception list.
- Configure the NIC and camera IP settings.
- Assign a User-Defined name to a connected camera.
- Execute a Force IP address to a camera instead of the default DHCP/LLA assigned address.
- Easily Configure the NIC as a DHCP server for connected GigE Vision cameras.

Quick GigE Vision Camera Network Configuration

- Start the Network Configuration program from the windows start menu: **Start ●Teledyne DALSA●Sapera Network Imaging Package●Network Configuration Tool**.
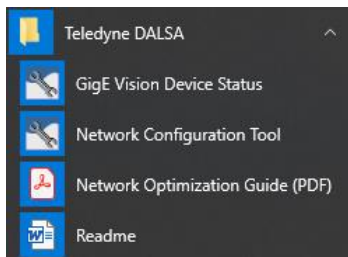
- Clicking on "Scan Network" Button will scan for all devices (conflicted and non-conflicted)
- The left display window will show all installed network adapters and any connected GigE Vision cameras.
- Click on a camera to see information such as MAC address, current IP address, serial and firmware numbers.
- With GigE cameras, click in the User Defined Name edit box and change the User Defined Name as required. Click on the Update button to write into the device memory.
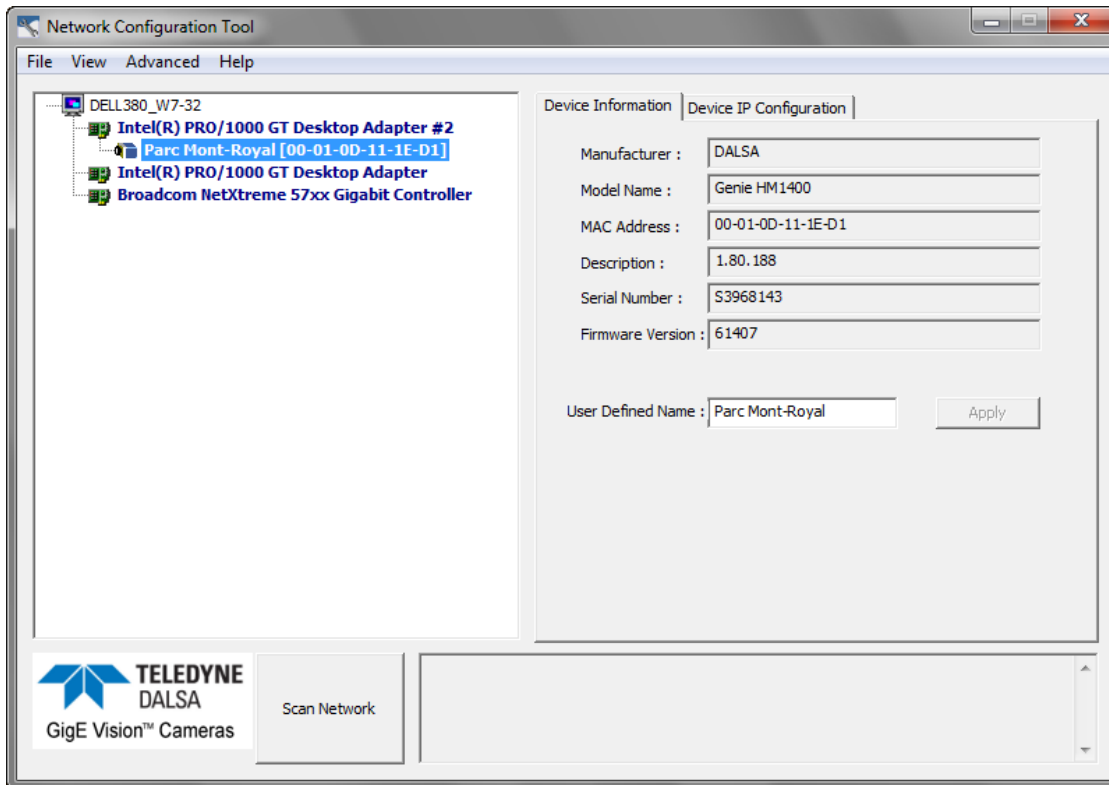
- If Persistent IP mode is selected enter the desired IP address, subnet mask, and default gateway.

Important: To recover the camera see the Recovering a Camera with an Invalid IP section.
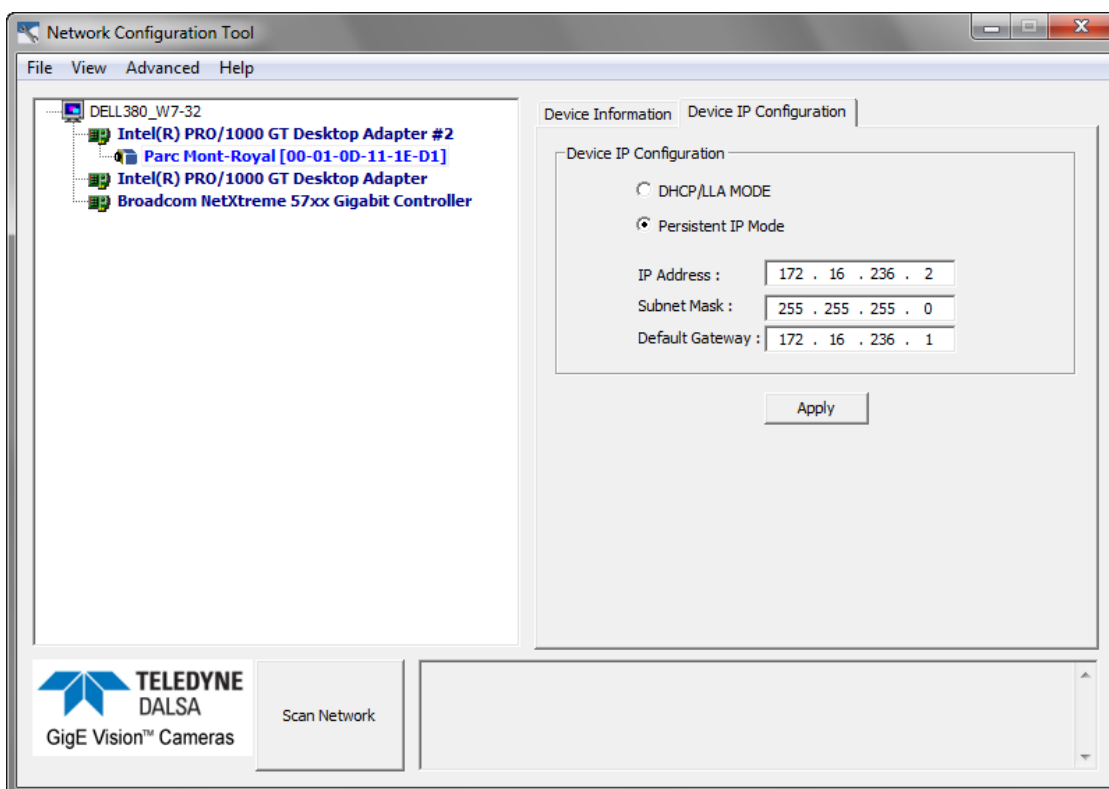
System Information, Configuration, and DHCP Server

Select the system icon (the computer symbol with computer name) in the left pane to display current system information which may be required when documenting GigE Vision installations. There are no user changeable fields in the **System Information tab**.
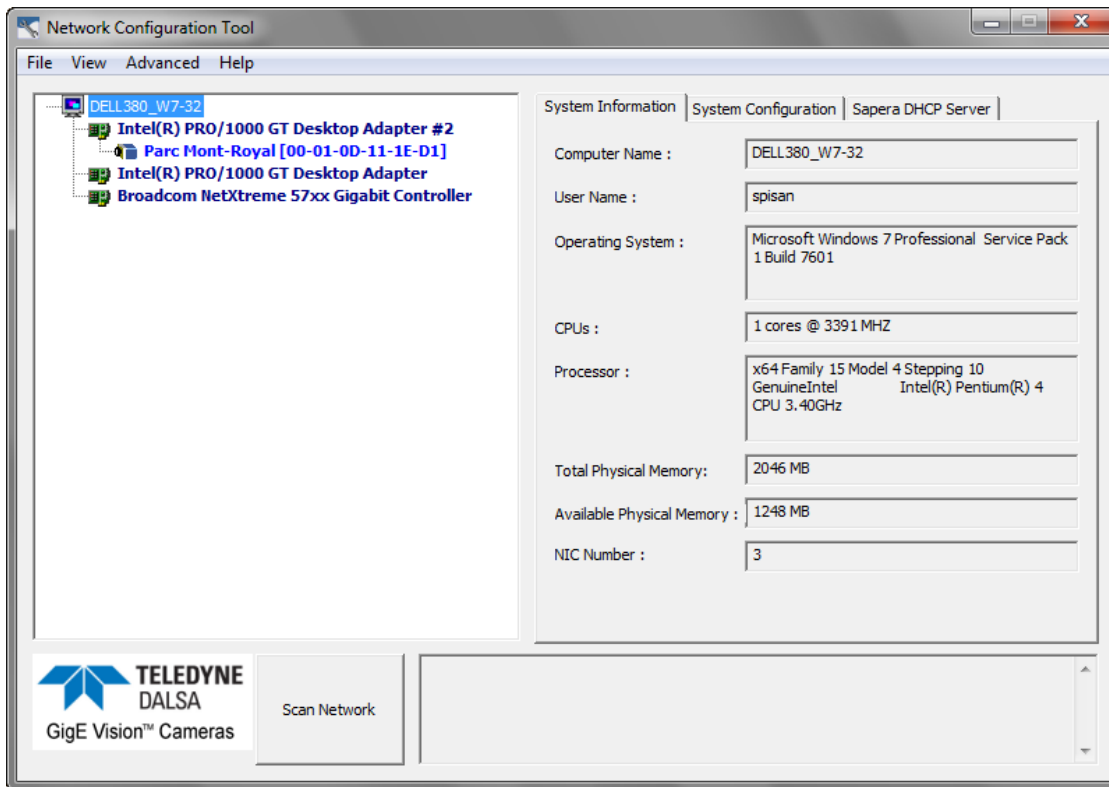
System Configuration Parameters

In the right-hand pane click on the **System Configuration tab**.

Three user settings are provided which can be changed from their default settings for production systems after all configuration items are tested and debugged.

- **Auto Discovery Period**: Sets the time delay between when new GigE Vision devices are searched for on the system network connections. This time interval can be increased if changes to the number of connected cameras is seldom made.
  - The default time period is 15 seconds.
  - This time interval can be increased if changes to the number of connected cameras is seldom made.
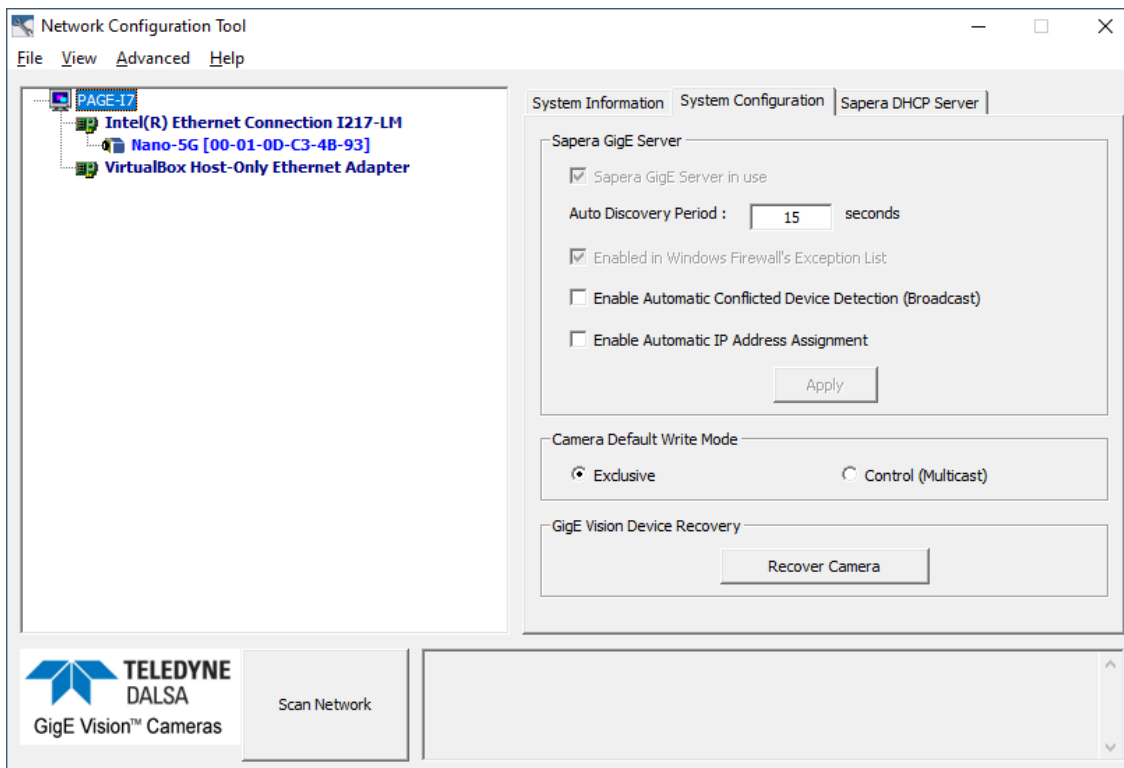 - Otherwise in the case where cameras are connected through an Ethernet switch, the Auto Discovery period should be shortened if most GigE Vision connect/disconnect events must be seen by the Sapera application via callbacks.
- **Windows Firewall Exception List**: By default, the Teledyne DALSA GigE Server is added to the Windows Firewall exception list. This ensures the Windows Firewall remains active (if it was enabled) without having to individually put each Sapera GigE application program in the exception list. If the computer is using a different firewall software package, refer to that firewall's software manual to allow the GigE Server to have access through it.

  Alternatively, it is possible to exclude a specified NIC from using the firewall. The NIC dedicated to the GigE Vision network does not need Windows firewall. See the Disabling Windows Firewall section for details on excluding a NIC from firewall settings.
- **Broadcast Device Conflict Detection**: By default, the Teledyne DALSA GigE Server attempts to detect and identify devices with invalid IP addresses for the current network. This broadcast mechanism consumes CPU cycles which may interfere with traffic on the network. When a multiple camera system is defined, tested and declared stable, the device conflict detection function can be disabled.
- **Automatic IP Address Assignment**: If a conflicted device or a device has an invalid IP address the camera is automatically assigned an IP address using the Force IP mechanism. The Force IP mechanism assigns the device a valid IP address within the NIC range that allows the camera to be discovered on the network. The Force IP address choice is not permanent and remains valid only until the device is powered off. For permanent changes to the device select Change IP Configuration.
- **Camera Default Write Mode**: The default connection mode in Sapera LT is "Exclusive" mode. Exclusive mode only allows one application to connect to the camera; any requests to access the camera from other applications will be denied.
  - For multicast, the Camera Default Write Mode must be set to Control (Multicast). When the host system is in this mode, applications running on the system can connect to cameras in read-only mode, provided no application is connected to the camera in "Exclusive" mode. However, only one application can connect to the device with read/write access.
  An advantage of setting this parameter using the Network Configuration Tool is that it only needs to be set one time for all applications and remains in this mode at subsequent system startups. For more information on using multicast, refer to the application note G3-AN0008 Genie Nano Multicasting, available on the Teledyne DALSA website.
- **GigE Vision Device Recovery**: Clicking this button use the Force IP mechanism to attempt to recover devices that in conflict.

> ⚠ Note that clicking the "Scan Network" button will force a search for devices with an invalid IP for the current network even if automatic broadcast is not enabled.

Teledyne DALSA DHCP Server Parameters

The system DHCP Server tab has configuration parameters for general DHCP server operation. For most setups the default settings are sufficient. Note that the Teledyne DALSA DHCP server is activated on a chosen NIC via a selection made on the NIC configuration (see NIC IP and DHCP Server Configuration).

- **Default Lease Time**
  By default the DHCP server will assign a device an IP address and will always use that same address whenever that device is reconnected (the server maps the IP address to the device MAC address). If a finite time is desired, un-check the Infinite selection box and enter the lease time on hours or days.

- **Server Response Time**
  Important: The parameter sets the time interval for the Teledyne DALSA DHCP server to acknowledge a DHCP request from a device and assign an IP address. By default, the default interval is 0 seconds. In the case where there is another DHCP server, this parameter can be set to a longer period to allow the primary DHCP server on the network to respond to devices.
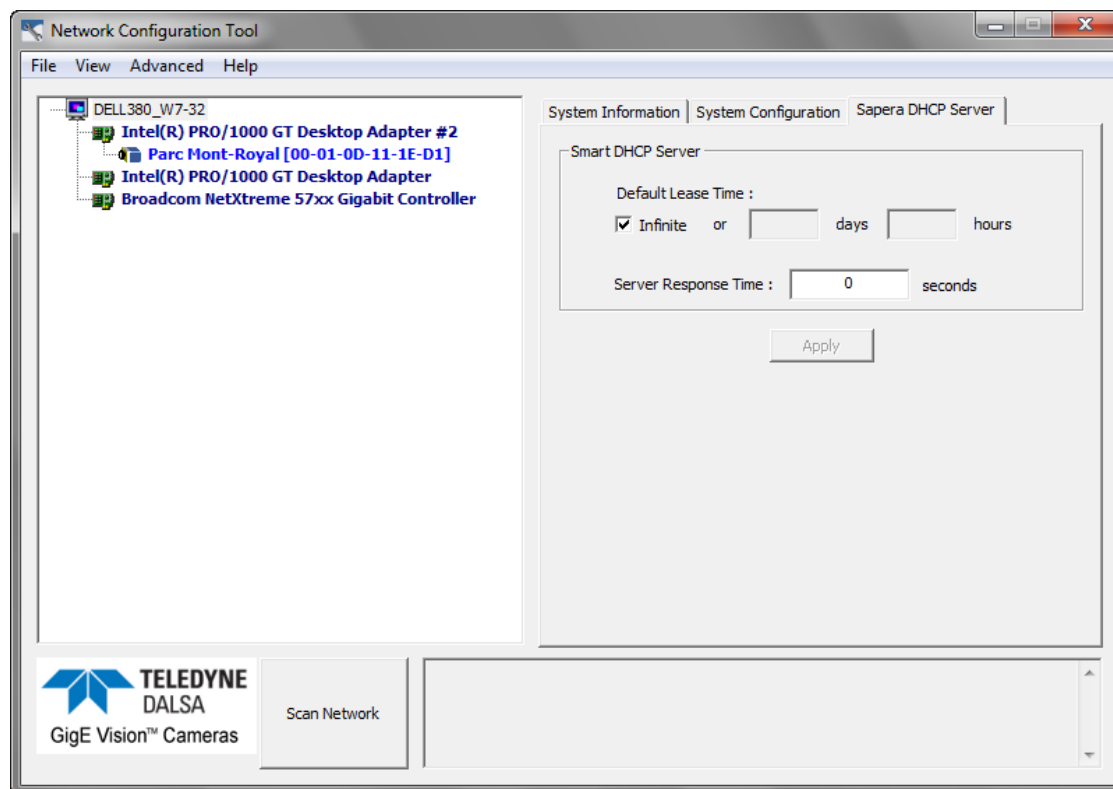
Network Card Information and Configuration

Select a network card icon in the left pane to see NIC information and its configuration parameters. The Teledyne DALSA Network Configuration tool ensures that no two NIC devices installed in the computer are on the same subnet, since that would create a conflict. A warning message is displayed in such a case, indicating that a settings change is required for one of the NIC.
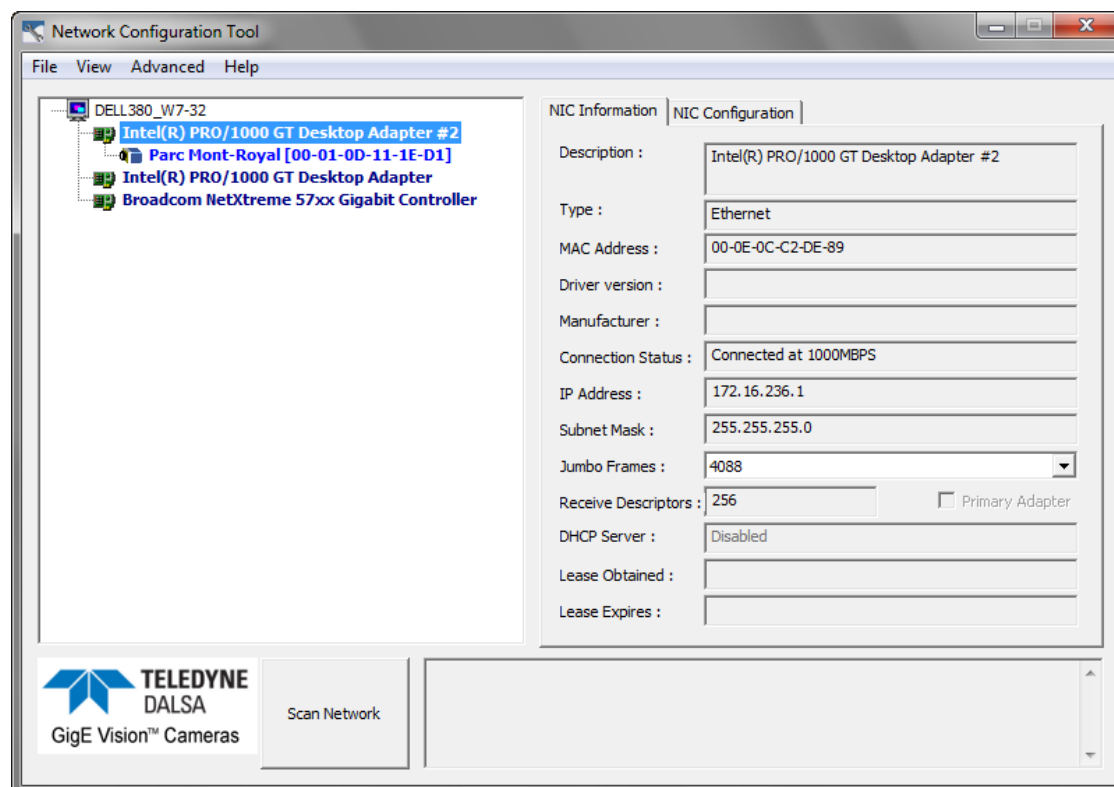
NIC IP and DHCP Server Configuration

For each NIC used for a GigE Vision network, select the NIC Configuration tab. Configure the IP mode (either DHCP/LLA or Persistent IP) and if required, enable the Teledyne DALSA DHCP server.

- If the DHCP server is enabled, the Teledyne DALSA DHCP server parameters are configured as described in Teledyne DALSA DHCP Server Parameters.
- If Persistent IP is selected (with or without the Teledyne DALSA DHCP server enabled), enter the desired IP address and Subnet Mask.

⚠	**Warning**: Changing the NIC IP address may put it on a different subnet than the GigE Vision camera. Changing the NIC IP configuration first might cause the case where the camera becomes inaccessible from the NIC. The proper sequence is to first change the camera IP configuration then change the NIC IP, else you will need to do a camera recovery (do a ForceIP by right clicking on the conflicted device).
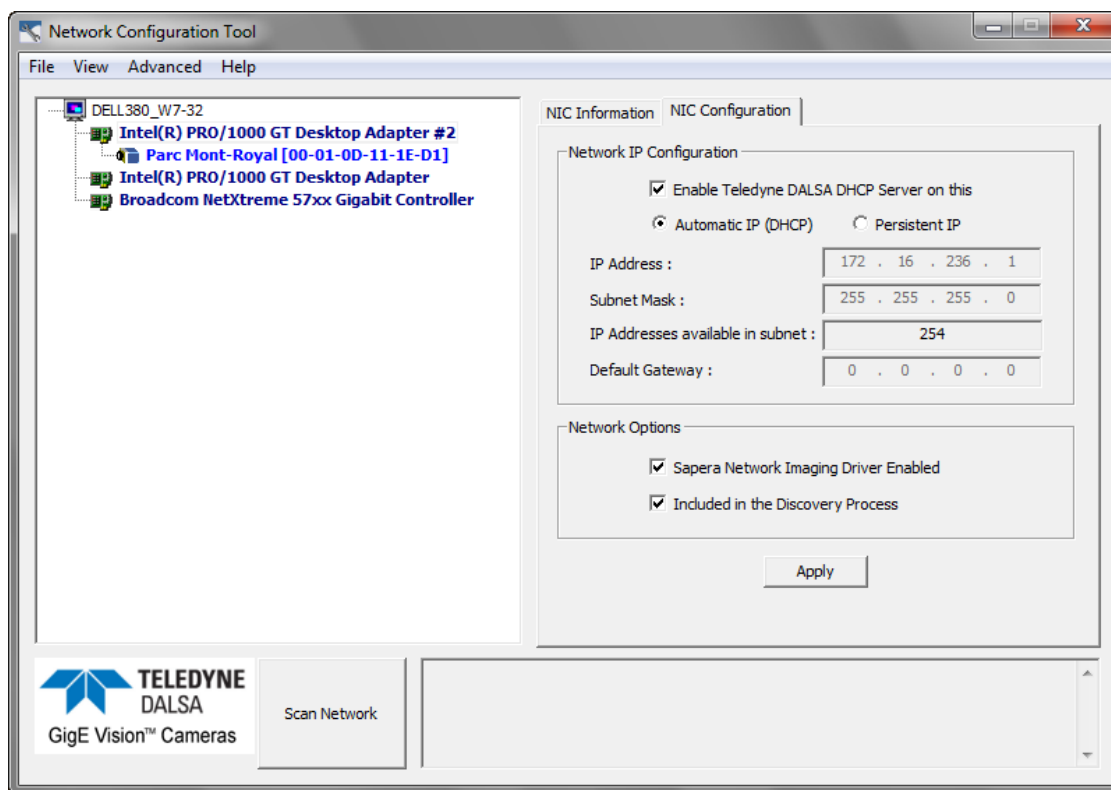
After installation, all system NIC devices have the Teledyne DALSA Network Imaging driver enabled, which streams image data efficiently to image buffers. Only the NIC connected to a GigE Vision camera or device requires the Network Imaging driver enabled to capture images. Other NIC ports in the system can be excluded from the Teledyne DALSA driver.

- Select other NIC devices in the system and disable the Network Imaging Driver if they are not used with a GigE Vision camera.
- Additionally, any system NIC can be excluded from the camera discovery process to eliminate unnecessary use of system resources for network connections that do not have GigE cameras, or where that network NIC should be ignored during the discovery process.

Recovering a Camera with an Invalid IP

When a GigE Vision camera has been configured with an IP address different than the NIC address range, use the Teledyne DALSA Network Configuration tool to configure both NIC or camera to the same address range.

To recover a GigE Vision camera:

- Start the Network Configuration program from the windows start menu: **Start•All Programs•Teledyne DALSA•Network Interface•Network Configuration Tool**.
- In the System Configuration tab, check that the "Enable Automatic Conflicted Device Detection (Broadcast)" is on (note this may generate more network traffic for each discovery).
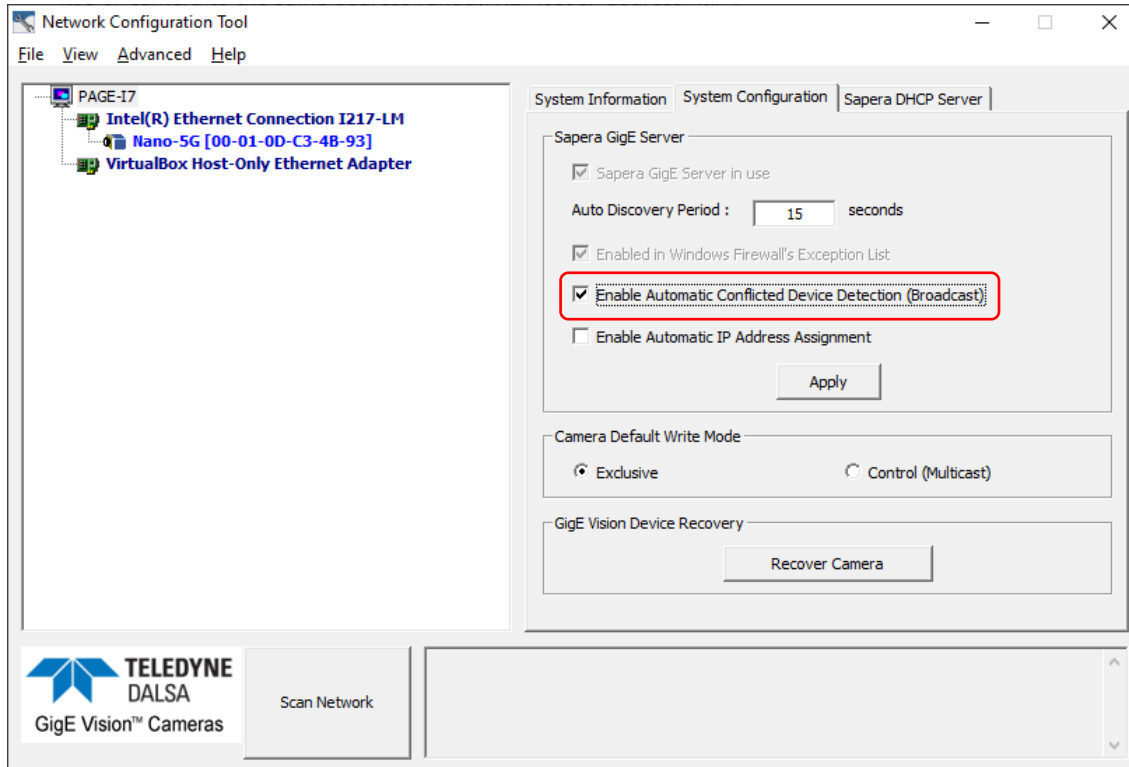
- Click "Scan Network" to scan for all devices (conflicted and non-conflicted). Conflicted devices are shown in red.
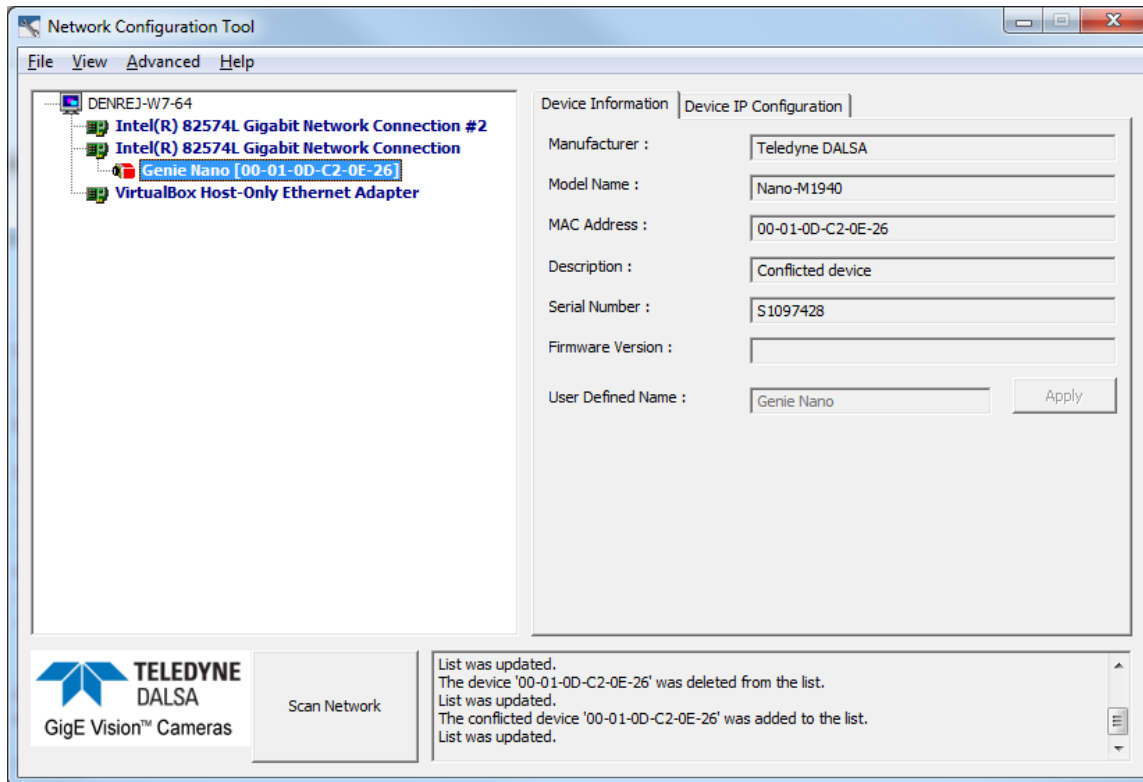
If no camera is found, you can use the Recover Camera utility to attempt to recover the camera using its MAC address.

- From the menu bar click on **Advanced** and then on **Automatic Recovery (Force IP)**.
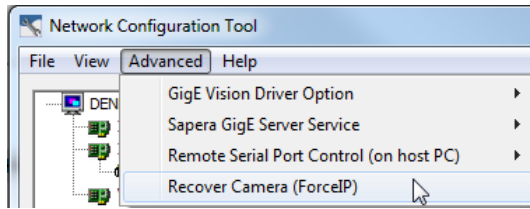
Alternatively, right-click on the camera an use the pop-up menu:
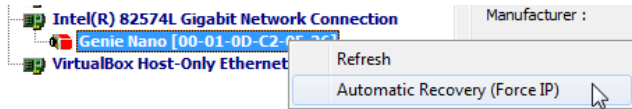
The command is also available from the Device IP Configuration tab:
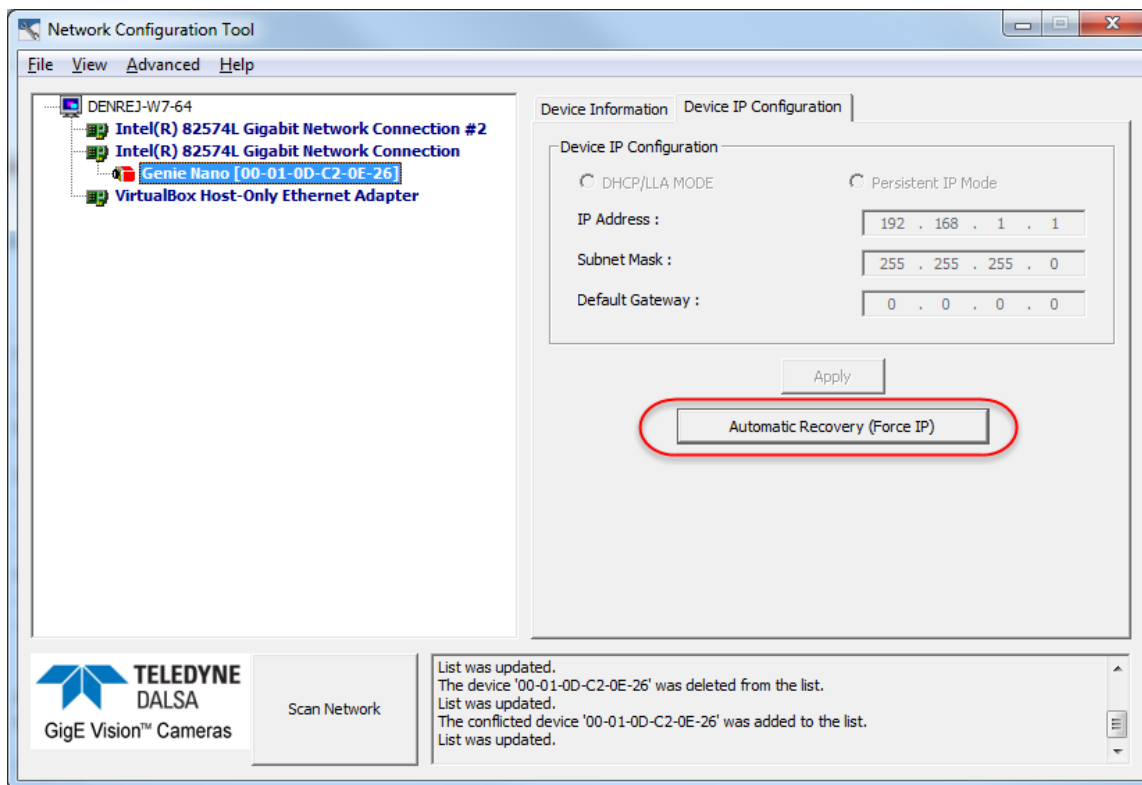
- The Force IP address choice is not permanent and remains valid only until the device is powered off. For permanent changes to the device select Change IP Configuration.

- If the camera requires a persistent IP address, select camera and on the Device IP Configuration tab assign a persistent IP immediately. Enter the new IP address and click Apply.
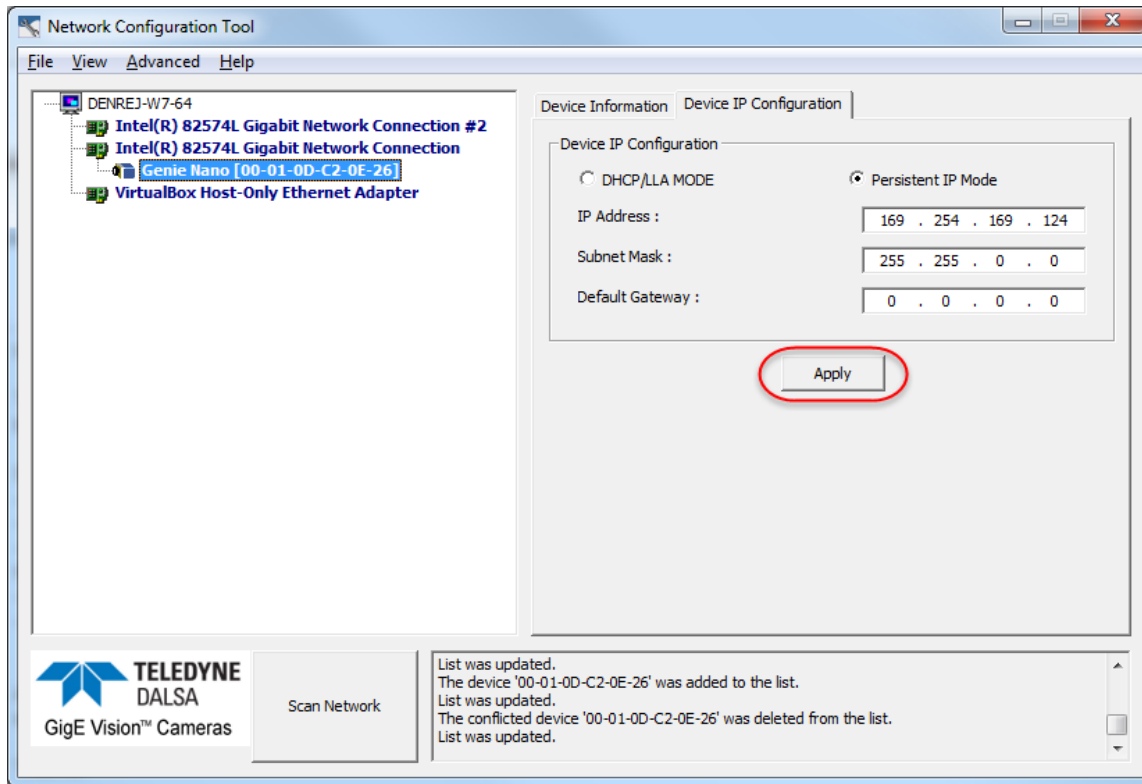
Recover Camera Utility

The Recover Camera utility is a command line program that uses the camera's MAC address to recover an incorrectly configured camera. The RecoverCamera.exe application is located in the *<INSTALL>\Program Files\Teledyne DALSA\Network Interface\Bin* directory.

The camera MAC address can be found on the product label affixed to the camera body. For example:
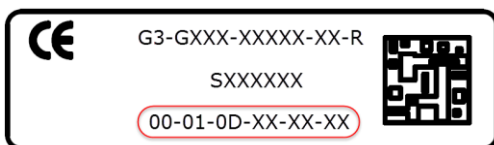
Run the RecoverCamera.exe from a command prompt. Usage instructions are provided.
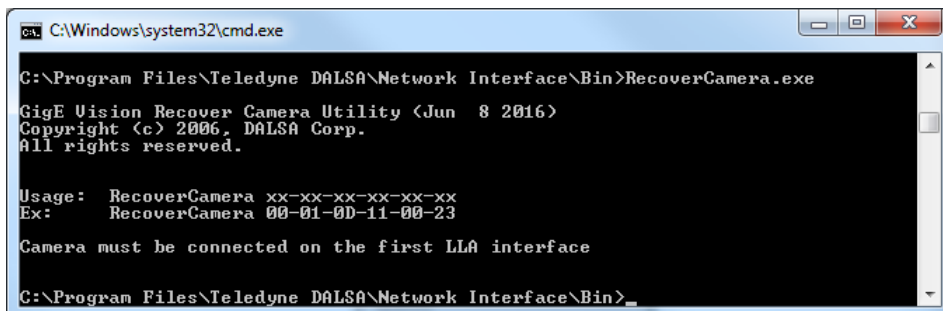
Serial Port Support

For GigE Vision devices that support serial ports the connection method can be configured to control how Windows serial ports are assigned. The setting options are available through the **Advanced > Remote Serial Port Control (on hots PC)** command.
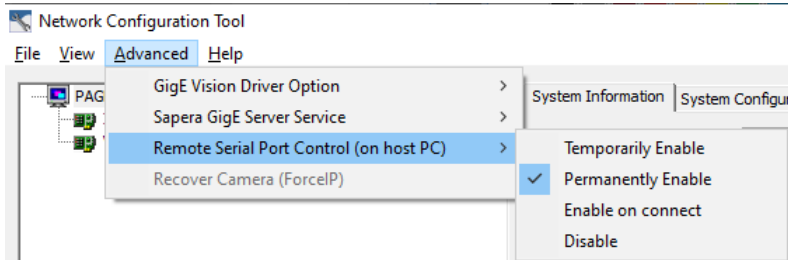
The following connection methods are available:
- **Temporary Enable**:when a camera is detected, a serial is assigned. The serial port is freed when the camera is removed.
- **Permanently Enable**:when a camera is detected, a serial port is assigned. The serial port index persists for that camera even if the camera is removed.
- **Enable on connect**: when an application connects to the camera, a serial port is assigned.
- **Disable**: No serial port is assigned when a camera is detected.

GigE Vision Driver Option

The GigE Vision Driver Option allows you to select between using the Teledyne DALSA interface or a Generic XML Interface. The Teledyne DALSA Interface provides additional support for legacy devices that use certain non-GenICam standard features.
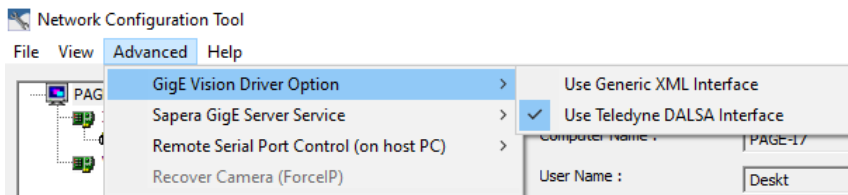
Sapera Configuration Utility

The **Sapera Configuration** program (**SapConf.exe)** allows you to see all the Sapera LT-compatible devices present within your system, together with their respective serial numbers. It can also adjust the amount of contiguous memory to be allocated at boot-time. After activating this program, it displays all the servers related to the installed devices as shown in the figure below (64-bit version shown).
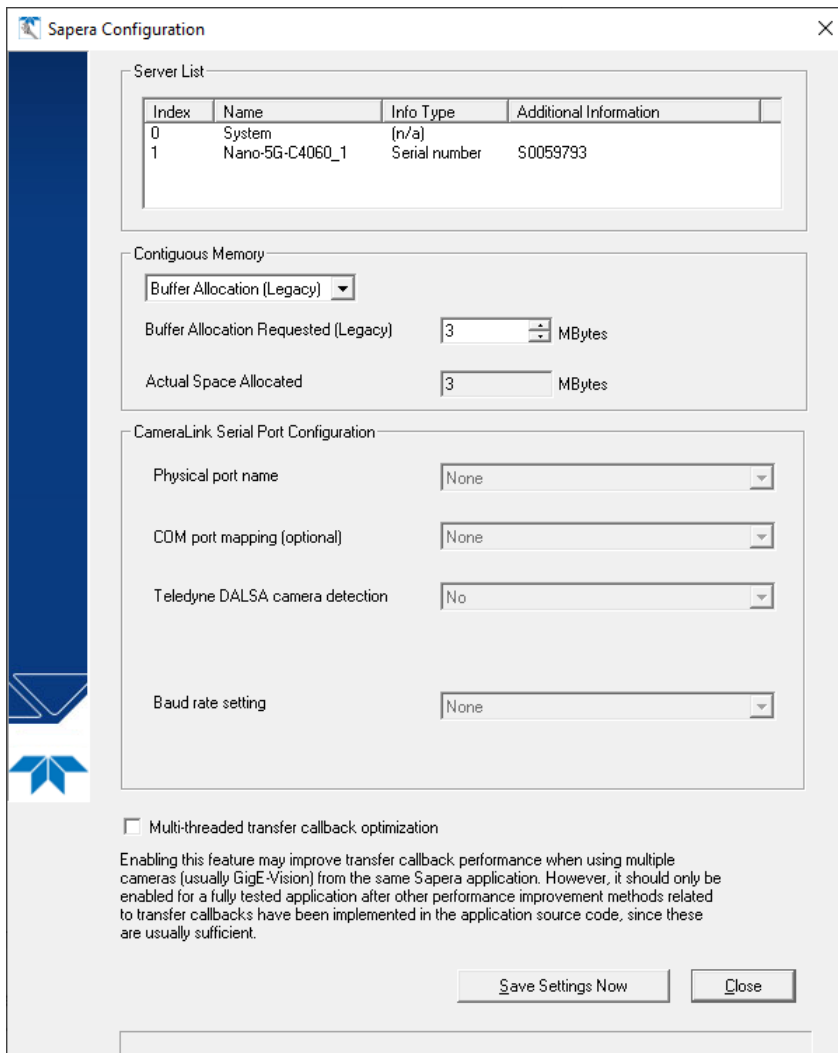
- The **System** entry represents the system server. It corresponds to the host machine (your computer) and is the only server that should always be present. The other servers correspond to the devices present within the system.

Configuring Contiguous Memory
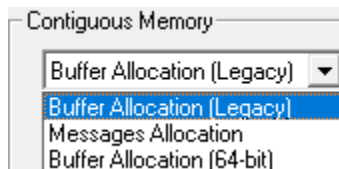
The **Contiguous Memory** section lets you specify the total amount of contiguous memory to be reserved for allocating **buffers** and **messages**. This memory is used by frame grabbers to allocate DMA tables; however, a certain amount of contiguous memory is required for Sapera LT buffer descriptors and 1MB for every 3000 buffers should be allocated.

Contiguous memory is reserved at boot time for the allocation of dynamic resources used for frame buffer management such as scatter-gather list plus other kernel needs. Adjust this value higher if your application generates any out-of-memory error while allocating host frame buffers or when connecting the buffers via a transfer object.

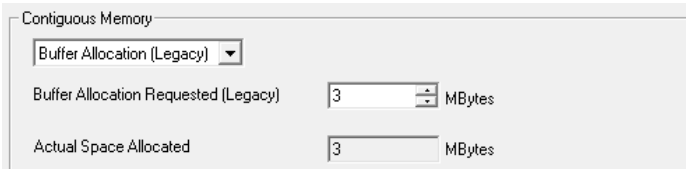|	
⚠	**Note:** All Sapera LT demos and examples **do not use contiguous memory** other than the 1MB per 3000 buffers required for buffer descriptors. Therefore, you should not modify these settings unless your application requires contiguous memory.

The drop-down list specifies the memory type to allocate.

Buffer Allocation (Legacy): Contiguous memory is allocated in the 1st 4GB of host memory. In practice, not all 4GB is available since it is also used by other hardware resources; the actual amount available can range from 2GB to 3.5GB. RAM amounts greater than 4GB are unused since there is no address space to map it to. The amount required is determined by the number of buffers only (DMA tables do not apply for GigE cameras). 1MB for every 3000 buffers should be allocated.

Buffer Allocation (64-bit): This does not apply to GigE cameras; used for frame grabber DMA.

Messages Allocation: This does not apply to GigE cameras

The **Requested** value displays what was requested.

The **Allocated** value displays the amount of contiguous memory that was allocated successfully.

Multi-Threaded Transfer Callback Optimization

☑ Multi-threaded transfer callback optimization

Enabling this feature may improve transfer callback performance when using multiple cameras (usually GigE-Vision) from the same Sapera application. However, it should only be enabled for a fully tested application after other performance improvement methods related to transfer callbacks have been implemented in the application source code, since these are usually sufficient.

Usage Notes When Writing Sapera Applications

- Always disable this option (the default) while developing and thoroughly testing the application, especially making sure that appropriate robustness standards are met.

- If the application does not meet performance requirements, all the known performance improvements which can be implemented in application code must be tried (for example, limiting operations as much as possible in the transfer callback function).

- If performance requirements are still not met, and there is only one camera per running instance of the application, then still leave disabled since it provides no performance benefit.

- Only consider enabling if performance requirements are not met with multiple cameras in the same running instance of the application.

- If enabling does not improve performance, then disable it.

- If enabling improves performance, the application must be once again thoroughly tested to prove that it still meets the same robustness requirements as before.

Creating a Status Report

> ⚠ Before contacting Teledyne DALSA technical support, the user should review the Troubleshooting section of this manual (see Troubleshooting). Most installation, configuration, and imaging issues are documented along with their solutions.

To aid technical support, the Teledyne DALSA Network Configuration tool can save a network configuration report. From the **File** menu select **"Save current status"**. You will be prompted for a filename for the report text file. This file should always be sent with any request for technical support.

Demos and Examples

Several generic demos and examples are available for both Sapera ++ and Sapera .NET. Complete source code is provided for projects in Microsoft Visual Studio 2010 to 2017.

Source code for Sapera LT ++ based demos and examples can now be compiled as Unicode instead of ANSI. Project files provided by Sapera for Visual Studio 2012 now support both character sets. However, project files for earlier versions of Visual Studio still support ANSI only. Project files for Visual Studio 2013/2015/2017 support Unicode only.

If your application requires a user interface, Sapera LT includes the GUI classes used by many of the demos to create commonly used dialog boxes. The GUI classes include a set of Microsoft® Foundation Classes (MFC) based dialog boxes designed to implement some of the most commonly used tasks for Sapera LT applications, such as loading an acquisition configuration file. They, however, do not constitute an official API. Rather, they are provided 'as is' with source code so that you may modify them at your discretion. For more information on these classes refer to the Sapera LT GUI Class Reference manual.

Certain device driver installations provide other demos and examples that demonstrate the specific usages and capabilities of the device. Refer to a specific device user's manual for further details.

Demo Source Code

Several demo programs are available with Sapera. They are more complete applications than the supplied examples. There are demos that cover Sapera LT ++ and Sapera .NET.

The demos main purpose is to provide the user with a starting application that can be modified in order to become the user's end application.

The Sapera LT ++ and Sapera LT .NET demo source code for the supported compilers are found in the following directory:

- `Sapera\Demos`

Projects are also provided to allow you to recompile all the demos in a batch, together with the Sapera LT ++ GUI Classes.

Example Source Code

Several example programs are available within Sapera. They are essentially basic applications demonstrating simple tasks like grabbing an image and loading an image file from the disk.

The main purpose of the examples is to provide the user with code samples that can be easily extracted and integrated into an application. Examples cover both Sapera LT ++ and Sapera .NET.

The Sapera LT ++ and .NET example source code for the supported compilers are found in the following directory:

- `Sapera\Examples`

Projects are also provided to allow you to recompile all the examples in a batch.

Demos and Examples for GigE Vision Devices

The following demo programs and corresponding source code are available:

Demo Name	Description
GigEBayerDemo	This program demonstrates the Bayer conversion functionality included in Sapera LT with a Teledyne DALSA GigE Vision™ camera. It allows you to acquire images either in continuous or in one-shot mode, while adjusting the acquisition parameters. It includes interactive control of Bayer conversion parameters. You may optionally apply Bayer filtering to acquired images.
	The minimum requirement to run this demo is a Sapera-compatible GigE Vision color camera that output Bayer format.
	Note, the SapBayer class has been deprecated and replaced by the SapColorConversion class.
GigECameraCompressionDemo	The compression demo works with cameras with onboard image compression such as the Genie TS with JPEG firmware (model dependent). The demo allows activating the camera's compression function and decompresses the image stream to display on the host system monitor.
	For a tutorial on using this demo, see the Sapera Camera Compression Demo section.
	The supplied executable is built using Sapera LT ++ plus the MFC library under Visual Studio 2013.
GigECameraDemo	This program demonstrates how to acquire images from a Teledyne DALSA GigE Vision™ camera. The demo either loads a configuration file (previously generated by CamExpert) or uses the camera defaults.
	The minimum requirement to run this demo is a Sapera-compatible GigE Vision camera.
	The supplied executable is built using Sapera LT ++ plus the MFC library under Visual Studio 2013.
GigEFlatFieldDemo	This program demonstrates how to use the flat field correction function included in Sapera LT ++ with a Teledyne DALSA GigE Vision™ camera. Flat Field Correction (FFC) includes Fixed Pattern Noise (FPN), Pixel Replacement, Photo Response Non-Uniformity (PRNU), and Shading Correction. The demo allows you to acquire images either in continuous or in one-shot mode, while adjusting the acquisition parameters. It includes interactive calibration of flat field gain and offset settings. You may optionally apply flat field correction to previously acquired images.
	The minimum requirement to run this demo is a Sapera-compatible GigE Vision camera.
	The supplied executable is built using Sapera LT ++ plus the MFC library under Visual Studio 2013.
GigEMetaDataDemo	This program demonstrates the metadata functionality supported by certain Teledyne DALSA GigE Vision™ cameras. It allows you to add custom metadata to images. In addition, it can grab a sequence of images from a Teledyne DALSA GigE Vision™ camera into memory and then display them.
	The minimum requirement to run this demo is a Sapera-compatible GigE Vision camera that supports the metadata feature.

GigESeqGrabDemo	This program demonstrates how to grab a sequence of images from a Teledyne DALSA GigE Vision™ camera into memory and then display them. The program allows you to record several images and save AVI files, plus load those AVI files for playback. Each image is stored in its own buffer and can be reviewed. A small number of images are allocated by default but can be increased using the buffer options inside the demo.
	The minimum requirement to run this demo is a Sapera-compatible GigE Vision camera.
	The supplied executable is built using Sapera LT ++ plus the MFC library under Visual Studio 2013.

The following compiled console examples and source code are available:

Example Name	Description
CameraEvents	Shows how to list all the available events with SapAcqDevice. Using the registering and unregistering callback mechanism, it shows also how to track when a specific event occurs.
CameraFeatures	Shows how to enumerate available features on a camera. It also shows how to retrieve feature specific information (for example, access mode), and how to change feature values.
CameraFiles	Shows how to upload/download files for GigE cameras that support file access such as firmware upload and LUTs.
CameraFirmwareUpdate	Shows how to update firmware for GigE cameras that support file access, allowing automatic firmware updates at the application level. (GenCP and CLHS cameras are also supported by this example.)
FindCamera	Shows how to list all detected cameras when more than one camera is present, listing them by username, serial number, model name or server name. By uncommenting a part of code, you will be able to change the user defined name of the camera.
GrabCPP	Grab Console. Shows how to grab an image from a selected camera into a Sapera buffer and then display it. The buffer is created according to the camera settings. Any Sapera compatible frame grabber or GigE camera can be used. This example is named Grab in .NET.
GigECameraMulticast	Shows how to perform a multicast broadcast. This allows a single camera to transmit images to multiple host computers that request to receive the multicast broadcast. The example demonstrates how to connect a host application to a camera as a master, which allows camera control access, or as a receiver for multicast image broadcasts.

Generic Sapera LT Examples

The generic Sapera LT example do not require an acquisition device. The following compiled console examples and source code are available:

| Example Name	Description
ColorSplit	Shows how to split and merge color images into single monochrome components. An RGB image is loaded, split into three monochrome components, then a simple processing is applied to the three components before they are merged back to RGB as output.
FileLoadCPP	Shows how to load an image file from the disk into a Sapera buffer and then display it. The buffer is created according to the image file properties. One of several images (monochrome, RGB, or YUV) can be selected for loading. This example is named FileLoad in .NET.

3D Sensor Examples

The following compiled console examples and source code are available for supported GigE 3D sensors:

Example Name	Description
GrabConsole3D	Shows how to grab profiles or ranges from a GigE 3D acquisition device. The buffer is created according to the camera settings, using the available 3D image formats SapFormatCoord3D_C16/AC16 or ACRW16. Buffer parameters, such as the invalid value and scaling and offset factors are listed, as well as statistics such as the pixel mean value, in image and world units.
GrabConsole3DWorld	Shows how to calculate real X and Z coordinates, as well as reflectance values (R). It does not display acquired images.
FileLoadConsole3D	Shows how to load a 3D image file (.tif or .crc) from disk into a Sapera buffer and then display it. Images provided use the available 3D image formats SapFormatCoord3D_C16/AC16 or ACRW16, for both ranges and profiles.

Acquiring with GigE Vision Camera Demo

The Sapera LT GigE Vision Camera Demo program allows you to grab and display a live image in a host buffer. This demo is a good starting point to verify that your camera and frame grabber are properly installed.

The following dialog box appears when starting Grab Demo:
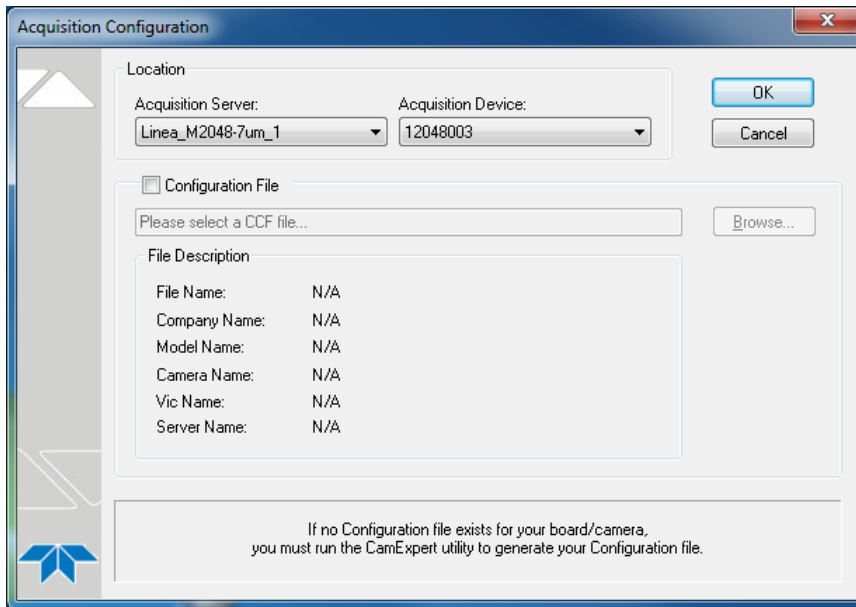
You must select the **Acquisition Server and the Acquisition Device**. The first one corresponds to the device you want to grab from; the second represents the acquisition device on this board (some devices may have more than one).

You can then select an acquisition configuration file (CCF File) compatible with your camera from the list of available files or use the camera default values without loading a .ccf file. CamExpert must be used to generate CCF files (for example, external trigger, cropping window, and so forth).

Click OK to start the demo.
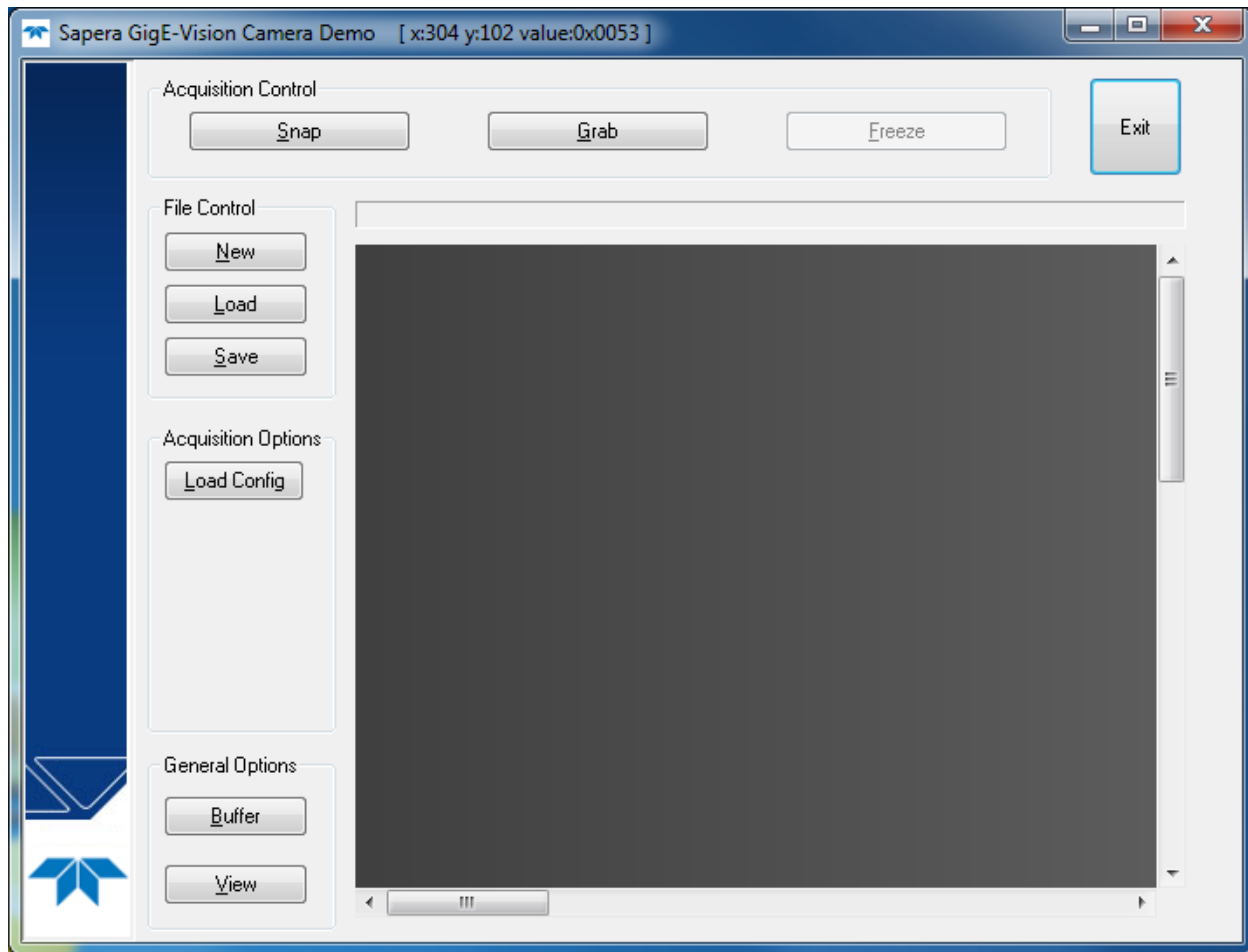

By using GigE Vision Camera Demo you can now:

- Control the acquisition using the **Snap**, **Grab**, and **Freeze** buttons.
- Load/save images from/to disks using the **Load** and **Save** buttons.
- Reload the CCF file using the **Load Config** button (this overwrites all the parameters modified in step 3).
- The **Buffer** button allows you to change the number of buffers used for internal cycling and the type of buffer used (contiguous, scatter-gather, off-screen, or overlay).
- The **View** button allows you to adjust the scaling and the select the bit range to display when grabbing images with formats greater than 8-bits.

Using the GigE Sequential Grab Demo

The sequential grab demo allows you to grab a sequence of images and save them as a .AVI file.
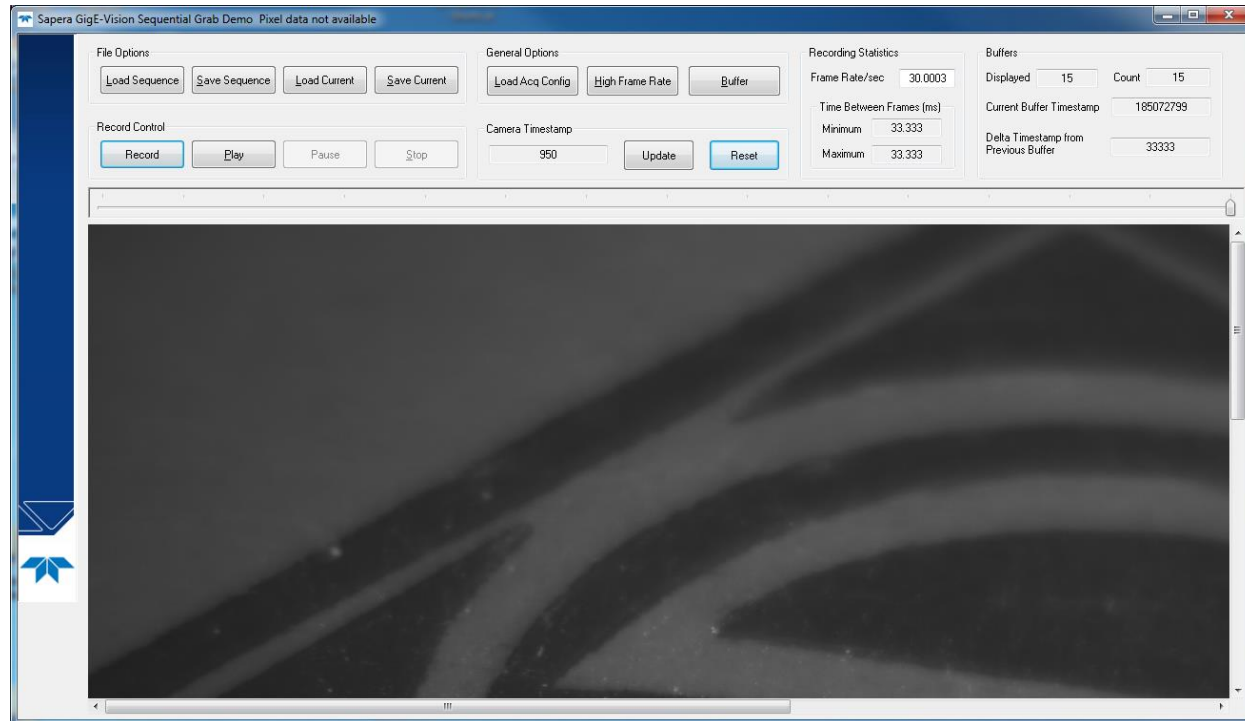
The user can set the number of images in the sequence. For high frame rate applications, the number of frames that generate transfer events can be increased to reduce the CPU overhead.
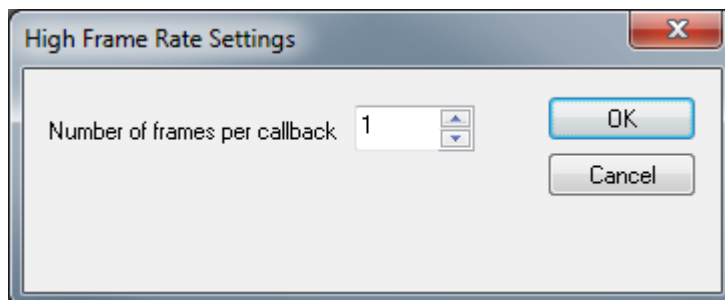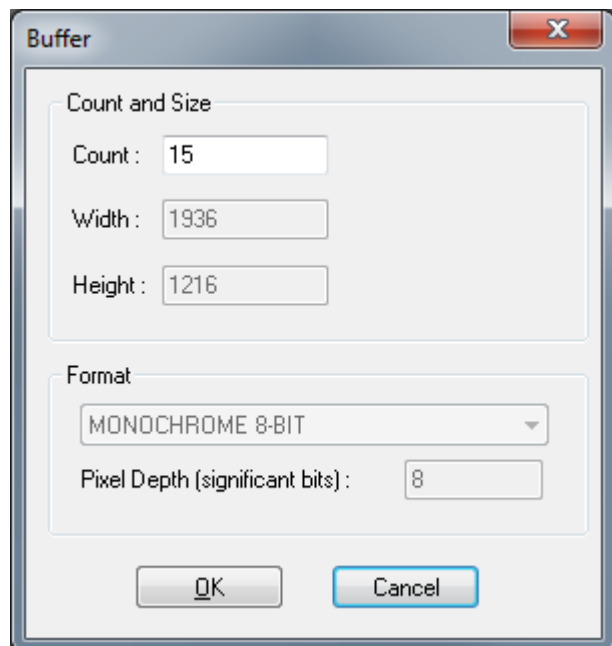
The demo also displays the timestamps generated by the camera and saved in the image buffer. These timestamps can be analyzed to ensure that no images are lost. In addition, clicking the camera timestamp Reset button provides an easy way to calculate the round trip required for a function to be sent to the camera and the response received, providing a means to evaluate the network speed.

General Options
- Load Acq Config
- High Frame Rate
- Buffer

Camera Timestamp
- 258048871
- Update
- Reset

Recording Statistics
- Frame Rate/sec: 30.0003

Time Between Frames (ms)
- Minimum: 33.333
- Maximum: 33.333

Buffers
- Displayed: 4
- Count: 15
- Current Buffer Timestamp: 257247888
- Delta Timestamp from Previous Buffer: 33333

Using the GigE Metadata Demo

For GigE cameras that support metadata, the GigE Metadata Demo allows you to select the metadata to generate for images and save this metadata to file. It also includes the same functionality as the GigE Sequential Grab Demo, such as camera acquisition timestamps.
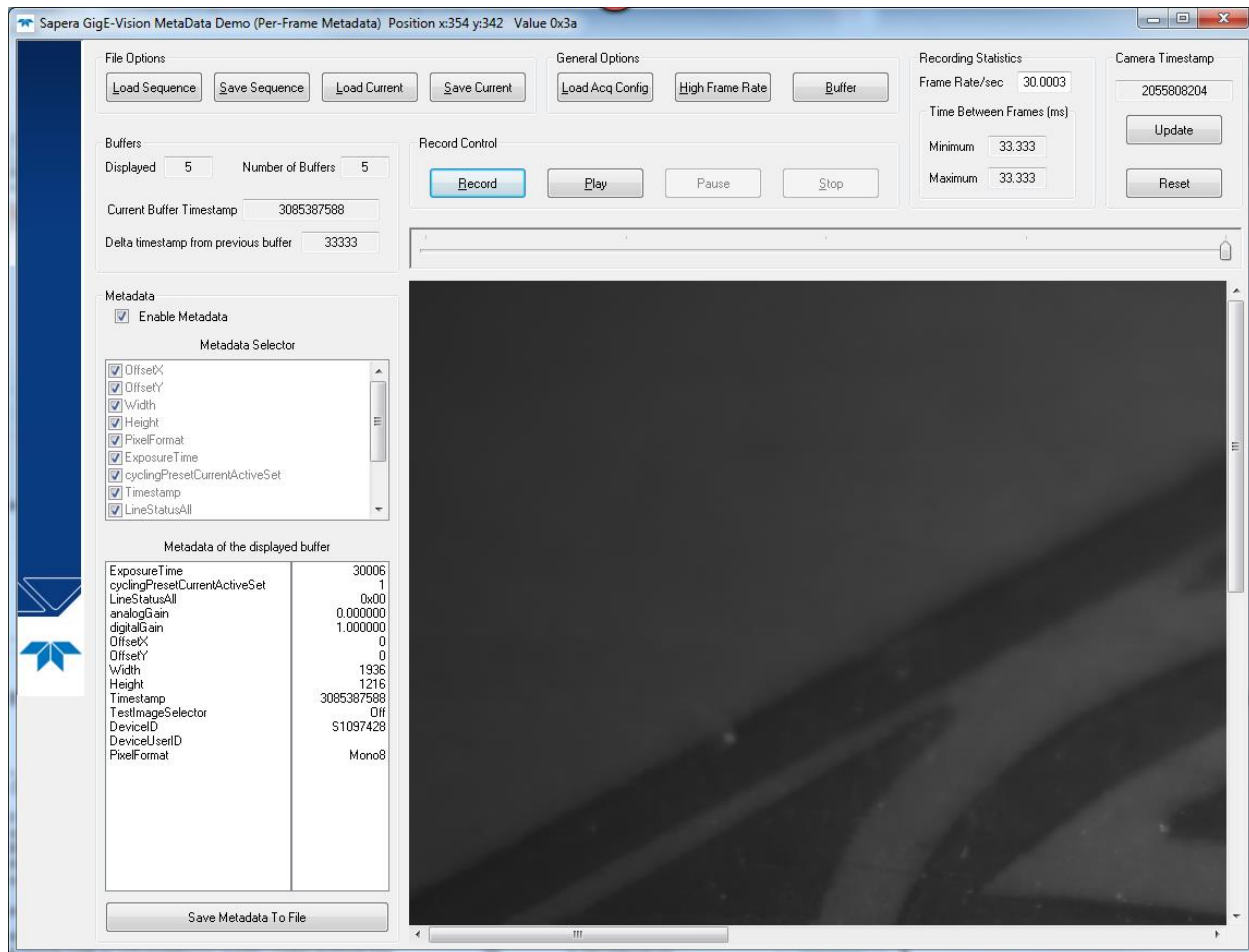
To activate the metadata functionality, use the **Enable Metadata** checkbox and select the required metadata.

Using the GigE Vision Flat Field Demo

Flat Field Correction is the process of eliminating small gain differences between pixels in a CCD array. When calibrated flat field correction is applied to the image, the CCD exposed to a uniformly lighted field will have no gray level differences between pixels. The Flat Field demo automatically functions both with hardware supporting flat field processing or performs the processing via the Sapera library on the host system processor.
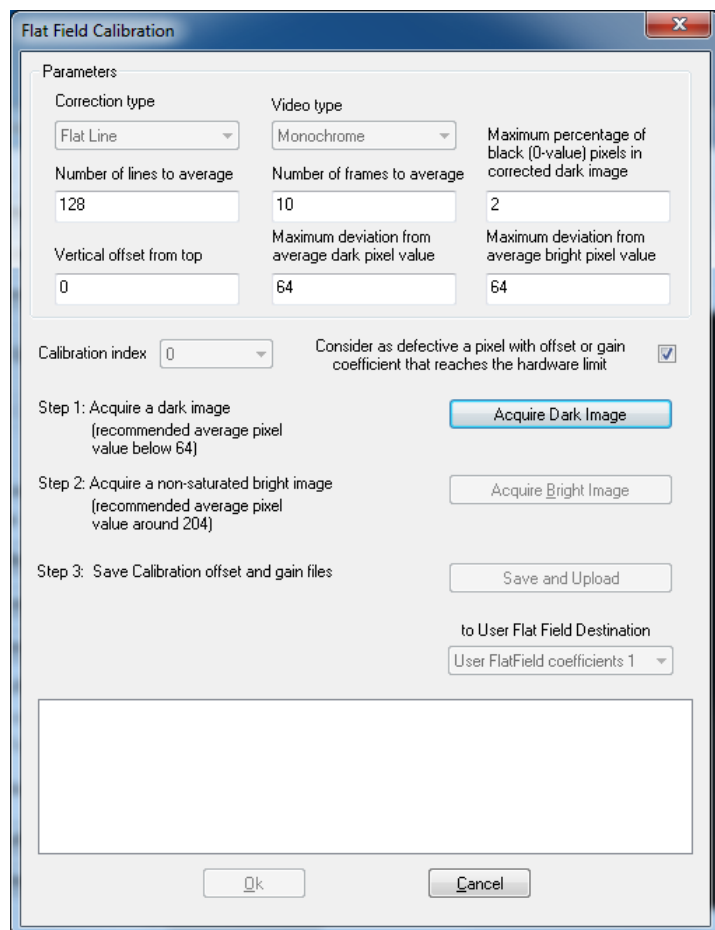
Flat Field Demo Main Window

The demo main window provides control buttons and a central area for displaying the grabbed image. Developers can use the demo source code as a foundation to quickly create and test the desired imaging application.
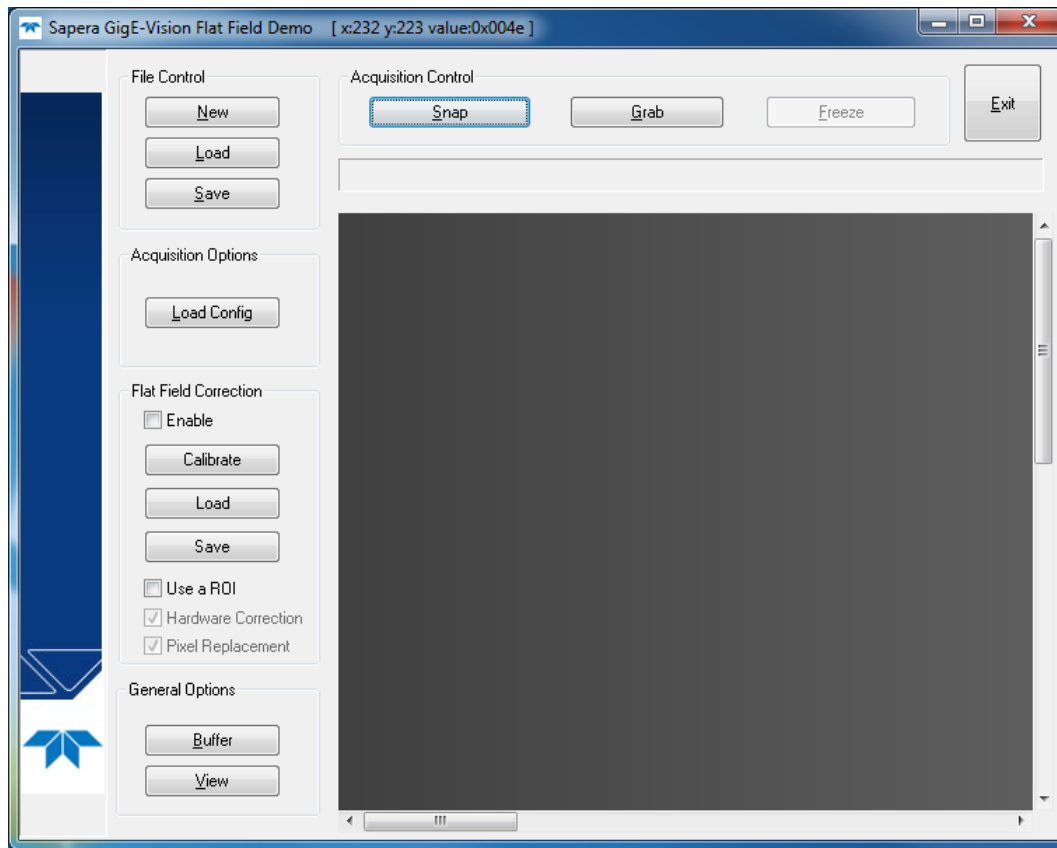
Set up Dark and Bright Acquisitions with the Histogram Tool

Before performing calibration, verify acquisition with a live grab. Also, at this time make preparations to grab a flat light gray level image, required for the calibration, such as a clean evenly lighted white wall or non-glossy paper with the lens slightly out of focus. Ideally a controlled diffused light source aimed directly at the lens should be used. Note the lens iris position for a bright but not saturated image. Additionally, check that the lens iris closes well or have a lens cover to grab the dark calibration image.

Verify a Dark Acquisition

Close the camera lens iris and cover the lens with a lens cap. Using CamExpert, click on the grab button and then the histogram button. The following figure shows a typical histogram for a camera grabbing a very dark image.
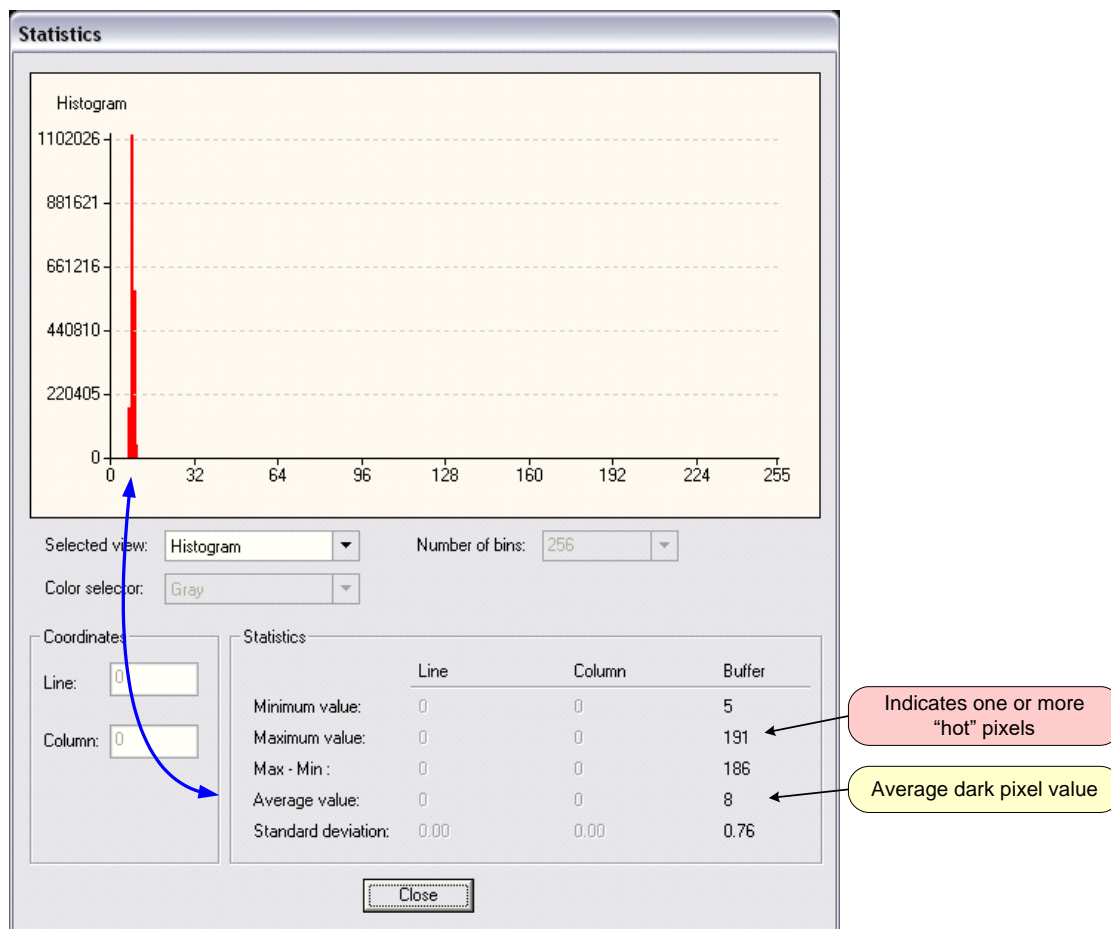
Important: In this example, the **average** pixel value for the frame is close to black. Also note that most sensors will show a much higher maximum pixel value due to one or more "hot pixels". The sensor specification accounts for a small number of hot or stuck pixels (pixels that do not react to light over the full dynamic range specified for that sensor).

Verify a Bright Acquisition

Aim the camera at a diffused light source or evenly lit white wall with no shadows falling on it. Using CamExpert, click on the grab button and then the histogram button. Use the lens iris to adjust for a bright gray approximately around a pixel value of 200 (for 8-bit pixels). The following figure shows a typical histogram for a bright gray image.

Minimum should not be black unless there is a "dead" pixel

Maximum should not be peak white unless there is a "hot" pixel (i.e. 255 for 8-bit, 1023 for 10-bit)

Average bright pixel value (bright gray but not white)
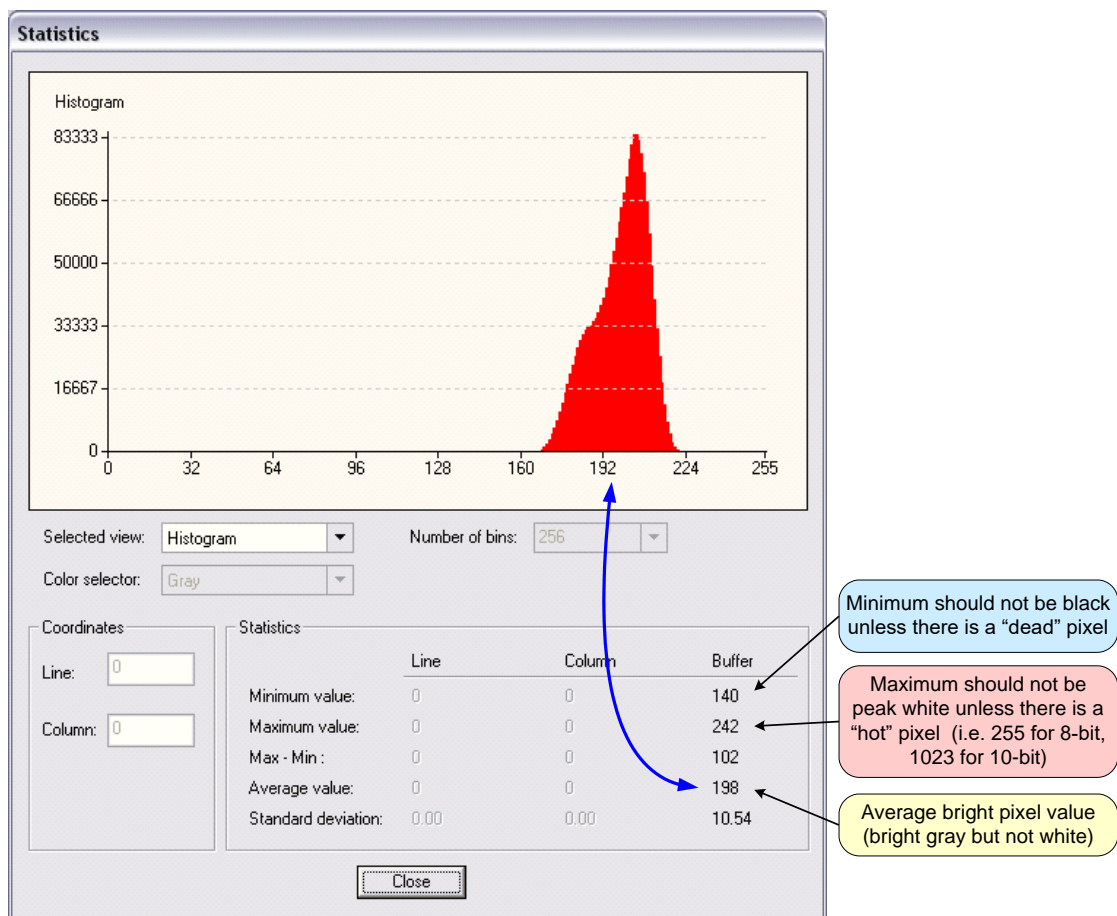
Important: In this example, the **average** pixel value for the frame is bright gray. Also note that sensors may show a much higher maximum or a much lower minimum pixel value due to one or more "hot or dead pixels". The sensor specification accounts for a small number of hot, stuck, or dead pixels (pixels that do not react to light over the full dynamic range specified for that sensor).

After the bright gray acquisition setup is done, note the camera position and lens iris position to be able to repeat it during the calibration procedure.

Using Flat Field Correction

The demo has typical file and acquisition controls as previously described for the Grab Demo. What is different is the Flat Field Correction control section which has three buttons and a check box. Follow the procedure described below to setup and use flat field correction.

Verify camera acquisition

First ensure that the camera is functioning and that the acquisition board is capturing live images. The Flat Field Demo provides acquisition controls to confirm image capture.

Enable

Before activating flat field or flat line correction, follow the calibration procedure described in this section (see "Flat Field Calibration "). To use real time flat field correction, first click in the **Enable** box. Then do image snaps or continuous live grab.

Save

Click on the **Save** button to store files with the flat field gain and offset data gathered with the calibration procedure. Files are saved as .bmp images and can be named as required to reference the camera used.

Load

Click on the **Load** button to retrieve files with the flat field gain and offset data gathered with the calibration procedure.

Flat Field Calibration

Calibration is the process of taking two reference images, one of a dark field – one of a light gray field (not saturated), to generate correction data for images captured by the CCD. Each pixel data is modified by the correction factor generated by the calibration process, so that each pixel now has an identical response to the same illumination.

The calibration process for an area scan camera can be over the whole frame or a selected number of lines within the frame. For line-scan cameras the user simply selects the number of input lines to average. The calibration control overview follows.

Click the **Calibrate** button. The calibration window opens as shown.
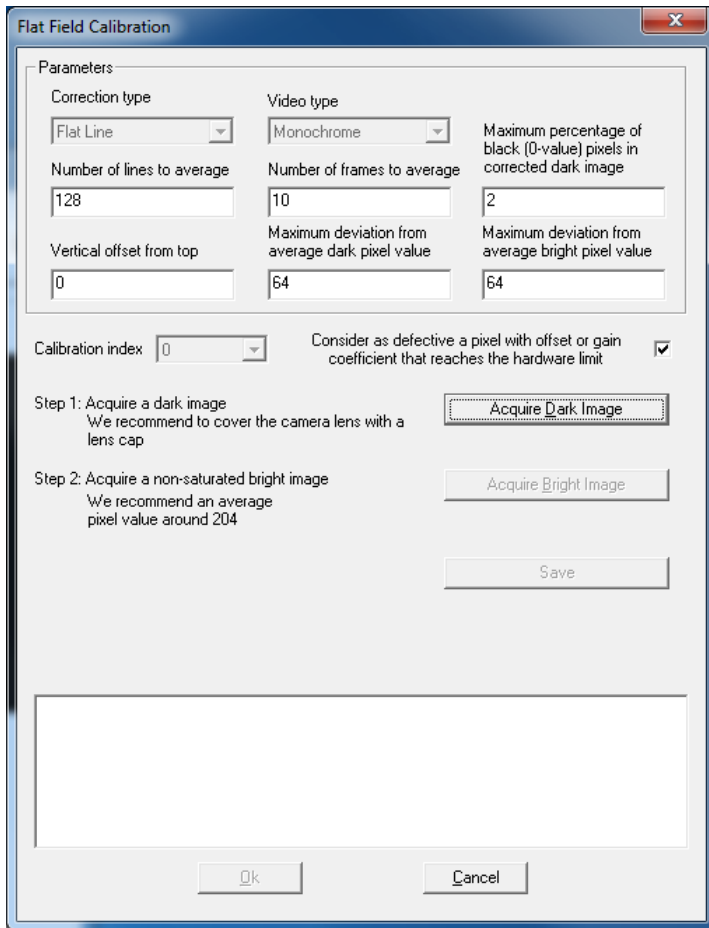
Setup Before Calibration

- First select the **Correction Type** as flat field or single flat line. Note that when using a line-scan camera, only flat line calibration is available.

- **Video type** will default to the acquisition type defined in the loaded camera file.

- Set the **Number of frames to average** during each calibration step. This should be set to more than one to avoid false data from random pixel noise.

- The field for **Maximum deviation from average** defaults to 25% of the gray level range captured, (64 for 8-bit capture, 256 for 10-bit capture, and so forth). This value sets the threshold for detecting static dead pixels – both dark or light. Users will need to adjust this field to best isolate dead pixels from their imaging source.

- The field for **Maximum percentage of black pixels in corrected dark image** defaults to 2. A high percentage of 0 value pixels should be avoided so that gain adjustments can be properly calibrated.

- When doing a single line calibration to apply to the captured frame, use the two selection fields **Number of lines to average** and **Vertical offset from top**, to select which video line will be used.

Calibration Procedure

- Setup the camera to capture a uniform dark image. Black paper with no illumination and the camera lens' iris closed to minimum can provide such a black image.
- Click on **Acquire Black Image**. The flat field demo will grab a video frame, analyze the pixel gray level spread, and present the statistics. If acceptable, use the image as the black reference.
- Setup the camera to acquire a uniform white image (but not saturated white). Even illumination on white paper can be used. It is preferable to prepare for the white level calibration before the calibration procedure.
- Click on **Acquire Bright Image**. The flat field demo will grab a video frame, analyze the pixel gray level spread, and present the statistics. If acceptable, use the image as the white reference.
- Test the calibration by enabling flat field correction during a live grab. If necessary, adjust the dead pixel detection threshold and repeat the calibration.
- Save multiple versions of calibration data to compare for best imaging or for different imaging setups.

Sapera Camera Compression Demo

The compression demo works with cameras with onboard image compression such as the Genie TS with JPEG firmware (model dependent). The demo allows activating the camera's compression function and decompresses the image stream to display on the host system monitor.

The demo program's decompression features are highlighted in the image below. The remaining buttons serve identical functions as found in many of the Sapera Demo programs.
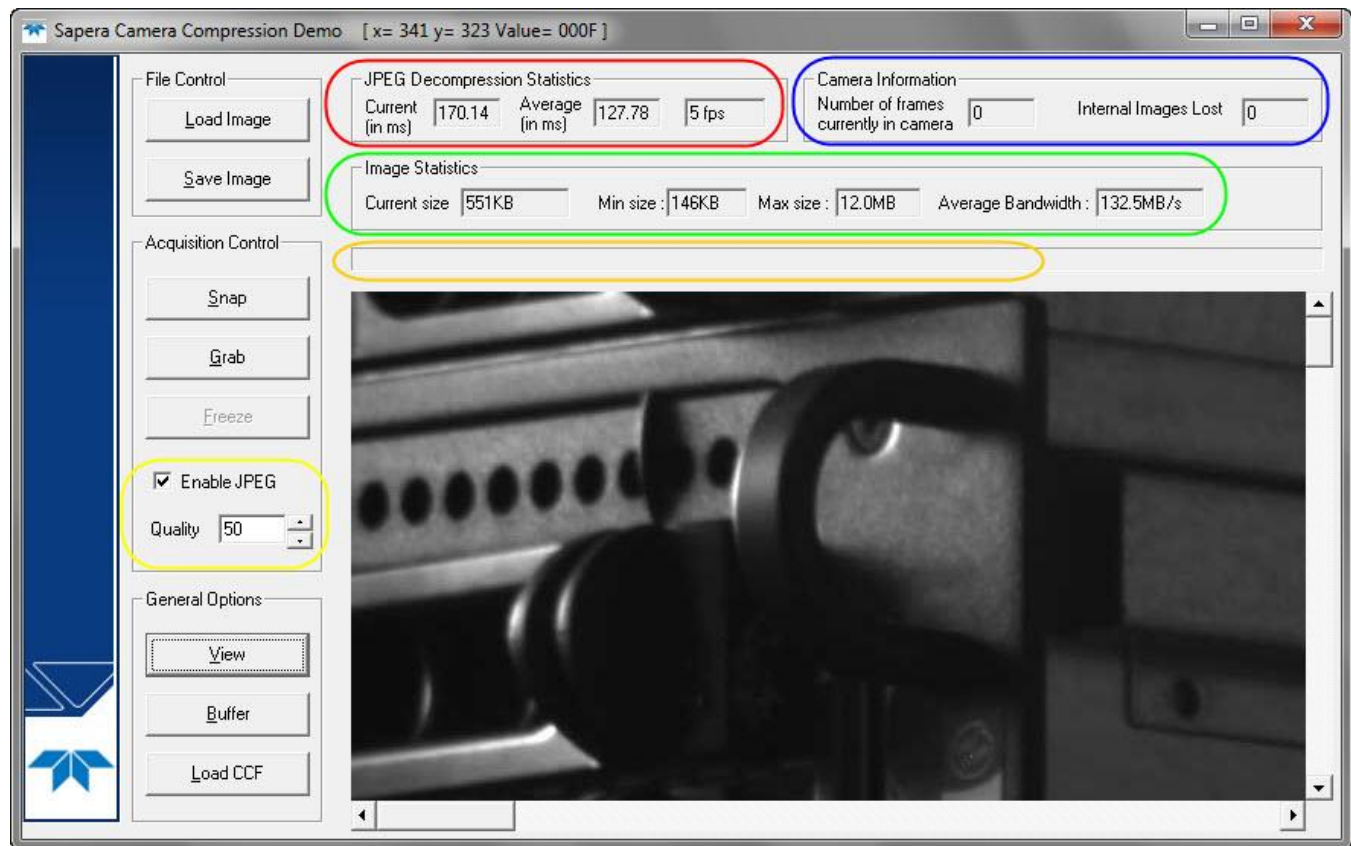
Enable JPEG

Enable the camera's JPEG compression function (yellow highlight) and select the image quality factor. The quality factor for a Genie TS ranges from:
- 1 (minimum quality/maximum compression)
- 99 (maximum quality/minimum compression)

JPEG Decompression Statistics

These three readouts (Red Highlight) provide information about the demo program's JPEG decompression performance. For a given camera and frame rate, different host computers and networks will show performance variations.

Image Statistics

The four readout fields (Green Highlight) provide real time information about the image data received from the camera. The current size and average bandwidth fields update live during the decompression, while the minimum and maximum fields provide feedback about image sizes after a change in the quality setting.
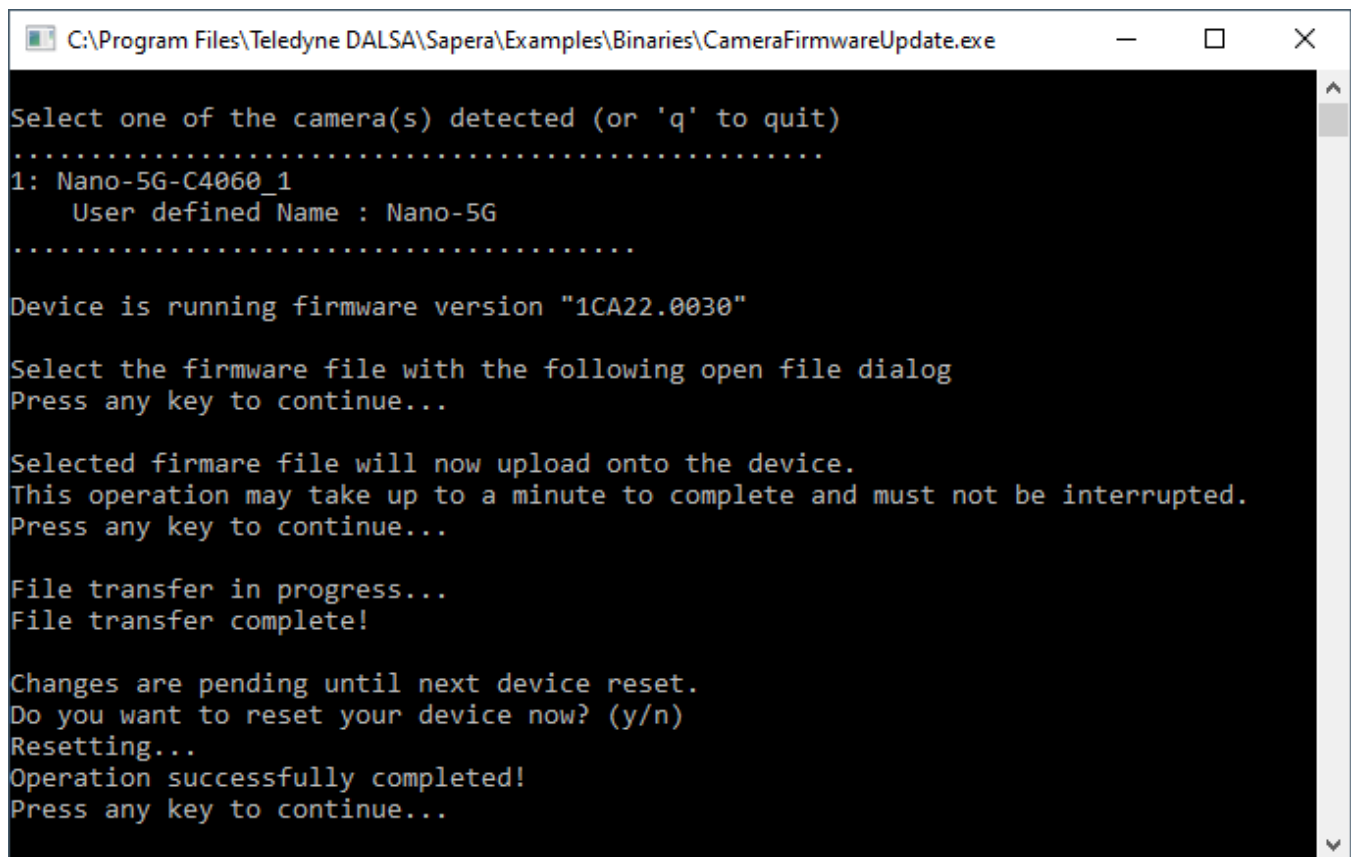
Camera Information

The two camera information fields (Blue Highlight) provide camera internal buffer information. The Genie TS used in this example has an internal circular buffer for outgoing image data in cases where the network or host computer are too busy to receive incoming packets. If the camera internal buffers are all filled and subsequent image frames overwrite previous frames, the image lost counter is incremented.

Message Area

The unlabeled field (Orange Highlight) can have messages about the demo program status, concerning non-typical events.

Camera Firmware Update Example

For Teledyne DALSA GigE cameras that support GenICam file access, the camera firmware update example demonstrates how to implement camera firmware updates and validation at the application level. This can be useful to ensure that cameras are equipped with the required firmware version certified for your system. The firmware version on the camera can be read (using standard SNFC features), validated and updated as required by your application.

| ⚠ | Note, all Teledyne DALSA GigE Vision cameras are designed with failsafe measures for the firmware update process. If, for any reason, the firmware update is interrupted, the camera will always revert to the previously installed firmware. |

Troubleshooting

Overview

In rare cases an installation may fail or there are problems in controlling and using the cameras. The GigE Server tray icon status provides visual information on possible camera problems. The three states are shown in the following table. Descriptions of possible conditions causing an installation or operational problem follow. Note that even a camera installation with no networking issue may still require optimization to perform to specification.

	No Device Detected	Device IP Error	Device Available
GigE Server Tray Icon: Note: It will take a few seconds for the GigE Server to refresh its state after any change.	A red X will remain over the GigE server tray icon when the device is not found. This indicates a network issue where there is no communication. *Or in the simplest case,* the camera is not connected.	The GigE server tray icon shows a warning when a device is connected but there is some type of IP error.	The GigE server tray icon when a camera is found and has obtained an IP address with no network issues. Optimization may still be required to maximize performance.

Why did the GigE Server Status Tray Icon Disappear?

After a normal installation without issues, the GigE Server Status Tray Icon may have suddenly disappeared. The user may have caused this unintentionally while exploring the features of the Teledyne DALSA Network Configuration Tool. Run the program again and click **Advanced** on the menu bar. Select the Use Sapera GigE Server item again and the Server Status Icon will reappear.
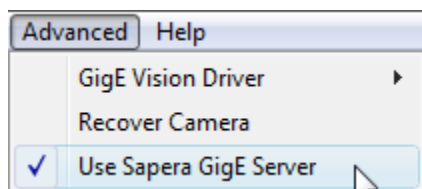
Problem Type Summary

Problems are either installation types where the device is not found on the network, or setup errors where the device is found but not controllable. Additionally, a device may be properly installed but network optimization is required for maximum performance.

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Problems are either installation types where the camera is not found on the network or setup errors where the camera is found but not controllable. Additionally, a camera may be properly installed but network optimization is required for maximum performance.

No Device Detected

A red X over the GigE server tray icon indicates that the camera is not found. This indicates either a major camera fault or condition such as disconnected power, or a network issue where there is no communication.

- Review the driver installation steps for the device.
- Refer to the Teledyne DALSA Network Imaging manual to review networking details.
- In multiple NIC systems where the NIC for the device is using LLA mode, ensure that no other NIC is in the same mode or switches to LLA mode. It is preferable that the Teledyne DALSA DHCP server is enabled on the NIC used with the device instead of LLA mode, which prevents errors associated with multiple NIC ports using LLA mode.
- Verify that your NIC is running the latest driver available from the manufacturer.

Device IP Error

The GigE server tray icon shows a warning with IP errors. Review the following topics on network IP problems to identify and correct the condition.

Multiple Camera Issues

- When using multiple cameras with a computer with multiple NIC ports, confirm each camera has been assigned an IP address by checking the GigE server.
- LLA mode can only be used for one NIC port. For other NIC ports use a DHCP server or persistent IP. For details see Warning Example 1a: IP error with multiple NICs and Warning Example 1b: IP error with multiple NICs.
- When using multiple cameras connected to an VLAN Ethernet switch, confirm that all cameras are on the same subnet setup on that switch.
- If a camera installed with other GigE Vision cameras cannot connect properly with the NIC or has acquisition timeout errors, there may be a conflict with the third-party camera's filter driver. In some cases, third party filter drivers modify the NIC properties such that the Teledyne DALSA Sapera Network Imaging Driver does not install. Verify such a case by uninstalling the third-party driver and installing the driver again.
- Verify that your NIC is running the latest driver available from the manufacturer.

Other IP Issues

- Warning Example 2: Subnet Mask or IP error
- Warning Example 3: Filter Driver Disabled

Device Available but with Operational Issues

A properly installed camera with no network issues may still not perform optimally. Operational issues concerning cabling, Ethernet switches, multiple cameras, and camera exposure are discussed in the following sections:

Always Important

- To reduce network traffic in problem free systems, use the Network Configuration tool to reduce camera discovery broadcasts. See Network Card Information and Configuration and System Information, Configuration.
- See Cabling and Communication Issues
- Conflicts with Third Party GigE Vision Drivers

Getting Timeout Messages

- See Acquisition Error with a Timeout Message
- Or specifically Disabling Windows Firewall

Other problems

- Review Ethernet Switch Issues, which covers some complex issues and pause frame flow control.
- The GigE Vision driver Auto-Discovery process does not generate Sapera connect/disconnect events for cameras on the subnet. With multiple cameras connected via an Ethernet switch to one NIC, the default auto-discovery interval may need to be shortened. See Sapera Disconnect-Reconnect Events are Lost for additional information.

Verifying Network Parameters

The Teledyne DALSA Network Configuration tool is used to verify and configure network devices and GigE vision camera parameters.

Before Contacting Technical Support

Carefully review the issues described in this Troubleshooting section. To aid Teledyne DALSA personnel when support is required, the following **status file** should be generated and included with the request for support.
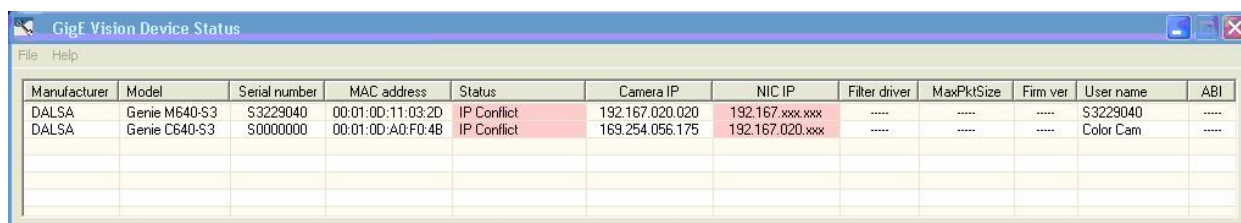
- Using the Teledyne DALSA network Configuration tool, the host computer network status file is generated by following the instructions Creating a Status Report.

Installation Issues and Functional Problems

This section covers issues that are apparent after installation or are indicated by the GigE server tray icon showing a warning symbol.

Warning Example 1a: IP error with multiple NICs

The screenshot below shows an IP conflict error due to two (or more) NICs that are all set to LLA mode. In this case both NICs are assigned the same IP subnet address preventing communication with any connected device.

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229040	00:01:0D:11:03:2D	IP Conflict	192.167.020.020	192.167.xxx.xxx	-----	-----	-----	S3229040	-----
DALSA	Genie C640-S3	S0000000	00:01:0D:A0:F0:4B	IP Conflict	169.254.056.175	192.167.020.xxx	-----	-----	-----	Color Cam	-----

- When multiple NICs are used, only one can be set to LLA mode. A second NIC connected to a camera must use the persistent IP mode or must have a DHCP server on that subnet (note that the Teledyne DALSA Networking Tool can function as the DHCP server). The following illustration shows such a setup.
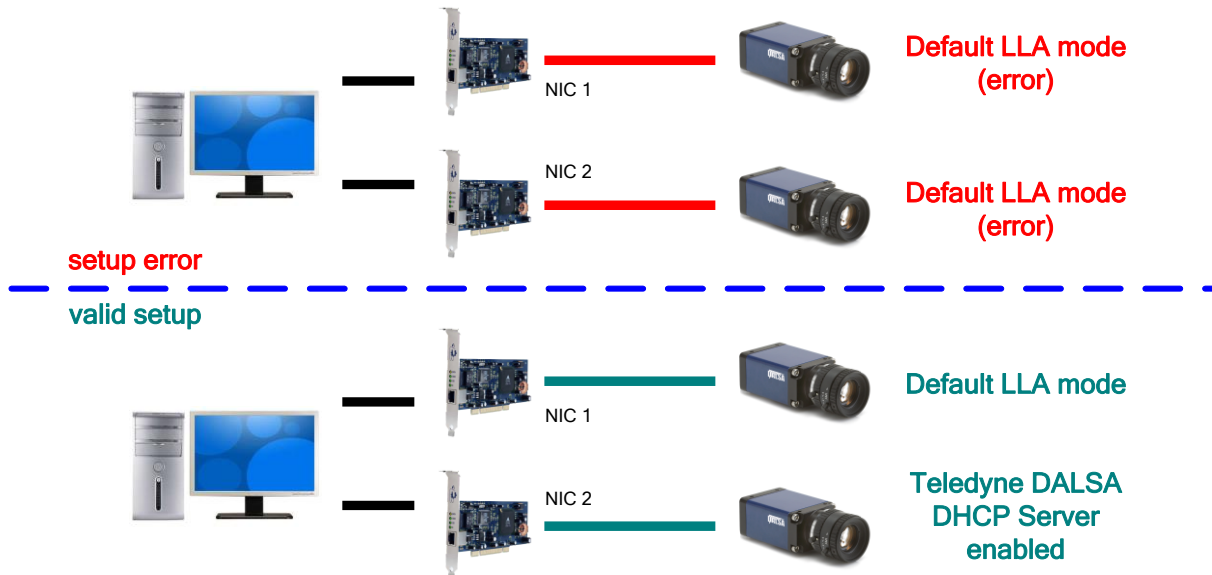
Warning Example 1b: IP error with multiple NICs

As a second example, the screenshot below shows an IP conflict error like the example above but the second NIC has no camera connected (only an Ethernet switch).

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229040	00:01:0D:11:03:2D	IP Conflict	192.167.020.020	192.167.xxx.xxx	-----	-----	-----	S3229040	-----

- The following illustration shows an example of this fault condition. The second NIC has no camera connected either directly or via a switch.
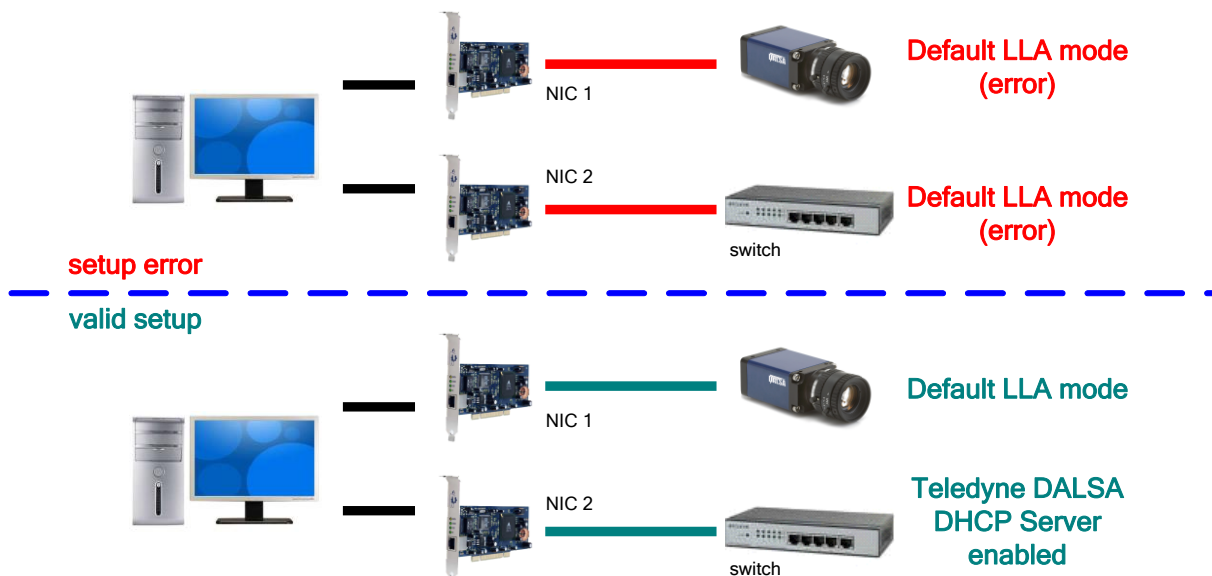
- The solution again is that the second NIC must use the persistent IP mode or must have a DHCP server (available from the Teledyne DALSA Network Configuration Tool) on that subnet.
- For more information see Ethernet Switch Issues and IP Configuration Mode Details.

Warning Example 2: Subnet Mask or IP error

The screenshot below shows that the camera device is not accessible. This IP error is an example of the camera being assigned a persistent IP address with an incorrect subnet mask.
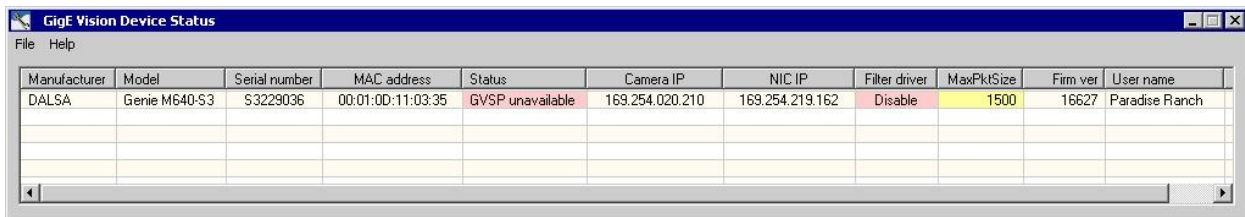
- This example error was made using the Teledyne DALSA Network Configuration tool, where the camera was set to Persistent IP mode with an incorrect subnet mask.
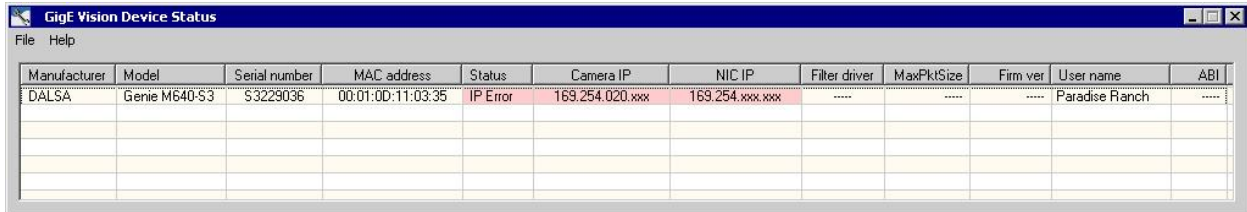- Once the incorrect setting was applied, the camera was not accessible to the Network Configuration tool or any application.
- The Teledyne DALSA Network Configuration tool provides a device recovery function to force the camera back to LLA mode. See the section Recovering a Camera with an Invalid IP.
- An alternative solution is to change IP address of the NIC to match the camera subnet. This might be preferable if a DHCP server is running on this segment.

Warning Example 3: Filter Driver Disabled

The screenshot below shows that the camera device was found but there is an issue with the filter driver (Teledyne DALSA Sapera Network Imaging Driver). Such problems occur because the filter driver has become disabled or never installed correctly.

- Verify that the Filter driver is enabled in the properties for the NIC used with camera. The screenshot below shows a typical installation.

- Information about the Teledyne DALSA Network Imaging Driver is also available from in the NIC Configuration tab of the Teledyne DALSA Network Configuration tool.

Device Available with Operational Issues

This section considers issues with applications, cabling, Ethernet switches, multiple cameras, and camera exposure.
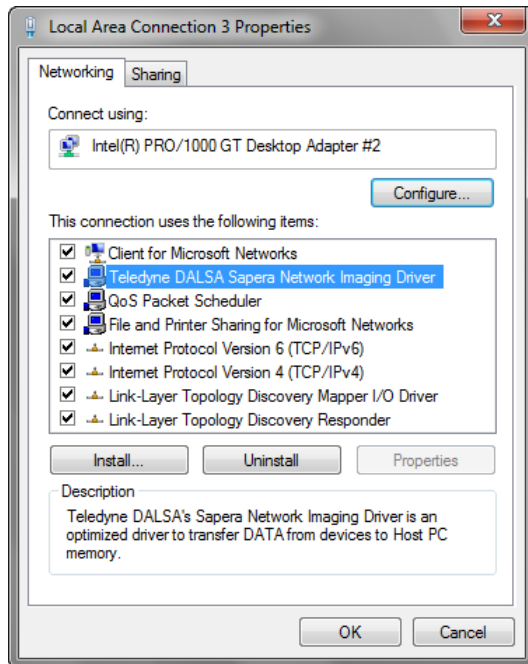
Sapera Disconnect-Reconnect Events are Lost

The GigE Vision server regularly polls for devices via GigE Vision DISCOVERY_CMD (Auto-Discovery). Cameras that are connected or disconnected generate Sapera events (EventServerAccessible / EventServerNotAccessible – see SapManager::RegisterServerCallback) for use by the application to identify cameras connected to a subnet. Polling is necessary because GigE cameras do not send a keep-alive signal back at a certain rate. It is thus the responsibility of the host software to poll (by design in the GigE Vision standard).

The Auto-Discovery interval is set by default to 15 seconds (see System Information, Configuration, and DHCP Server). If multiple camera disconnect / reconnect events occur between the polling interval, those events are lost. If an application must account for all events, the polling interval should be shortened when an Ethernet switch is used, especially since a switch masks the existence of connected devices.

But note that increased polling will increase network traffic and the polling interval may still not be short enough to guarantee that all quick camera disconnect /reconnects events will be seen.

Cabling and Communication Issues

Communication problems:

- Check that the Ethernet cable is clipped both to the camera and the NIC or switch on the other end.
- Use a shielded cable where the Hirose connector shell electrically connects the GigE Vision device chassis to the power supply earth ground. This can eliminate trigger issues in a high EMI environment.
- Verify the Ethernet cabling. Poor cables will cause connections to auto-configure at lower speeds. Ensure that the Ethernet cable is CAT5e or CAT6. This is very important with long cable lengths.
- Use a secured Ethernet cable in a high vibration environment.
- When using very long cables, up to the maximum specified length of 100m for gigabit Ethernet, different NIC hardware and EMI conditions can affect the quality of transmission.
- Minimum recommended Ethernet cable length is 3 feet (1 meter).
- Use the camera Ethernet status LED to confirm a gigabit connection. Note that a gigabit connection may still have many packet resends, rendering the connection useless. This condition has been seen with different NIC products.
- With Teledyne DALSA cameras, check the Ethernet status LEDs on the RJ45 connector (refer to each camera manual). The network speed indicator should show the expect connection speed and the activity LED should flash with network messages.
- Run the Sapera Log Viewer: **Start•All Programs•Teledyne DALSA•Sapera LT• Sapera Log Viewer**. Start the acquisition program, such as CamExpert. There should not be any "packet resend" messages; else this indicates a control or video transmission problem due to poor connections or extremely high EMI environments.

Conflicts with Third Party GigE Vision Drivers

There is a potential issue when the Teledyne DALSA GigE Vision driver is installed along with other third-party GigE Vision drivers. The installation proceeds without error and the device is seen by the Teledyne DALSA Network Configuration tool. But there is an error when attempting an image acquisition.

Uninstall or disable the third-party GigE Vision driver before using the Teledyne DALSA GigE Vision driver.

Acquisition Error with a Timeout Message

A streaming error is typical with a firewall not allowing the filter driver through. As an example, CamExpert will run (but start slowly due to initialization timeouts), the Genie is visible in the device pane, but no parameters are shown to control the camera.

- If the host computer is using a firewall, either add the GigE Server in the firewall exception list or disable the firewall completely on the NIC used only with the Genie. Review the following information on disabling Windows Firewall on the NIC used with Genie.
- Run the Sapera log viewer program. A firewall block is identified as a timeout event as shown in the following screen capture (the Genie identifier will match the Genie in use).
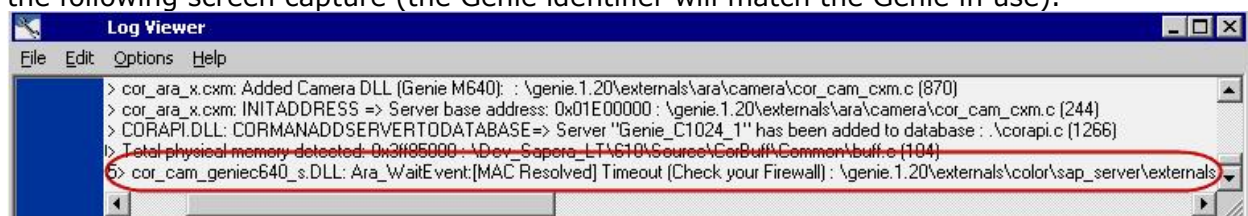
Disabling Windows Firewall

Connecting the Genie camera to a system running a firewall would require careful planning of the camera IP and the ports used by the streaming video and messaging. In general, the Genie camera is installed in a private network or within a corporate network with an external firewall. In both these cases, the host system that the Genie connects to does not need to run a firewall, therefore eliminating installation issues.

The Network Configuration tool automatically adds the Sapera GigE Server in the list of Exceptions of the Windows firewall. Therefore, in most situations, you don't have to take any special precaution to have the Genie run through the firewall.

The following figure shows how to turn off the Windows firewall when the computer is behind a corporate network firewall. Run the Windows firewall application from the start menu **Start • Control Panel • Windows Firewall**. If the host computer is running a firewall from a third party, review the program's documentation to disable its execution.
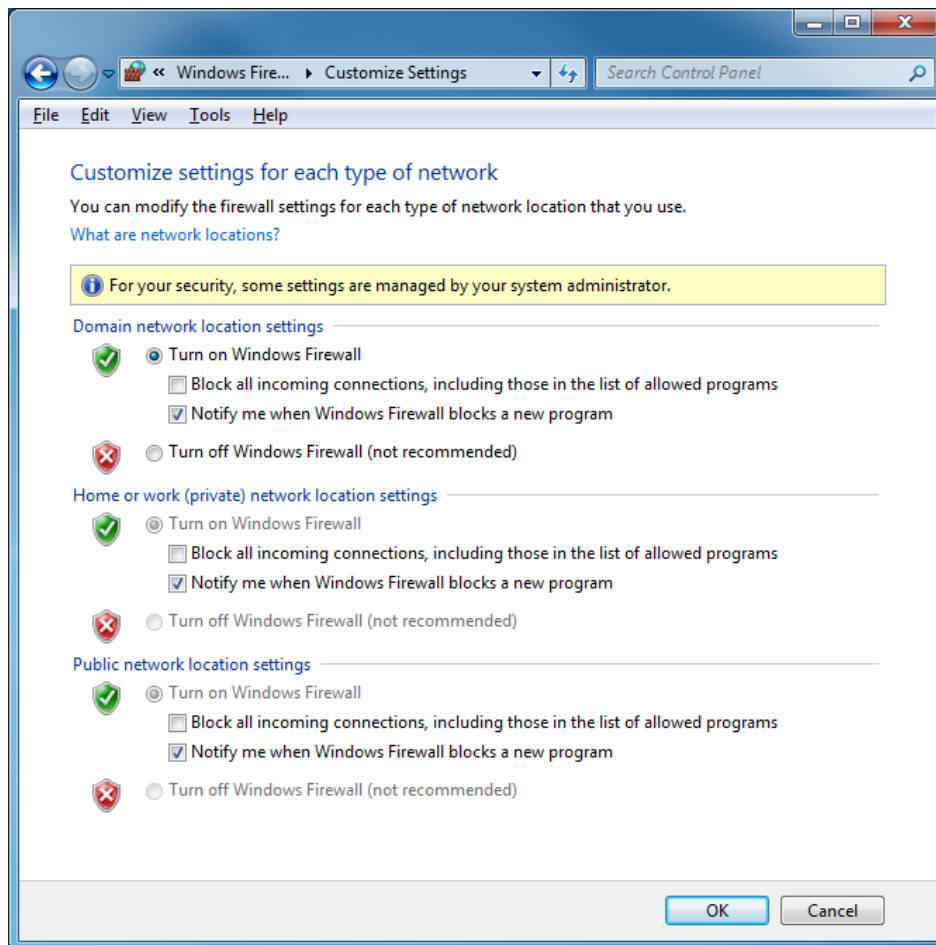
With a computer that is not behind a corporate firewall an alternative is to disable Windows firewall only for the network adapter dedicated for the Genie camera. Such a computer would have two or more network adapters where one NIC only connects to the Genie—never the Internet. You can use the Teledyne DALSA Network Configuration Tool to determine which network adapter is connected to the Genie.

The following figures show an example of the Windows firewall On but disabled for the network adapter used by Genie.
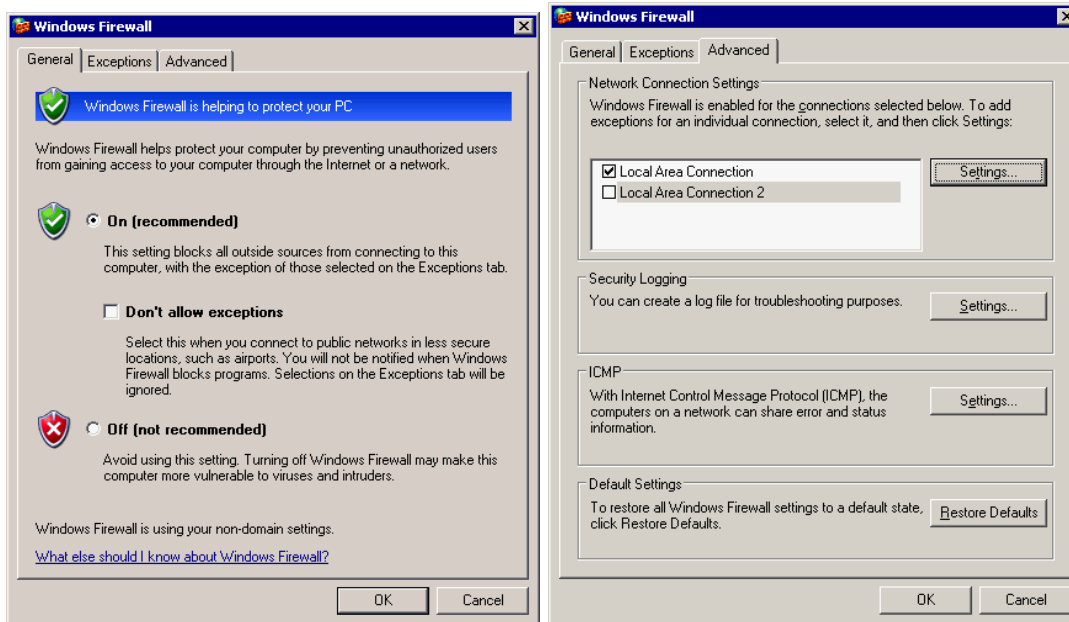
Grab has Random Bad Data or Noise

This issue has all but disappeared with current NIC technology but is mentioned to ensure solutions are available for most installations. The problem is seen as random noise and missing sections of video data from the acquisition. All configuration parameters seem correct and the Ethernet cable is secure. The following image shows an example of this type of bad acquisition while testing a Genie installation with CamExpert (with the Genie set to generate its internal test pattern).
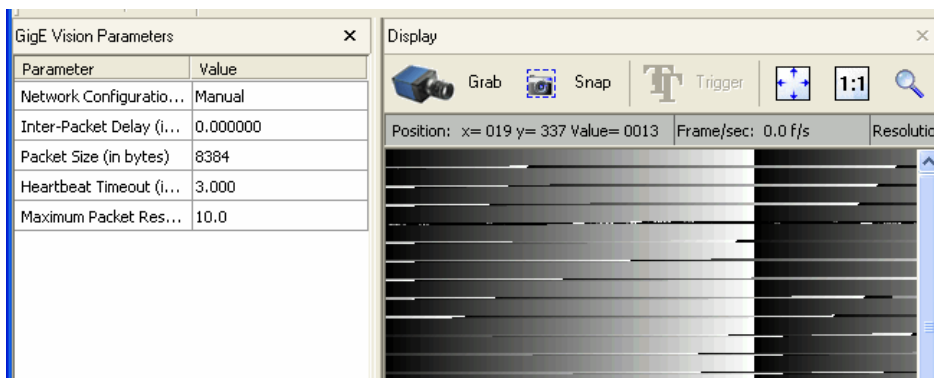
Following are various examples of this data transmission problem. The solutions vary but commonly involve reducing the maximum packet size claimed by the NIC used.

Grab has Random Bad Data or Noise – Case 1

- This problem has been seen on some computers where the NIC used does not fully support passing the maximum jumbo frame possible from the Genie.
- In the NIC configuration, keep the jumbo frame size set to the maximum allowed.
- When using a Teledyne DALSA camera with the Teledyne DALSA CamExpert tool, test for a good acquisition by reducing the camera packet size used via the GigE Vision optimization parameters. Also check for packet resend messages with the Sapera tool "Log Viewer".

Grab has Random Bad Data or Noise – Case 2

- This problem has been seen with network adapters using the Realtek RTL8169 chip and associated low-level driver. In this case the NIC reports a false maximum jumbo frame size.

- In the NIC configuration, set the jumbo frame size set to less than the maximum allowed. In this example the NIC reports supporting a maximum jumbo frame size of 8384 but good acquisitions are possible only when the size is reduced to 7k.
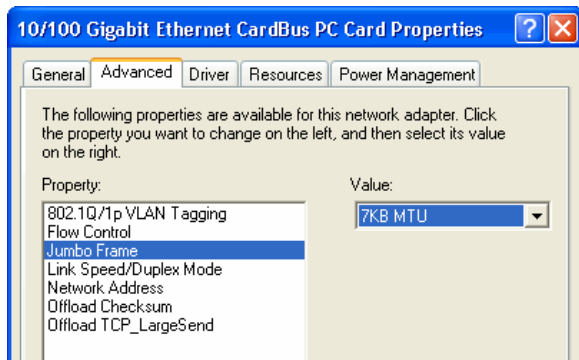
- When using a Teledyne DALSA camera with the Teledyne DALSA CamExpert tool, test for a good acquisition by reducing the camera packet size used via the GigE Vision optimization parameters.
- Verify there are no packet resend messages with the Sapera tool "Log Viewer".

Grab has Random Bad Data or Noise – Case 3

- This problem has also been seen with network adapters that do not support jumbo frames but still report a false maximum packet frame size.
- When using the Teledyne DALSA CamExpert tool, if the Network Configuration Mode is left as Automatic (default), CamExpert uses the value the NIC reports as its maximum. This maximum value is actually not supported.
- Test for a good acquisition by reducing the camera packet size used. Set the value to a starting value of 1500 to verify acquisition before trying a higher value.

Older Laptop Computer Networking Issues

This issue has all but disappeared with current NIC technology but is mentioned to ensure solutions are available for most installations. Laptop computers with built in GigE network adapters may still not be able to stream full frame rates from various cameras. Laptops with gigabit Ethernet PCMCIA boards may not be able to stream video at all unless network parameters are modified. Thorough testing is required with any laptop computer.

Streaming video problems may change depending on the computer chipset and NIC combinations. Laptops running on battery power may exhibit more bandwidth issues due to the inherent power saving characteristics of laptops.

This section describes a few configuration items to modify for best performance. Verify the GigE Vision device at the frame rates required or to determine the maximum frame rate possible with the laptop used.

Problems with Disconnecting NICs

GigE Vision cameras installed in environments with physical motion, vibrations, or high EMI may be disconnected by the NIC. The following items need to be reviewed to solve the problem.

- Motion or vibrations may cause data loss because the Ethernet cable connection is not secure. Use a locking Ethernet cable (see any Genie manual for information on locking Ethernet cables).
- High EMI may cause the NIC to drop data or to disconnect and reconnect at a lower data rate. Such situations do not have simple solutions and may require shielded Ethernet cables.
- Some NIC products may not tolerate any data disruptions. Any condition causing the NIC to drop the connection may make it unrecoverable. Communication cannot be reestablished without power cycling. In this case, trying a variety of NIC products is suggested.

Ethernet Switch Issues

An Ethernet switch usually works transparently and presents no problems. Review the following list when troubleshooting switch issues.

Basic Points for all Ethernet Switches
- Is the Ethernet switch powered on?
- Are all ports used configured as active; not disabled.
- Are all ports running at gigabit speeds–not low speed (i.e. not 10 or 100 Mbps).
- Is the switch configured to use or allow Jumbo Frames? Note that unmanaged switches cannot be configured; they either support jumbo frames or not.
- Verify the Ethernet cabling. Poor cables will cause connections to auto-configure at lower speeds.

More Complex Configurations
- When using a VLAN Ethernet switch, confirm that the GigE Vision camera and controlling computer are on the same VLAN group setup on that switch.
- When using a chain of switches, ensure that inter-switch connection speeds are the same (1000 Mbps).
- When using a multi-port switch with multiple cameras all grabbing, problems such as individual cameras randomly disconnecting point to a switch fault with high traffic configurations. Change the switch to one from a different manufacture or a later model. This condition was identified with an Advantech 8 Port Unmanaged Industrial Ethernet Switch EKI-2728 and the manufacturer claims to have resolved the issues with a revised version (internal identification: -BE).

Image Loss with Many Cameras Connected to one NIC
- Example: A large number of cameras are connected to one NIC and each camera works correctly when tested. But when all cameras are triggered simultaneously, images are lost from a number of cameras. In such a case the NIC maximum bandwidth is exceeded if there is no mechanism to temporarily hold back data from cameras. Genie cameras support the IEEE 802.3x pause frame flow control protocol automatically, therefore the solution is to use an Ethernet switch that supports flow control. See IEEE 802.3x Pause Frame Flow Control for additional information.

Appendix A: File Locations

The table below lists the different file groups and locations:

Directory	Contents
Network Interface	Sapera Network Imaging Package
Sapera	Sapera LT Readme and version history documents
	Third-party software licenses (for example, GenICam)
Sapera\Bin	Utility programs
Sapera\CamExpert	CamExpert frame-grabber and camera configuration utility
Sapera\Expert	Z-Expert 3D sensor configuration utility
Sapera\CamFiles	Camera configuration files for frame grabbers
Sapera\Classes	Sapera LT ++ header files (Basic and GUI Classes) Sapera LT ++ source code (GUI Classes only)
Sapera\Components\NET	.NET classes
Sapera\Demos	Source code for GUI-based demo applications
Sapera\Demos\Binaries	Executable files for GUI-based demo applications
Sapera\Examples	Source code for console-based demo applications
Sapera\Examples\Binaries	Executable files for console-based demo applications
Sapera\GenICam_2_4	GenICam CL Protocol run-time support for Teledyne DALSA CameraLink cameras
Sapera\Help	On-line documentation (Compiled HTML and PDF formats)
Sapera\Help\VisualStudio	Integrated C++ and .NET help for Visual Studio 2010, 2012, 2013, 2015, and 2017
Sapera\Images	Images files used by demos and examples
Sapera\Include	Header files for C libraries
Sapera\Lib	Import libraries for Microsoft and Borland (Embarcadero) compilers
Windows\system32 directory	Dynamic Link Libraries (DLLs)
Windows\system32\drivers directory	Device drivers

Appendix B: Supported Image Formats

The table below lists the image formats currently supported by the Teledyne DALSA Network Imaging Package.

PFNC Format	Sapera Data Format
Coord3D_C16	SapFormat.COORD3D_C16
Coord3D_AC16	SapFormat.COORD3D_AC16
Coord3D_ACRW16	SapFormat.COORD3D_ACRW16
Mono8 BayerGR8 BayerRG8 BayerGB8 BayerBG8	SapFormat.Mono8
Mono16 BayerGR10 BayerRG10 BayerGB10 BayerBG10	SapFormat.Mono16
BGR16	SapFormat.RGB161616
BGRY16	SapFormat.RGB161616_MONO16
BGR16	SapFormat.RGB16161616
BGRa5551	SapFormat.RGB5551
BGR565	SapFormat.RGB565
BGR8	SapFormat.RGB888
BGRY8	SapFormat.RGB888_MONO8
BGRa8	SapFormat.RGB8888
RGB16_Planar	SapFormat.RGBP16
RGB8_Planar	SapFormat.RGBP8
YUV422_8_UYVY	SapFormat.UYVY
YUV422_8	SapFormat.YUY2

Contact Information

The following sections provide sales and technical support contact information.

Sales Information

Visit our web site:	www.teledynedalsa.com
Email:	mailto:info@teledynedalsa.com

Technical Support

Submit any support question or request via our web site:

Technical support form via our web page:	
Support requests for imaging product installations	
Support requests for imaging applications	http://www.teledynedalsa.com/en/support/options/
Camera support information	
Product literature and driver updates	

When encountering hardware or software problems, please have the following documents included in your support request:

▪ The Sapera Log Viewer .txt file

⚠	Note, the Sapera Log Viewer and PCI Diagnostic tools are available from the Windows start menu shortcut **Start•All Programs•Teledyne DALSA•Sapera LT**.