GCT 2.0 | Manual

R02 / 2021-06-16

Table of Contents

1 Introduction

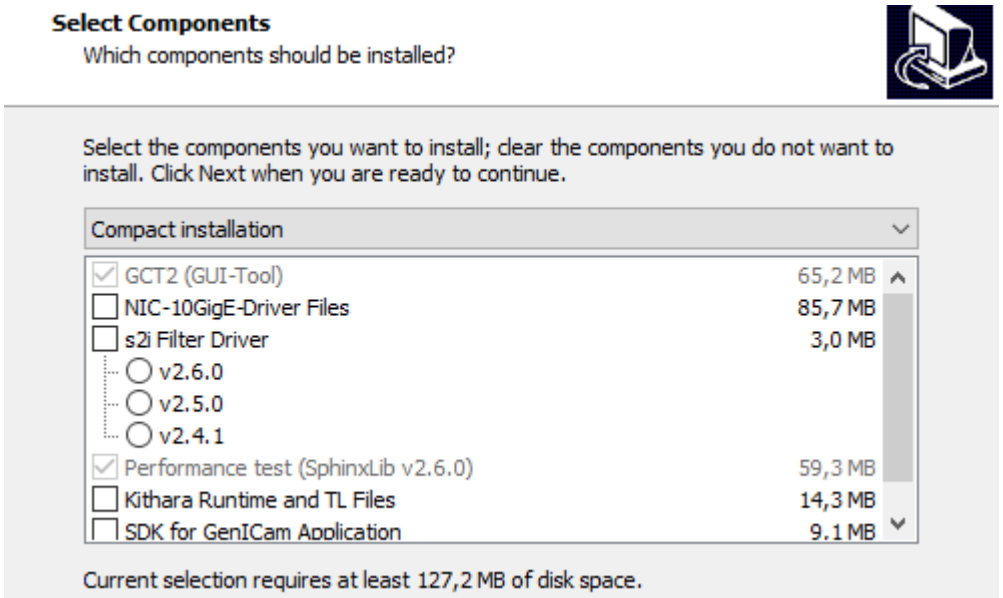
1.1 What is GCT v2.x

The GenICam Control Tool (GCT) permits to communicate with cameras which fulfil the GenICam standards. GCTv2.x is the successor product of GCT v1.x. It uses the transport layer interface and provides more features.

1.2 Installation of GCT v2.x

The installation program can be downloaded from https://www.chromasens.de/gct2-current

GCT v2.x does not require the installation or uninstallation of GCT v1.x. Both can exist parallelly on the PC. If GCT v2.x was already installed before, an information will indicate you to overwrite the previous version of v2.x.



There are six components for the installation.

1. The first component is GCT and it is a mandatory part.
2. The second component (`NIC-10GigE-Driver-Files`) copies the installer program for the driver files of the Intel-supported GigE network adapters to the PC. If your network adapter meets the criterion, you can select this component. The adapter driver can be started manually later. It will not be executed automatically during GCT installation.
3. If the third component (`s2i Filter Driver`) is selected, the filter driver will be installed. If no filter driver is installed, or an older version is installed, you can select this component. If the one of the listed versions of the s2i filter driver file is already installed, you don`t need to select it.
4. Performance test provides a batch file that permits to test the image data transfer.
5. Kithara Runtime and transport layer files. Select this component for installation only if the Kithara Realtime should be applied to the camera. For more information about Kithara, refer to chapter 12.
6. SDK for GenICam Application. If this component is selected, the corresponding headers, library files, documents and sample code of SDK are installed.

For the components `NIC-10GigE-Driver Files` and `s2i Filter Driver`, the required installation files are copied by default to the folder `C:\Program Files\Chromasens\GCT\drivers` if the respective component is selected.

The s2i filter driver is normally installed automatically if the component is selected. To change/uninstall the s2i filter manually later or to install the NIC-10GigE driver, you must start the respective batch- or exe-file in its subfolder and reboot the PC as needed. In addition, a change in the BIOS settings is needed before the very first installation of s2i filter driver, as described in section 1.4.1

1.3 System Requirements

Hardware requirements:

- A GenICam-standard camera
- If Evo-Kamera is used, 10-Gigabit Ethernet network interface card (also known as 10Gb NIC) and 10-Gigabit Ethernet cable
- If SWIR-Kamera is used, 1-Gigabit Ethernet network interface card (also known as 1Gb NIC) and 1-Gigabit Ethernet cable
- Intel Core i7 or higher
- 16GB RAM or higher

Software requirements:

- Win10 x64 bit operating system
- If Evo-Kamera is used, driver of 10-Gigabit Ethernet network interface card
- If SWIR-Kamera is used, driver of 1-Gigabit Ethernet network interface card

1.4 Setup of the 10-GigE or 1-GigE adapter

1.4.1 General preparation

If the component **s2i Filter Driver** is selected during installation, it is installed automatically from the installer. If you want to change the filter driver manually afterwards, refer to section 1.4.1.1.

1.4.1.1 Installing the s2i filter driver

To be able to apply the s2i filter driver in GCT, at least version 2.4.0 of the filter driver must be installed (V2.5 is recommended). The batch files for installation and removal can be found in the folder:
`C:\Program Files\Chromasens\GCT\drivers\s2iFilterDriver`.

If an older version is installed, for example V2.1.4, it should be updated.

To remove an older version of the s2i filter driver:

1. Run the batch file `UninstallFilterDriver.bat`.
2. Reboot the PC.
3. In the folder `C:\windows\system32\drivers` remove the file `s2iGEVFilter.sys` if it is still present.

To install the s2i filter driver:

1. Run the batch file `InstallFilterDriver.bat` as administrator.
2. Reboot the PC.

For more information, refer to the instruction `HowTo_Install_Driver_Windows.pdf` in the folder `C:\Program Files\Chromasens\GCT\drivers\s2iFilterDriver`.

1.4.1.2 Disabling Secure Boot

Secure Boot must be disabled in the BIOS settings. To access the BIOS settings, you must press the BIOS key of your PC, while the PC is starting. The BIOS key could be **F10**, **F2**, **F12**, **F1,** or **DEL**, depending on the manufacturer of the mainboard.

1.4.1.3 Connecting the camera

Connect the required Gigabit Ethernet cable(s) to the network adapter. If a teaming should be configured, you should connect both cables to the network adapter and then power up the connected camera.

1.4.2 Setup for adapters supported by Intel driver under Windows 10 64-bit

If the following conditions are fulfilled, the setup can be performed using a Powershell script as described below:

- 10-GigE adapter (for Evo-Cameras) supported by an Intel driver
- Windows 10 64-bit

  Or
- 1-GigE adapter (for SWIR-Cameras)

Otherwise, the setup of the network adapter must be performed as described in section 1.4.3.

To setup the adapter using the Powershell script:

1. If 10-GigE adapter is used, install the intel driver for 10-GigE network adapter manually.

   By default, the network adapter driver can be found in the folder `C:\Program Files\Chromasens\GCT\drivers\NIC-10GigE\Win10` if the option **NIC-10GigE-Driver Files** was checked during GCT installation. The newest driver version can be also downloaded from the Intel website under https://downloadcenter.intel.com/de/download/25016/Intel-Network-Adapter-Driver-for-Windows-10.

   Double-click the executable network adapter driver to run its installation.

   If 1-GiE adapter is used, the driver is probably already installed by windows itself.

   Start Windows PowerShell as administrator. Windows 10 comes with a Cortana search box in the taskbar. Just type `powershell` in the search box. Right-click on **Windows PowerShell** on the results, select **Run as administrator**, and confirm with **Yes**. Then type the following row in the PowerShell console window to run the PowerShell script `config10GigE.ps1` (if 10 GigE adapter should be configured) or `config_1GigE.ps1` (if 1 GigE adapter should be configured)

   C:\Users\Public\Documents\Chromasens\GCT\config10GigE.ps1

   C:\Users\Public\Documents\Chromasens\GCT\config_1GigE.ps1

2. According to displayed hint, enter **y** or **n**, to setup for each adapter connection, or to create a teaming (i.e., link aggregation) group:

```
PS C:\users\Public\Documents\Chromasens\gct> .\config10GigE.ps1
This program configures the 10 GigE network connections.
A teaming can be created optionally if the network interface card is supported by intel driver.
==========================
Start IntelNetCmdlets...
IntelNetCmdlets is started.
==========================
Detecting existing teaming group(s)
Found following teaming group(s). If you want to setup network interface card for evo-camera, it is recommended to remov
e existing teaming group.


TeamName         : Gruppe:  LAG
TeamMembers      : {HPE Ethernet 10Gb 2-port 560SFP+ Adapter #2, HPE Ethernet 10Gb 2-port 560SFP+ Adapter}
TeamMode         : StaticLinkAggregation
PrimaryAdapter   : NotSet
SecondaryAdapter : NotSet



==========================
Do you want to remove  Gruppe:  LAG  which contains  HPE Ethernet 10Gb 2-port 560SFP+ Adapter #2 HPE Ethernet 10Gb 2-por
t 560SFP+ Adapter ?
[y/n] Please enter the key 'y' for 'yes', or 'n' for 'no'.
```

If a teaming group (link aggregation) exists already, you must remove it first before starting a new setup. In this case, enter **y**.

```
 2  10 Gigabit Ethernet connection(s) are found.

InterfaceDescription                        Name             Speed Index
--------------------                        ----             ----- -----
HPE Ethernet 10Gb 2-port 560SFP+ Adapter    Ethernet 3 10000000000     0
HPE Ethernet 10Gb 2-port 560SFP+ Adapter #2 Ethernet 4 10000000000     1


============================
Do you want to setup for  Ethernet 3 ?
[y/n] Please enter the key 'y' for 'yes', or 'n' for 'no'.
```

```
Do you want to setup for  Ethernet 4 ?
[y/n] Please enter the key 'y' for 'yes', or 'n' for 'no'.
```

Depending on which of the both Powershell scripts is executed, all the 10-GigE or 1-GigE adapter connections will be listed. If only a single connection will be used, then chose this connection to perform the setup. If a teaming will be used, then perform the setup for both connections.

```
Do you want to create teaming from two 10 GigE network adapters?
[y/n] Please enter the key 'y' for 'yes', or 'n' for 'no'.
```

Then decide whether a teaming should be created. (By default, teaming is not necessarily needed.)

If no teaming is needed, then enter **n** to skip the teaming setup. A hint will let you enter an IP address for a single connection. Then the setup of the network adapter is finished. Otherwise, if a new teaming should be created, enter **y**.

```
Current Available 10 GigE network adapters are displayed as below
==========================

InterfaceDescription                        Name             Speed Index
--------------------                        ----             ----- -----
HPE Ethernet 10Gb 2-port 560SFP+ Adapter    Ethernet 3 10000000000     0
HPE Ethernet 10Gb 2-port 560SFP+ Adapter #2 Ethernet 4 10000000000     1


==========================
Please enter the index of the first 10 GigE network adapter of the teaming group.
0
Please enter the index of the second 10 GigE network adapter of the teaming group.
1
The two 10 GigE network adapters  Ethernet 3 ( HPE Ethernet 10Gb 2-port 560SFP+ Adap
 10Gb 2-port 560SFP+ Adapter #2 ) will build a teaming now...
==========================
Please enter a name of the teaming, which will be created.
TestTeaming
```

Then type each index of both connections from which a teaming should be built. The index values are listed above. In this example, we can see that the available connections have index 0 and 1.

Then give the teaming a name, and at the end enter the IP address for teaming. Now the setup of adapter with teaming is finished.

If the IP-address of some adapters should be configured, you will be asked to enter y for those adapters. You can enter the IP-address, then enter **2** (for subnet mask 255.255.0.0) or enter **3** for (subnet mask 255.255.255.0) to finish the ip configuration.

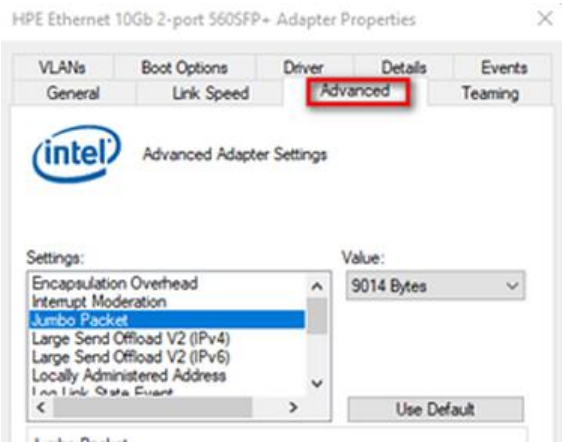
```
Do you want to set IP address for a single connection?
[y/n] Please enter the key 'y' for 'yes', or 'n' for 'no'.
y
Current Available 1 GigE network adapters are displayed as below
==========================

InterfaceDescription                    Name            Speed Index
--------------------                    ----            ----- -----
Intel(R) Ethernet Connection (5) I219-LM Ethernet   1000000000     0
Intel(R) Gigabit CT Desktop Adapter      Ethernet 6 1000000000     1


==========================
Do you want to set IP address for  Ethernet ?
[y/n] Please enter the key 'y' for 'yes', or 'n' for 'no'.
y
Please enter the ip address for connection  Ethernet
For Evo-camera, the ip address of adapter should be set to 169.254.100.xxx. And xxx is not equal 100.
For SWIR-camera, the ip address of adapter should be set to 192.168.100.xxx. And xxx is not equal 10.
192.168.100.113
[2/3] Please enter 2 for subnetmask 255.255.0.0 or enter 3 for subnetmask 255.255.255.0.
3
```

1.4.3 Setup for adapters not supported by Intel driver or under Win 7 64-bit

In contrast to section 1.4.2, this section is now oriented to the network adapters, which are not supported by Intel, or the operating system is Win7 x64. Setup depends on the adapter manufacturer. Normally you need to install the driver of your own 10-GigE adapter first, then set parameters with proper values manually, and create a teaming group if necessary. The GUI of setup can vary from adapter to adapter. The following setup is just an example.

To setup the adapter manually:

1. On the Windows **Start** menu, click **Settings**.
2. In the **Settings** window, click **Network & Internet**, and then click **Change adapter options**. The **Network Connections** window opens.
3. Right-click one ethernet connection of the Gigabit Ethernet network card, and then click **Properties**. The Properties dialog box opens.
4. Click **Configure**, and then click the **Advanced** tab. The available parameters may vary and are depending on the adapter.



5. Set proper values for the relevant parameters:

Attribute name (English)	Attribute name (German)	Value
Interrupt Moderation	Interrupt-Drosselung	Enabled
Jumbo packet	Jumbo Packet	9014 Byte
Large-Send-Offload V2(IPv4)	Large-Send-Offload V2(IPv4)	Enabled
Large-Send-Offload V2(IPv6)	Large-Send-Offload V2(IPv6)	Enabled
Direct Cache Access	Direct Cache Access	Enabled
Receive Buffers	Empfangsbuffer	Max (e.g. 4096)
Flow control	Flusssteuerung	Disabled
Interrupt Moderation Rate	Interrupt-Drosselungsrate	Adaptive
Low Latency Interrupts	Low Latency Interrupts(LLIs)	Disabled
Transmit Buffers	Übertragungspuffer	Max (e.g.16384)
Rx and Tx from Offloading Options	Rx und Tx von Offload-Optionen	Enabled
Receive Side Scaling	RSS (Empfangseitige Skalierung)	Enabled
RSS queues	RSS-Warteschlangen	2
Log Link State Event	Verbindungsereignis protokollieren	disabled

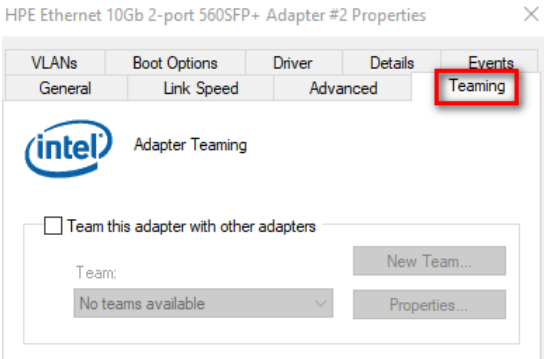
6. In the Network Connections window, for both 10-GigE network adapter connections, right-click it, click **Properties**, click the **Network** tab, and only enable **s2i GigE-Vision Filter Driver** and **Internet protocol version 4 (TCP/IPv4)**.

7. If only one cable is used for image data transfer, then this step can be skipped. But for users who use two cables to connect the camera without dual single link, a teaming (alias link aggregation) group must be set extra.

   a. Set same parameter values for both connections of the Gigabit Ethernet network card as described in step 5.

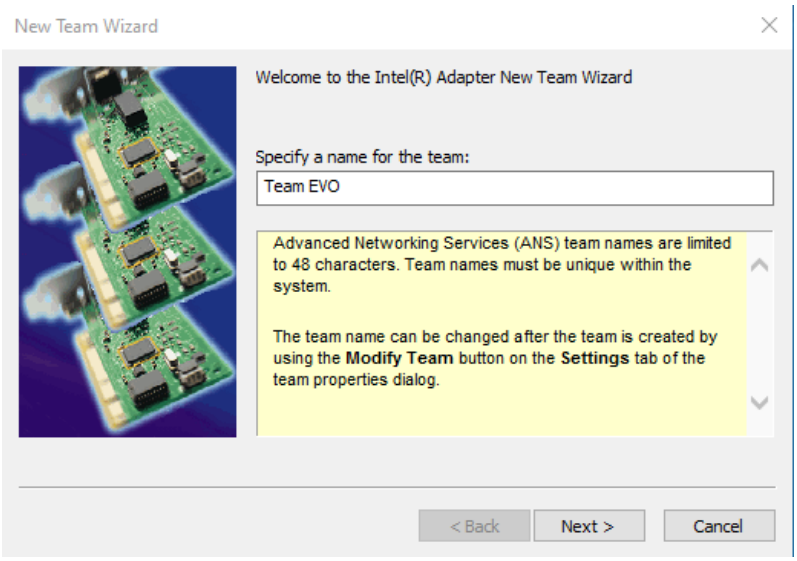
   b. After setting the parameters for both connections, choose one connection, right-click and click **Properties**.

      Click **Configure** and click the **Teaming** tab. The position of this tab and the teaming wizard can also vary and depend on the adapter. If you still cannot start the teaming wizard, please contact the adapter manufacturer.

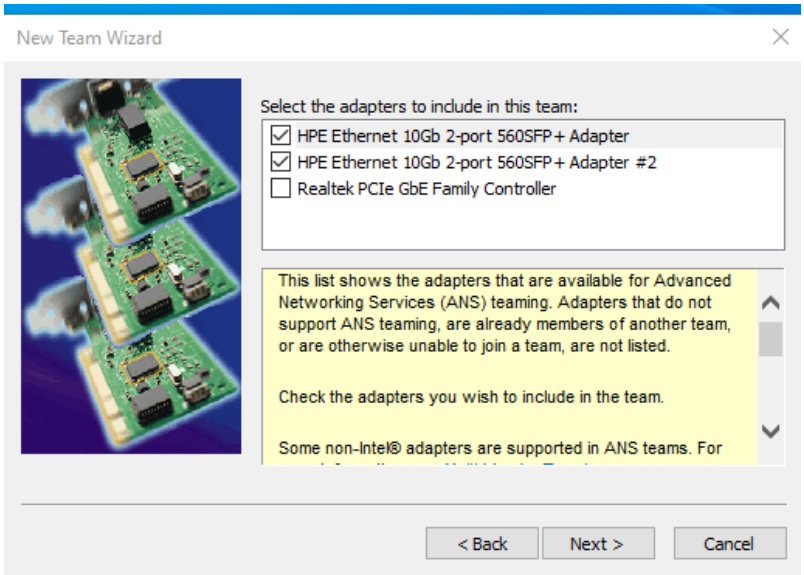


   c. Select the **Team this adapter with other adapters** check box (German description: **Diesen Adapter einer Gruppe mit anderen Adaptern zuordnen**)

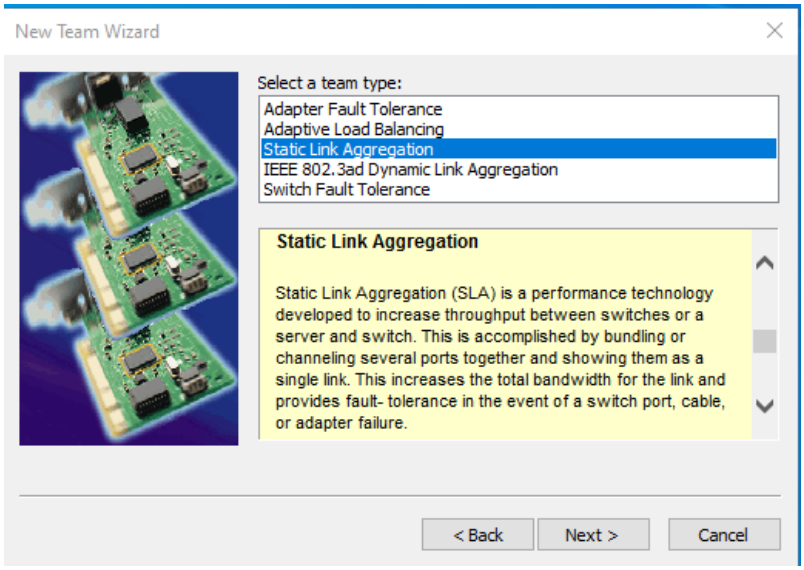
   d. Click **New Team…**, and enter a name for the teaming group (for example **Team EVO**) and then click **Next**:



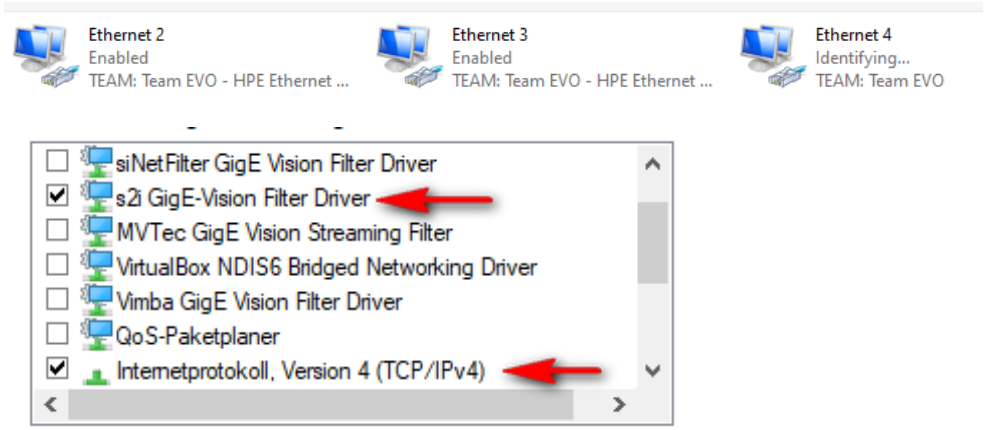
   e. Select both connections of the ethernet adapter and then click **Next**:



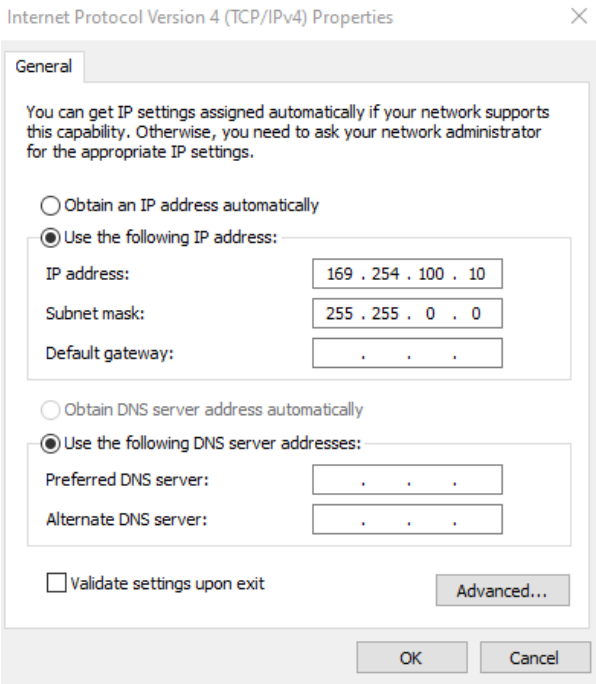
f. Select **Static Link Aggregation**, click **Next**, and then click **Finish**.



g. A new ethernet connection **Team EVO** is now created. Enable only the options **s2i GigE-Vision Filter Driver** and **Internet Protocol version 4 (ICP/IPv4)** for this new created connection:



8. Set the IP address:
    a. If a teaming group has been configured, right-click the connection of the teaming group. Otherwise, right-click the configured ethernet connection of the Gigabit Ethernet adapter (for example HPE Ethernet 10Gb 2-port 560SFP).
    b. Click **Properties**.
    c. Select the **Network** tab.
    d. Select **Internet Protocol version 4 (TCP/IPv4)** and then click **Properties**.
    e. Select Use the following IP address and set the IP address to 169.254.100.x (x NOT equal 100.)
    f. Set **Subnet mask** to 255.255.0.0 and then click **OK**.



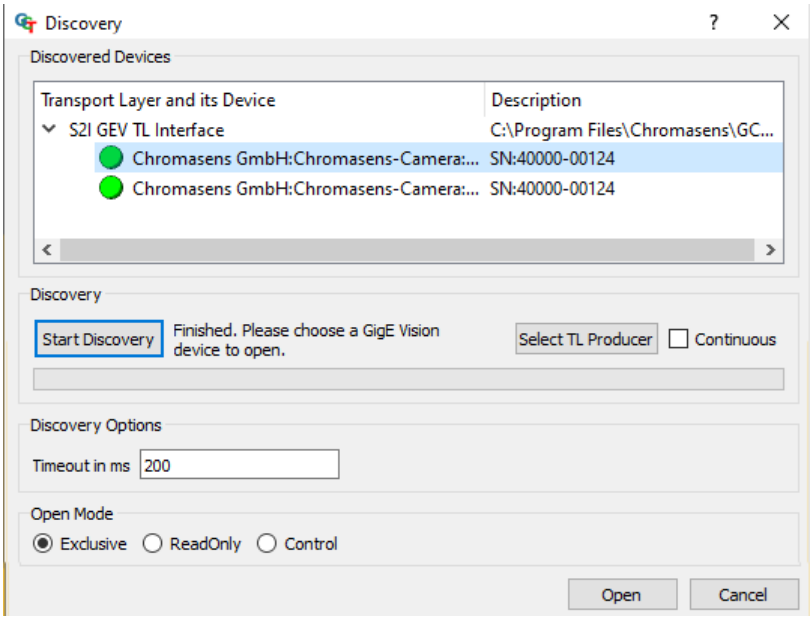
2 Connecting the camera

To be able to access the camera, GCT needs to create a connection to the camera and to download an XML file that specifies the camera interface.

To connect the camera:

1. Switch on the camera. Initialization can take up to about 40 seconds.
2. Start GCT.
3. Click on toolbar **Run device discovery**  , or from menu **Camera** -> **Discovery**, or use hotkey **Ctrl+D**

   The **Discovery** dialog box opens and in the **Discovered Devices** list shows information about the detected camera. If the camera is not found, wait a few seconds, and then click **Start Discovery**.
4. In the **Discovered Devices** list, select the camera, and then click **Open**. GCT now downloads the file with the camera interface specification, which takes a few seconds. Afterward, the **Discovery** dialog box is closed, and the available camera parameters are shown in a tree structure on the left side.



The camera discovery is controlled by several parameters and options, which can be modified if necessary:

Parameter	Default value	Description
Timeout	200 msec	If no camera can be found in the specified time, the discovery process stops and the dialog shows "`No GigE Vision device has been found`." This value can be adjusted.
Continuous	Disabled	If you select this check box, the discovery process is repeated until you stop it.
Open Mode	Exclusive	Specifies how the camera should be opened.

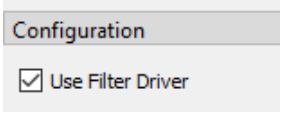
Select TL Producer	The producer(.cti) files present in the “GENICAM_GENTL64_ PATH” folders will be listed and selected	Producer file, which should be used to detect and communicate with the camera.

3 Disconnecting the camera

After the camera is connected, the **Discovery** button is replaced by a **Disconnect**  button. Click this button to unlink the connection. This can be also done by clicking menu **Camera** -> **Disconnect** or using hotkey **Ctrl+D**. If you want to disconnect the camera while it is grabbing images, it is recommended to stop the grabbing process completely before you click **Disconnect**. The disconnection progress may take several seconds, due to the cleanup of generated temporary data in background.

4 Grabbing images

If the producer file `GEVTLS2I.cti` (by default) is used to discover and connect the camera, the option **Use Filter Driver** is present below the feature tree. If a different transport layer file is used, this option is not present.



Capturing image is the main function of a camera. There are several parameters which influence the grabbing process.

Explanation of “filter driver”:

Quoted from: https://www.stemmer-imaging.com/en/knowledge-base/gige-vision-driver-implementation/

Due to the fact that the GigE Vision standard is a mere protocol description, generic driver implementations are possible. The simplest and most portable solution is to use the operating system IP network stack. This is often referred to as socket driver because all large operating systems provide the socket interface for network access (e.g., Windows Sockets or POSIX Sockets). However, normally this solution offers the poorest performance.

Improvements are available by adopting the so-called high-performance or filter drivers. Typical of both driver types is that they bypass the generic operating system network stack to provide better performance by specialized implementation. The driver runs in the operating system kernel and can therefore work on network data with the highest priority. Image data compilation already occurs in the driver and the image as a whole is transferred to the application. Because the network stack is bypassed, less CPU capacity is bound up and data security improves (fewer lost packages) due to the higher CPU priority. Even if the implementation of both driver types is different (driver directly for one network chip or generically for all network cards in the Windows filter stack), both offer the same improved performance for the protocol structure of GigE Vision.

4.1 Parameters

Parameter	Position	Comment
Use Filter Driver	Configuration area of GCT	Default value: Enabled. Present if `GEVTLS2I.cti` producer file is used
Image Width	In xml tree: Image Format Control -> Region Selector -> Width	Ensure that **Region Selector** has the value **Region 1** and that its **Region Mode** is set to **On**. **Region 2** is in most cases unavailable except in dual single link applications.
Image Height	In xml tree: Image Format Control -> Region Selector -> Height	Ensure that **Region Selector** has the value **Region 1**
Acquisition Line Time	In xml tree: Acquisition Control -> Acquisition Line Time	Describes the time between current scan line and the next scan line. The higher the line time, the less the scanned rows (slower). The result is more stable.

Acquisition Integration Time	In xml tree: Acquisition Control -> Acquisition Integration Time	
Trigger Source	In xml tree: Acquisition Control ->Trigger Selector->Trigger Mode	Default value: **Off** for **Frame Start**, **Frame Active** and **Line Active** in free-running mode.
Test Pattern (optional, often used to test the grabbing function, or shading)	In xml tree: Image Format Control -> Test Pattern Generator -> Test Pattern Image Format Control -> Test Pattern Generator -> Test Pattern Value	Default value: **Off**. If a test pattern should be used, then you can choose a certain test pattern and its corresponding value.

Because the filter driver can improve data processing, it should be enabled for capturing of large images.

To start grabbing, click **Start grabbing** on the toolbar, to stop grabbing, click **Stop grabbing** on the toolbar. The both operations can also be executed by clicking the menu **Camera** -> **Start Grabbing**, or using hotkey **Ctrl+G**.

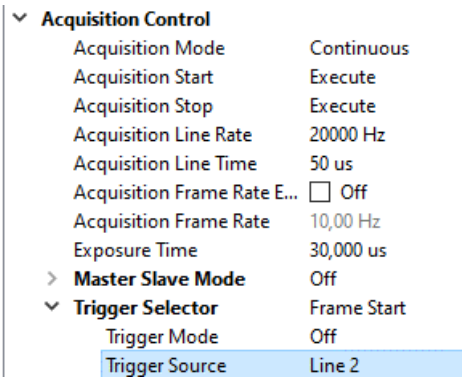
The grabbing process continues to grab images (frame) from the camera repeatedly. If only a single frame should be grabbed, click **Acquire a single frame** on the toolbar.

4.2 Possible reasons for GEV_TIMEOUT_ERROR

Sometimes during image grabbing, there comes no image from the camera, and the message log shows GEV_TIMEOUT_ERROR in the bottom area. This can be caused by following reasons.

4.2.1 Trigger mode not set correctly

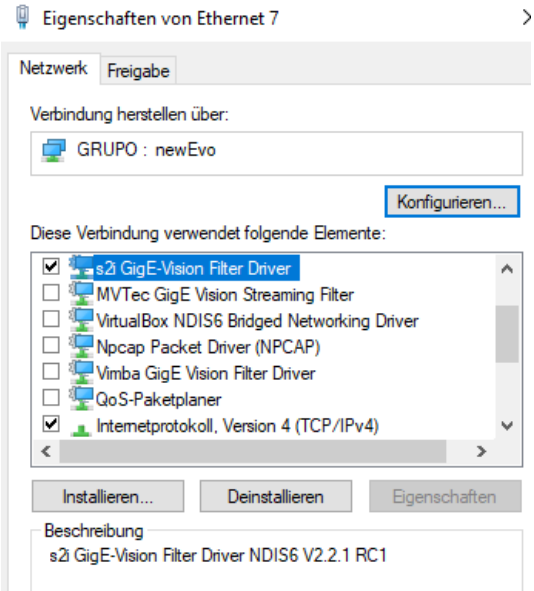
Trigger source: If there is no explicit trigger available and the camera should run in “free-running” mode, but the value of trigger source does not correspond to this mode, then GCT will return “GEV_TIMEOUT_ERROR” and cannot grab images.



4.2.2 Filter driver not installed properly

GCT can use the filter driver developed by s2i. If the filter driver should be used for the grabbing process, it must be installed and enabled correctly beforehand in the adapter settings.

To check the adapter settings, go to **Start** menu -> **Settings** -> **Network & Internet**. On the **Settings** window, click **Change adapter options**. A new dialog box opens with a list of network connections. Right-click the corresponding GigE Ethernet connection for the camera and then click choose **Properties**. If a teaming group is used, then right-click the teaming group and choose its attributes. Ensure that **s2i GigE-Vision Filter Driver** is selected and that the version is correct.



4.2.3 “Secure Boot” not disabled in BIOS settings

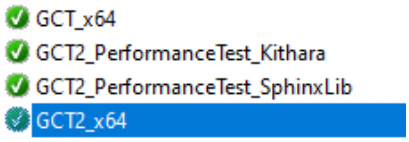
If the filter driver is installed properly and can also be detected, but “GEV_STATUS_DRIVER_READ_ERROR” appears during grabbing, it could be due to **Secure Boot** in the BIOS settings. In this case refer to section 1.4.1.2.

4.2.4 Firewall is not completely allowed for GCT

Data transfer between camera and PC requires firewall allowance. Normally, the firewall rule is exclusively allowed for GCT automatically after installation.

To verify the firewall rule:

1. On the Window **Start** menu, click **Settings**-> **Update & Security** -> **Windows Security** -> **Firewall & network protection.**
2. Click **Advanced settings** and highlight **Inbound Rules** in the left panel.
3. Find the rule name **GCT2_x64**, open its properties, and ensure that the firewall rule is allowed for all types: **domain**, **private**, and **public**.



4.2.5 Reboot

If GEV_TIMEOUT_ERROR occurs only if the filter driver is activated, you can reboot your PC to resolve unknown conflicts in the hardware.

4.3 Mouse operations on the image

During or after image acquisition, you can work on the image as follows.

Function	Operation
Zoom in (factor x 1.05)	Mouse wheel forward
Zoom out (factor * 0.95)	Mouse wheel backward
Move image	Move mouse while holding left mouse button pressed
Reset image to original size	Click 
Expand image to full display area	Click 
Read RGB value as 8bit	Move mouse onto the image

5 Saving/Loading an image

GCT permits to save the currently acquired image as a BMP or TIFF file, and to load such files.

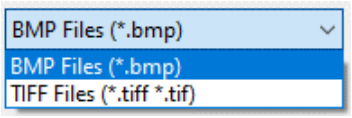
5.1 Saving an image

To save an acquired image:

1. If GCT is grabbing images continuously, stop image acquisition.
2. Click  on the status bar beneath the view area 

.

For a typical RGB8 or Mono8 format, the image can be saved as BMP file. For formats such as Mono10, Mono12 or RGB10p32, it can be saved as TIFF file. Each color value of each channel is then scaled from 10 or 12 to 16bit in the TIFF file.



5.2 Loading an image from disk

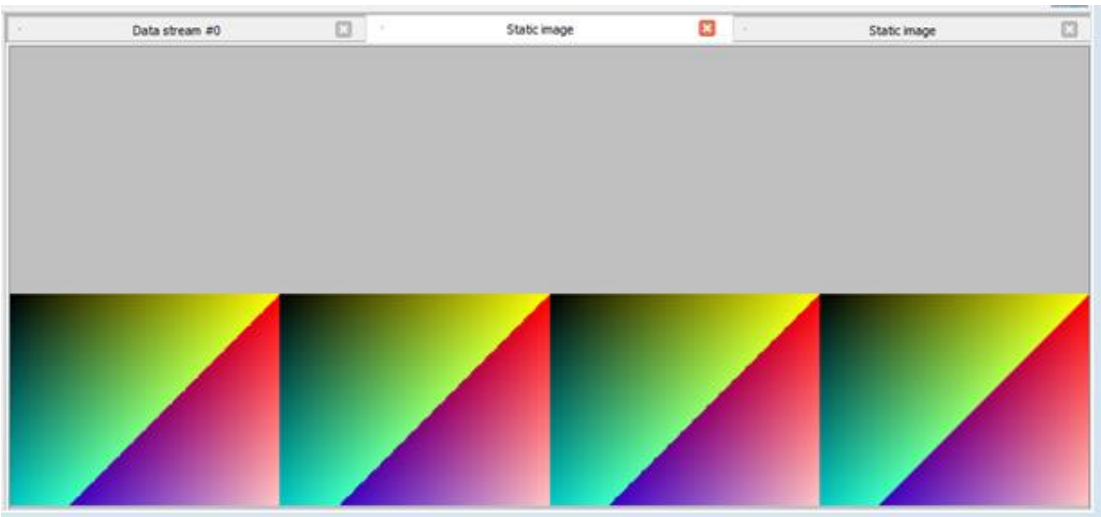
Previously saved images can be loaded back into GCT.

To load an image:

1. On the toolbar, click **Load image**  .
2. On the file dialog box, click the desired file type in the list, to display the respective images:

3. Select a file, and then click **Open**.

Each opened image is displayed in a separate **Static Image** tab. The images can be viewed with mouse actions, as described in section 4.3. The 16bit TIFF images are currently displayed as 8Bit image, so the RGB values are scaled to 0-255.



6 Update/Download

The firmware of the camera can be updated and downloaded. How the firmware is delivered, depends on the camera type. It can be a single `.bin` file or a ZIP file containing several files.

Firmware delivered as ZIP file contain the following components:

- application,
- bitstream,
- camera XML file,
- dark reference files (DSNU),
- shading files (PRNU),
- sensor file,
- gamma lookup table file,
- user data,
- package description file.

6.1 Updating the firmware

To update the camera firmware:

1. Download firmware from the Chromasens website.
2. Start GCT and connect the camera.
3. On the toolbar click **Open update dialog** , or on the **Tools** menu, click **Up-/Download**, or use hotkey **Ctrl+U.**

   The **Update/Download** dialog box opens.
4. Click **Select Update File**. A file dialog box opens.
5. If the firmware is a single binary file, select this file. Otherwise select the text file `..._listfile_...  .ini` from the list shown above, and then click **Open**.

   If the package contains more than one list file, take care to select the file that corresponds to the sensor of your camera model.

   GCT selects the appropriate file type in the **Update** list, and then shows a warning message.
6. Check whether the file type is correct: for the list files, it is **Firmware Package File**. If the wrong file type is shown, select the correct file type.
7. Click **Start Update**.
8. On the appearing warning message, click **Yes** to start the upload process.

   Depending on the file size, file upload may take a few seconds up to several minutes. During upload a progress bar is shown.
9. Wait until the firmware has been uploaded completely.
10. Check the log files: If the upload was successful, it contains a green confirmation message for each uploaded file. If an upload was not successful, do not switch off the camera, but upload the respective component again.
11. If the upload has been completed successfully, switch the camera off and after a few seconds on again. This is necessary to complete the firmware update.

If you need to upload special files to the camera, contact support first. The files must be uploaded in a special order. If you upload files in the wrong order, this cause damage to the camera.

6.2 Downloading a firmware component

Each firmware component can be downloaded and saved to a file.

To download a firmware component:

1. Start GCT and connect the camera.
2. On the toolbar click **Open update dialog**  , or on the **Tools** menu click **Up-/Download**.

   The **Update/Download** dialog box opens.
3. In the **Download** list, click the desired firmware component.
4. Click **Download to**. A file dialog box opens.
5. Select a folder, enter a file name, and then click **Save**.

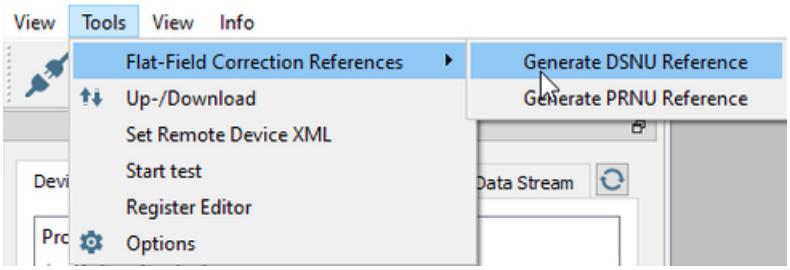
7 Creating a black-reference (DSNU)

To create a black-reference:

1. Switch off illumination and cover the lens with a black or dark piece of cardboard or plastic so that there is no light on the sensor. Check that the piece covers the whole lens.

2. Prepare an image with GCT. Either click the **Acquire a single frame** on the toolbar, or click **Start grabbing**, wait until an image is shown and then click **Stop grabbing**.

3. On the **Tools** menu, select **Flat-Field Correction References**, and then click **Generate DSNU Reference**.



   The **Create DSNU Reference** wizard opens.

4. On the **Select image source** page, click **Use grab view image**, and then click **Next Step**.

5. On the next page, click at the first step (**1) Set ImageClibrationMode…**), then at the second step, and at last at the third step.

6. If all three steps were reported as successful, click **Next Step**. The **DSNU Reference Generator** window opens and shows the grabbed image in expected image calibration mode.

7. In the **Settings for Average Value**, enter values for **Y-Position** and **Height** to specify the area to be used for reference generation, or click **Start 2-Click-Selection** and click start and end position on the image.

8. To create and save the reference data, click **Save DSNU File to Local PC**, specify folder and file name in the appearing file dialog box, and then click **Save** and close the wizard.

9. On the toolbar click **Open update dialog**, and in the **Update/Download** dialog box lick **Select Update File**. A file dialog box opens.

10. Select the DSNU file, and then click **Open**. GCT selects the appropriate file type in the **Update** list. If the file type is correct, confirm the appearing warning message.

11. Click **Start Update**, wait until the file has been uploaded completely, and then close the dialog box.

12. To activate DSNU, click the **LUT Control** feature group,

13. Click **LUT Selector** and click the respective DSNU LUT in the value list:

14. At the **LUT Enable** feature, select the check box.

To create a dark-reference from an existing image file:

1. Perform steps 1 to 3 of the above procedure.
2. On the **Select image source** page, click **Load image from storage**, and then click **Next Step**.
3. Click **Choose BMP File** on the following page and open the desired image file in the appearing file dialog box.
4. Specify a pixel offset, and then click **Next Step**.
5. Continue with step 7 of the above procedure.

NOTE:	While **Image Calibration Control** is active, the temporarily modified features are locked and cannot be modified until the feature is set to **Off**. Currently, the input image (regardless of whether acquired directly with the grabbing process or loaded from PC) will be converted to 8 bit and then used to calculate the DSNU reference.

8 Creating a shading reference (PRNU)

To create a shading reference:

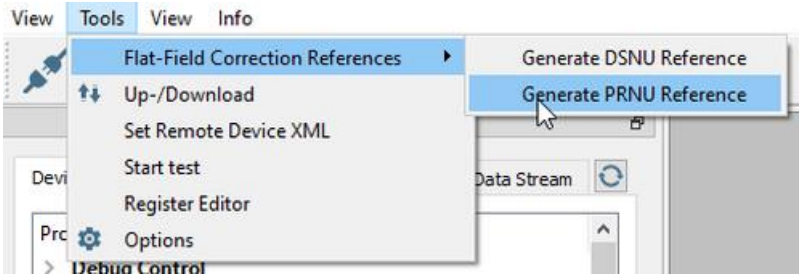
1. Check lighting and focusing.

2. Disable continuous white-control and save the parameters to the camera.

3. If possible, prepare a moving white target. If you use a stationary target, place the target a bit out of focus, to reduce the effect of dust or scratches on the calibration result.

4. Prepare an image with GCT. Either click the **Acquire a single frame** on the toolbar, or click **Start grabbing** ,wait until an image is shown, and then click **Stop grabbing** .

5. On the **Tools** menu, select **Flat-Field Correction References**, and then click **Generate PRNU Reference**.



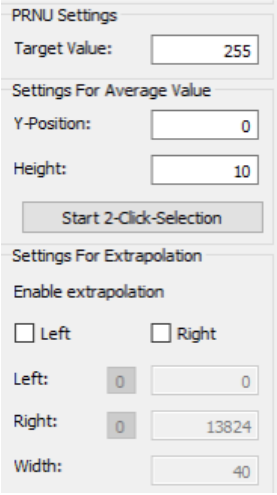
The **Create PRNU Reference** wizard opens.

6. On the **Select image source** page, click **Use grab view image**, and then click **Next Step**.

7. On the next page, click at the first step (**1) Set ImageCalibrationMode…**), then at the second step, and at last at the third step.

8. If all three steps were reported as successful, click **Next Step**. The **DSNU Reference Generator** window opens and shows the grabbed image.

   On the next page, shading parameters must be specified in the **PRNU Settings** area on the right side:



9. Specify the target value for white, and the area that should be used to create the shading data:

   Target Value: Target value of white after the shading reference has been applied. The default target is 255, but normally it is set to a smaller value between 220-230.

   Y-Position, **Height**: Start and height of the area used to generate shading data. If you specify 100 and 300 as values, 300 lines starting at line 101 are used. Enter values into the boxes, or click **Start 2-Click-Selection**, and then click on the start and end position of the desired area on the image. The specified area is then marked with green color.

10. If the image has black borders on the left/right side, specify an area for extrapolation:

    For extrapolation on the left side, select the **Left** check box, for the right side, the **Right** check box. In the **Left** and **Right** boxes, enter the start positions of the areas used for extrapolation, and in the **Width** box the width of the areas.

    Start and end position of the areas are marked with red color on the image.

11. To show the result of the shading correction with the specified parameters, click **Test PRNU**.

12. To save the shading reference data, click **Save PRNU File to Local PC**, specify folder and file name in the appearing file dialog box, and then click **Save** and close the wizard.

13. At the **Image Calibration Control** feature group, click **Image Calibration Mode** and then click **Off** in the value list. This resets the previously modified features to their original values.

14. On the toolbar click **Open update dialog** **,** and in the **Update/Download** dialog box lick **Select Update File**. A file dialog box opens.

15. Select the PRNU file, and then click **Open**. GCT selects the appropriate file type in the **Update** list. If the file type is correct, confirm the appearing warning message.

16. Click **Start Update**, wait until the file has been uploaded completely, and then close the dialog box.

17. To activate PRNU, click the **LUT Control** feature group.

18. Click **LUT Selector** and click the respective PRNU LUT in the value list.

li

19. Click **LUT Enable** and select the check box.

20. Set **Brightness** and **Contrast** to a value about 0.9.

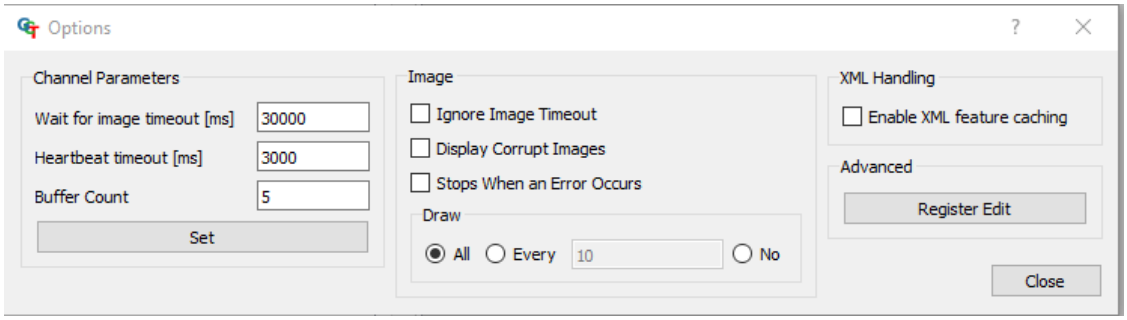
To create a shading reference from an existing image file:

- Perform the steps of the above procedure, but click **Load image from storage** in step 6, click **Next Step**, click **Choose BMP File** on the following page, and open the desired image file in the appearing file dialog box.

NOTE:	While **Image Calibration Control** is active, the temporarily modified features are locked and cannot be modified until the feature is set to **Off**. Currently, the input image (regardless of whether acquired directly with the grabbing process or loaded from PC) is converted to 8 bit and then used for calculating the PRNU reference

9 GCT Options

To open the **Options** dialog box, click **Options** on the toolbar, or click **Options** on the **Tools** menu.



Option name	Default value	Description
Wait for image timeout	30000	If the next image is not received after the specified time, then it will send a timeout. The value can be modified. When GCT is restarted, it is set back to 30000.
Heartbeat timeout	3000	Read the value of **GevHeartbeatTimeout** from the camera (control channel).
Buffer Count	5	Specifies the number of buffers used for each stream. The value should be at least 2 or 3.
Ignore Image Timeout	Not selected	Can be selected if the acquisition process should continue despite timeout error.
Display Corrupt Image	Not selected	Can be selected if an image should be displayed despite missing data
Stops If an Error Occurs	Not selected	
Draw	All	Can be set to display every x frames, or to shut off display to reduce CPU usage.
Enable XML feature caching	Not selected	So that the actual value is retrieved directly from the camera, instead of from a cached register.

The options (except **Wait for image timeout** and **Heartbeat timeout**) are saved in `GCC.ini` in a user-specific folder:
`C:\Users\USER_SPECIFIC_FOLDER\Documents\Chromasens\GCT2\GCC.ini`
.

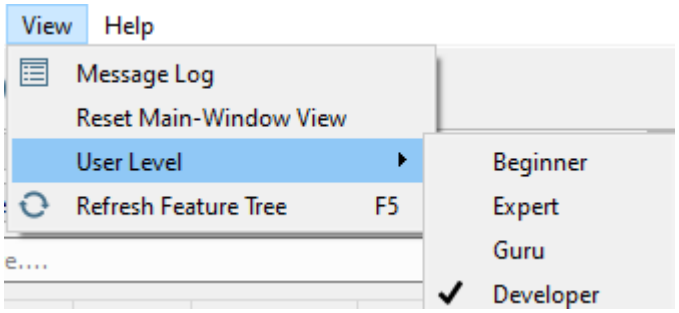
10 Camera features

10.1 User level

Each camera contains an XML file specifying the available camera features, When GCT connects to the camera, it loads the XML file and shows the features as a tree structure.

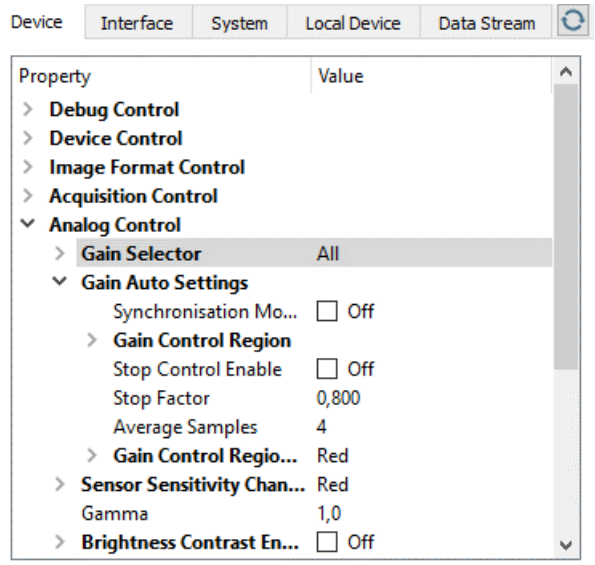
Each feature has a visibility level. While all features are displayed for user level **Developer**, many advanced features are hidden for user level **Beginner**.

To modify the user level, click the **View** menu, point to **User Level**, and then click the desired level:

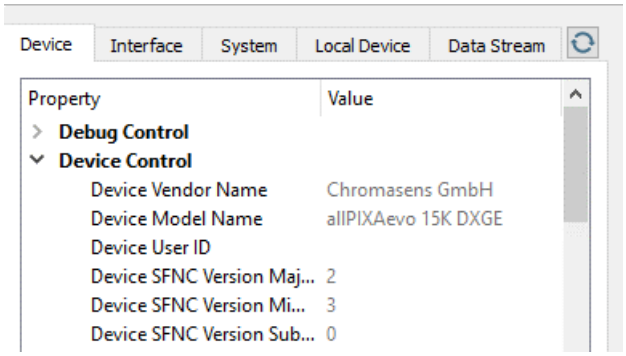


10.2 Modifying features

On the left side of the GCT window, features and their values are shown in a tree structure organized in feature groups. To show the features of a feature group, click on the arrow preceding the group name.



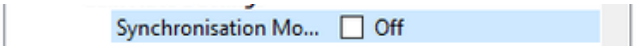
Some features are read-only. Their values are shown in gray color in the feature tree:



Some features cannot be modified during grabbing. Therefore, their values are also shown in gray during grabbing.

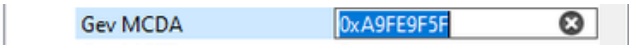
How values are changed, depends on the data type of the feature:

- For binary features, select or clear the shown check box.

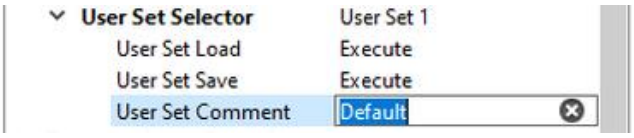


- For numerical values, click on the value. A box and a slider appear that permit to modify the value:

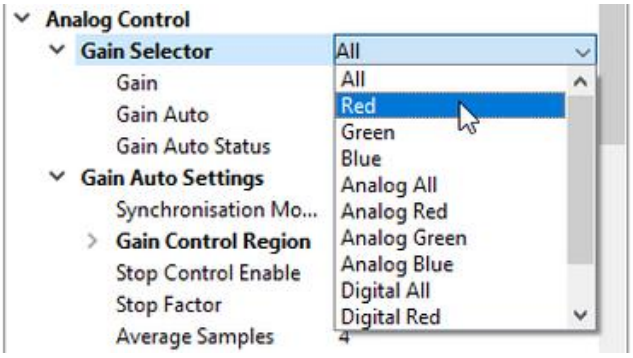
- For hexadecimal values, click on the value. A box appears that permits to modify the value:



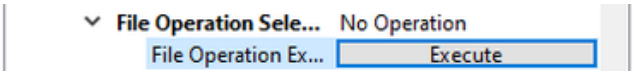
- For features containing text, a text box appears, at which you can edit the value:



- For the feature type enumeration, a value list appears. Click again on the value to open the list, and then click the desired value:



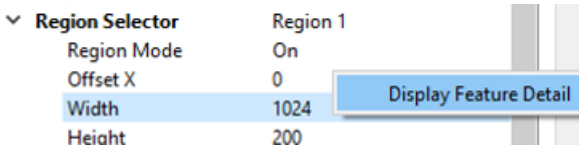
- For command features, an **Execute** button appears:



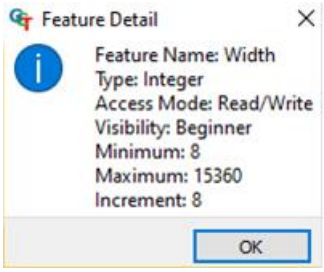
  To execute the function, click **Execute**.

10.3 Showing feature details

To show feature details, double-click the feature name or right-click the feature and then click **Display Feature Detail**:



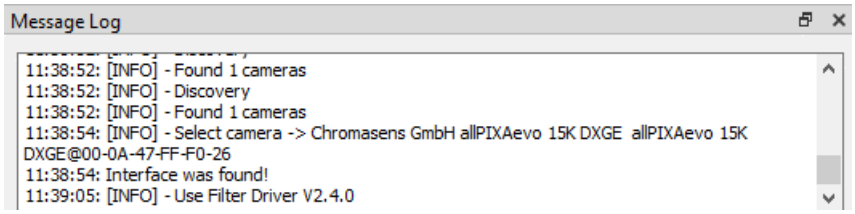
A message box then shows information about type, access, and values:


Feature Detail
Feature Name: Width
Type: Integer
Access Mode: Read/Write
Visibility: Beginner
Minimum: 8
Maximum: 15360
Increment: 8
OK

11 Other functions

11.1 Show message log

To show the message log, click **Message Log** on the **View** menu or click **Show message log window** in the bottom right corner of the GCT window. A **Message Log** area is then shown below the image area:



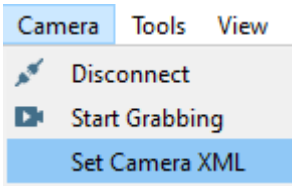
To copy messages to the clipboard, mark the messages, right-click on the selected messages, and then click **Copy** on the appearing context menu.

To copy all present messages, right-click on the **Message Log** area, click **Select All** on the appearing context menu, and then press **Ctrl+C**.

11.2 Uploading a camera XML file

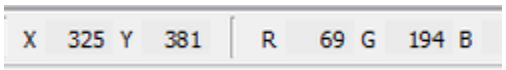
To upload a camera XML file:

1. On the **Camera** menu, click **Set Camera XML**.
2. In the appearing file dialog box, select the XML file, and then click **Open**.



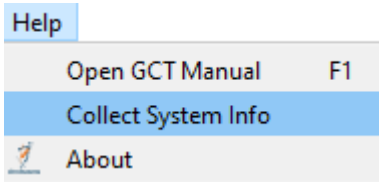
11.3 Showing pixel values of an image

If you move the mouse onto an image, coordinates and color values are displayed in the line below the image view at the right end:



11.4 Collect System Information

GCT provides the possibility of collection system information such as operating system, RAM, CPU, installed software products from Chromasens, etc. This can be saved in a text file by clicking **Help** -> **Collect System Info**.



12 Kithara

12.1 Introduction of Kithara RealTime

Kithara Software was developed by the company Kithara. The real-time extension of Kithara is a comprehensive system library, which combines industrial automation, machine vision, hardware drivers and communication seamlessly, while being completely flexible and modular at the same time. In nearly any conceivable industrial application, Kithara RealTime can provide fast image capturing with the GigE Vision standard and can achieve a high real-time performance. Running Kithara RealTime requires dedicated CPU cores. On those reserved cores, the real-time system is booted, which, from here on, functions just like a separate RTOS which Windows retains its full operability on the remaining CPU cores. From this point on, Windows and the real-time system run simultaneously and parallel to each other on the same computer, without one restricting the other.

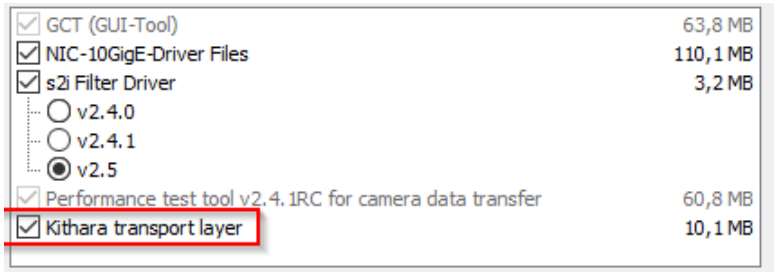
12.2 Licensing

A valid software license including a USB dongle is required to use the Kithara transport layer. Please contact Chromasens about information on licensing options:

https://www.chromasens.de/en/distribution/contact

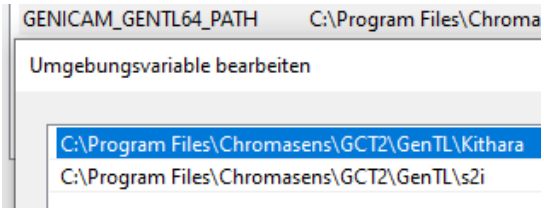
12.3 Installing the Kithara Transport Layer

The Kithara transport layer permits to communicate with GigE cameras based on theKithara software. If Kithara should be used, select the **Kithara transport layer** check box during installation:



After the installation of the Kithara transport layer, the Windows system is configured to suit Kithara, and the transport layer file `ls_tl_gev_kithara.cti` and its library file `gevKithara_kernel.dll` are placed in the default folder: `C:\Program Files\Chromasens\GCT2\GenTL\Kithara`.

After the installation of this component, the system environment variable `GENICAM_GENTL64_PATH` is expanded with the transport layer folder from Kithara and from s2i:



Kithara locates and uses the existing network adapters. This can be configured during the installation of GCT in the Kithara configurator dialog if the component **Kithara transport layer** was selected. You can also skip the Kithara configurator dialog during the GCT installation and start the configurator dialog later in GCT. For more information of the Kithara configuration dialog, refer to the next section.

After the Kithara transport layer has been installed, you must restart the PC.

12.4 System Configuration for Kithara

If the Kithara transport layer is being installed, some system parameters are also configured for the Kithara application, and you must restart the PC after installation has finished.

While you do not need to change the configuration manually, it could still be useful to take a look at the Kithara-related configurations.

12.4.1 Kithara Configurator

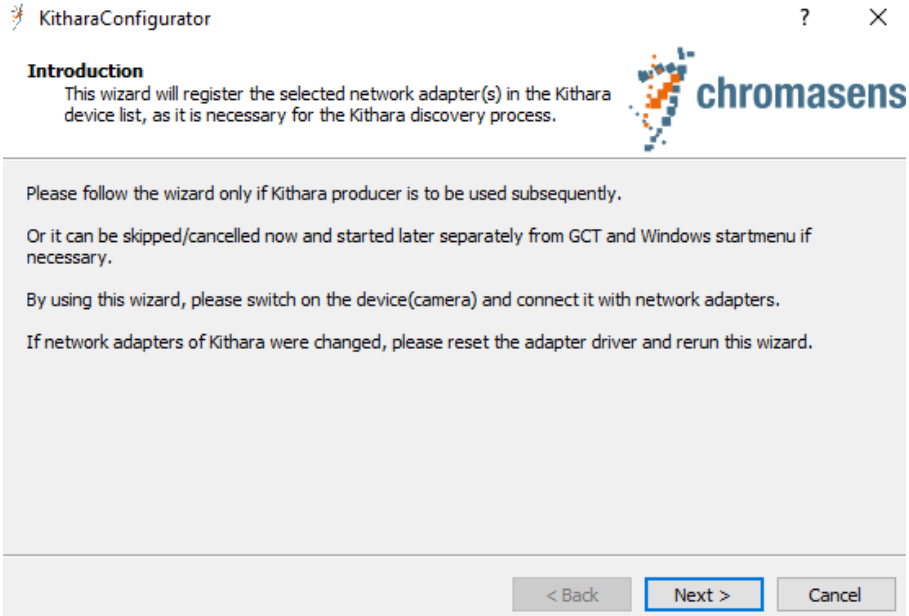
If the **Kithara transport layer** check box has been selected during installation of GCT, the **Kithara Configurator** is started during installation. Alternatively, you can start it later by clicking **Kithara Configurator** on the **Tools** menu of GCT.

The configurator adds a file `kithara_config.txt` to the folder `C:\Users\Public\Documents\Chromasens\GCT2`, which contains the hardware IDs of the network adapters on which Kithara will be executed. Without this file, the Kithara transport layer is not able to detect the devices in GCT. The Kithara Configurator also adds the dedicated CPU cores for Kithara (refer to section 12.4.2) and disables Hyper-Threading (refer to section 12.4.3). The Kithara Configurator will prompt the system to reboot to update the changes.

To configure the system with the Kithara Configurator:

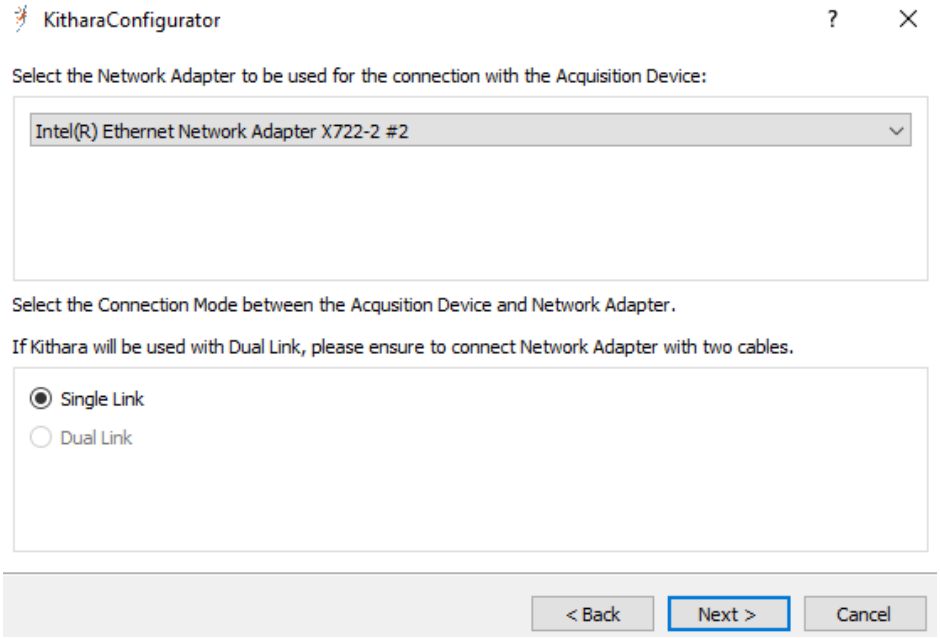
1. Power on the camera, and connect it with 10 GigE network adapter by using one or two cables.

2. Start **Kithara Configurator**, on the **Introduction** page, click **Next**.



   On the next page the current 10GigE nework adapters are listed. Adapters that are connected and in use are shown as active; adapters that are not connected or at which the device is switched off are shown as inactive.

3. If Kithara is going to be used with a single cable connection, select the corresponding adapter port in the adapter list, click **Single Link**, and then click **Next**.



4. If Kithara is going to be used with two cables (which connect two dual ports of the same network adapter), select any one of the two adapter ports in the adapter list, click **Dual Link**, and then click **Next**.

IMPORTANT NOTE	The Kithara configuration can currently be executed once before the first use of Kithara. After Kithara has been used at least once, the configured adapter port(s) are dedicated to Kithara and cannot be used from within Windows unless the driver is set back manually. In the Windows Device Manager the network adapters can be found in the **Kithara System Device** section. If the cable connection for Kithara is changed, it is required to reset the network adapter driver to the original Windows network adapter driver (so that the device can be found under Windows) and rerun the Kithara Configurator.

12.4.2 Reserve dedicated CPU cores for Kithara

If the Kithara transport layer is installed during the GCT installation, two cores of the multicore processor are automatically reserved for the Kithara real-time applications, while Windows and the remaining programs are restricted to the remaining processor cores.

If GCT is uninstalled, the reserved processor cores are freed automatically.

For more information about CPU reservation, refer to:
https://kithara.com/en/docs/krts:tutorial:setupdedicated.

12.4.3 Disabling hyperthreading

If the processor supports hyperthreading, do not split a physical core between Windows and Kithara to maximize runtime efficiency. If the Kithara transport layer is installed during installation of GCT, the two following commands are executed during the installation in background using Powershell:

```
bcdedit /set hypervisorlaunchtype off
```

```
Disable-WindowsOptionalFeature -Online -FeatureName Microsoft-Hyper-V-All -NoRestart
```

12.5 Using the Kithara Transport Layer

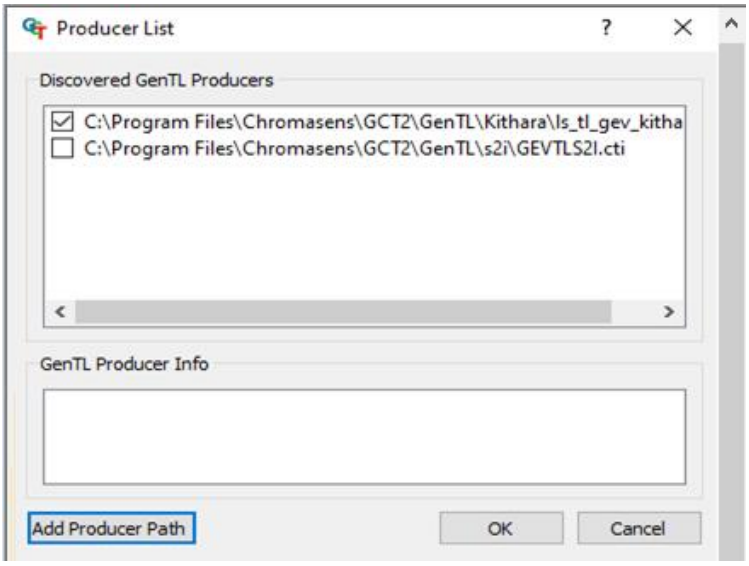
1. Plug in the license USB dongle before using the Kithara Transport Layer

2. When you start GCT, the first step is to detect the camera. The Kithara TL can be used like any other producer but requires the system to be configured properly. The configuration is done automatically during the installation of GCT. For more information, see sections 12.3 and 12.4.

12.5.1 GCC.ini content of Kithara Producer

During the first discovery process after installation, GCT fetches the paths from the system environment variable GENICAM_GENTL64_PATH and searches for `.cti` files in each of those folders. If cti transport layer files are found and can be parsed, the camera can be detected with the corresponding transport layer. This may take several minutes during the first discovery process.

When you click **Select TL Producer**, the found files are shown:



To enable use of the Kithara transport layer, select the check box of the file `ls_tL_gev_kithara.cti`, clear the check box of the default file `GEVTLS2I.cti`, and then click **OK**. The discovery process is then started using the Kithara transport layer.

If the discovery process has already been executed, the content of producer path, producer filename, and selected producer for the discovery are already adjusted automatically in the file `GCC.ini`. file. Therefore, if the discovery has already been executed, the file `GCC.ini` could look as follows in the block of `[DefaultProducers]`.

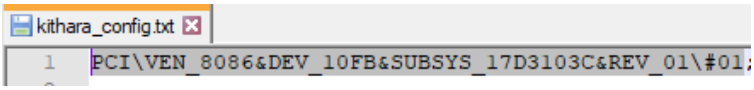
```
[DefaultProducers]
ProducerList=C:\\Program Files\\Chromasens\\GCT2\\GenTL\\Kithara\\ls_tl_gev_kithara.cti, C:\\Program Files\\Chromasens\\GCT2\\GenTL\\s2i\\GEVTLS2I.cti
AdditionalSearchPath=C:\\Program Files\\Chromasens\\GCT2\\GenTL\\s2i
SelectedProducerList=C:\\Program Files\\Chromasens\\GCT2\\GenTL\\Kithara\\ls_tl_gev_kithara.cti
```

- `ProducerList` contains the found cti transport layer files.
- `AdditionalSearchPath` contains the additional search paths for cti files, which can be added by clicking **Add Producer Path**.
- `SelectedProducerList` contains the cti transport layer files which are selected to be applied for the discovery process.

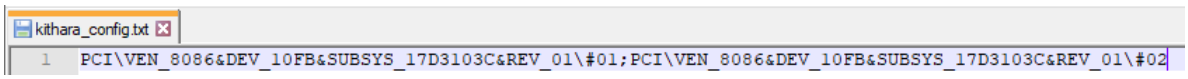
12.5.2 Kithara_config.txt

The file `kithara_config.txt` in the folder `C:\Users\Public\Documents\Chromasens\GCT2` is created by using the `Kithara Configurator` (see section 12.4.1).

If only a single link is used with Kithara, this file contains the hardware ID of the chosen connection as single entry:

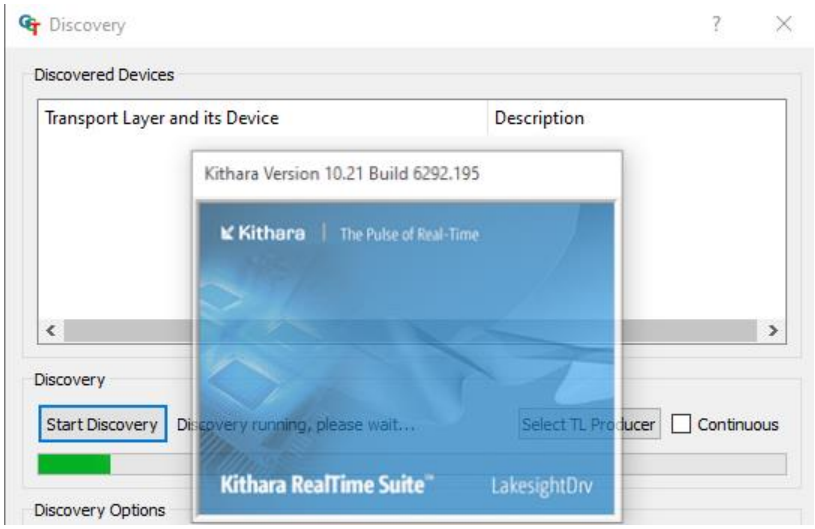


If dual link is used with Kithara, this file contains two items from the dual connections, separated by a semicolon:



12.5.3 Camera discovery with the Kithara Transport Layer

If the Kithara transport layer file `ls_tl_gev_kithara.cti` has been selected in the **Select TL Producer** dialog box, and the file `kithara_config.txt` in the folder `C:\Users\Public\Documents\Chromasens\GCT2` has been configured, a blue Kithara window may appear for some seconds during the first camera discovery with Kithara TL.:



12.5.4 Resetting network adapter driver back to Windows driver

After discovering the camera with the Kithara transport layer file, the corresponding network adapter connections are assigned to the Kithara driver and can no longer be found in the list of normal network adapters in the Windows Device Manager.

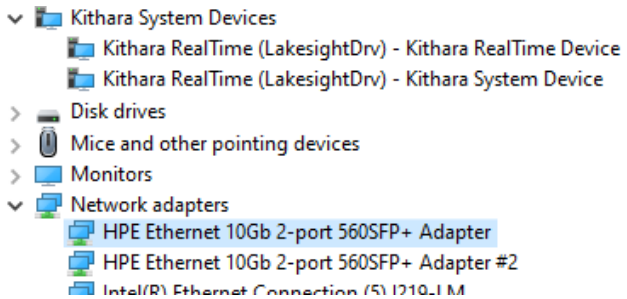
As shown in the following screenshot of the Windows Device Manager, the two entries of the dual port HP network adapter (**HPE Ethernet 10Gb 2-port 560SFP**) are not available in the **Network adapters** list. Instead, they are present in the **Kithara System Devices** list with the name **Kithara RealTime -PCI Intel 10 GbE Network Controller**.

It is not an issue if the camera is always only to be used with the Kithara transport layer. But if the adapter should be used outside the Kithara application, the adapter driver must be set back to the original Windows driver, so that it can again be available for other windows applications.

To reset a Kithara RealTime PCI network controller:

1. On the Windows **Settings** window, click **Network & Internet** and on the next window click **Change adapter options**.
2. Right-click one of the **Kithara RealTime PCI** network controllers, and then click **Properties**.
3. Click **Configure** and on the next dialog box click the **Drivers** tab.
4. Click **Update Driver**.
5. Click **Search driver on my PC** and then click **Select available drivers from a list of my PC**.
6. Select the suitable adapter driver and then click **Continue**.

After these steps, the adapter (**HPE Ethernet 10Gb 2-port 560SFP** in this example) is removed from **Kithara System Devices**, and is again available in the **Network adapters** list:



12.6 Performance Test with Kithara

When the Kithara transport layer is installed, a separate performance program is copied to the folder:
`C:\Users\Public\Documents\Chromasens\GCT2\performanceTest\withKithara`.

To run the performance test with Kithara, a Kithara-specific dongle representing the license must be plugged in an USB slot. If this dongle has not been delivered yet by Chromasens, contact sales or support.

The performance test program with Kithara is independent of GCT. It can be started directly without any configuring.

The program has the following parameters:

- start_line_time: Start value of camera acquisition line time in microseconds.
- stop_line_time: End value of camera acquisition line time in microseconds.
- line_time_step_width: Time step from **start_line_time** to **stop_line_time** in microseconds.
- iteration_time: Test duration of each line time in seconds (integer).
- width: Image width in pixels. If this parameter is not set, the current width is used.
- height: Image height in pixels. If this parameter is not set, the current height is used.
- rgb10: Format flag. If 0, the format RGB8 (each pixel has 24 bit) is used for image acquisition. If 1, RGB10p32 (each pixel has 32 bits) is used instead. In case of RGB10p32, the camera transfers 33.3% more image data.

Example of a command line:

```
PerformanceTest.exe start_line_time 30.0 stop_line_time 40.0
line_time_step_width 5.0 iteration_time 60 rgb10 1
```

This means, the camera uses RGB10p32 as image format, starts with an acquisition line time of 30.0 microseconds (us), stops after 40.0us, and the step is 5.0us. With each acquisition line time, the test of each different line time will take 60 seconds. The running program can be stopped by pressing any key.

When the performance program is started, Kithara searches all available ports of the PC. If the camera is connected with a single cable, the corresponding index must be entered as shown below. If the camera is connected to a dual port network adapter with two GigE-cables, the indices of both ports must be entered.

In the example shown below, a dual port network adapter occupies two ports with the same identifier `PCI\VEN_8086&DEV_10FB&SUBSYS_17D3103C&REV_01`. The ports differ from each other only by the ending #01 or #02:

```
-----------------------------------------------------------------------
----                          GigE Performance Tool
-----------------------------------------------------------------------



0: PCI\VEN_8086&DEV_10D3&SUBSYS_A01F8086&REV_00\#01
1: PCI\VEN_8086&DEV_10FB&SUBSYS_17D3103C&REV_01\#01
2: PCI\VEN_8086&DEV_10FB&SUBSYS_17D3103C&REV_01\#02
3: PCI\VEN_8086&DEV_15E3&SUBSYS_07381028&REV_00\#01
Select an adapter to open (finish with -1): [-1]
```

So, if a camera is connected to both ports of this network adapter, then index 1 and 2 must be both selected to start acquisition.

```
--------------------------------------------------------------------------
----                          GigE Performance Tool
--------------------------------------------------------------------------



0: PCI\VEN_8086&DEV_10D3&SUBSYS_A01F8086&REV_00\#01
1: PCI\VEN_8086&DEV_10FB&SUBSYS_17D3103C&REV_01\#01
2: PCI\VEN_8086&DEV_10FB&SUBSYS_17D3103C&REV_01\#02
3: PCI\VEN_8086&DEV_15E3&SUBSYS_07381028&REV_00\#01
Select an adapter to open (finish with -1): [-1] 1
Select an adapter to open (finish with -1): [-1] 2
Select an adapter to open (finish with -1): [-1]

The following cameras have been found:
0: Chromasens-Camera Chromasens GmbH [00:0A:47:FF:F0:2A][40000-00157]
Packet size: 8240.
Width: 10240
Height: 1024
PixelFormat: RGB10p32
 Line time min: 17.452 (from feat. param: 17.452)
Using 18.0000 us line time
```

12.7 Troubleshooting Kithara Transport Layer

12.7.1 No camera is found during discovery

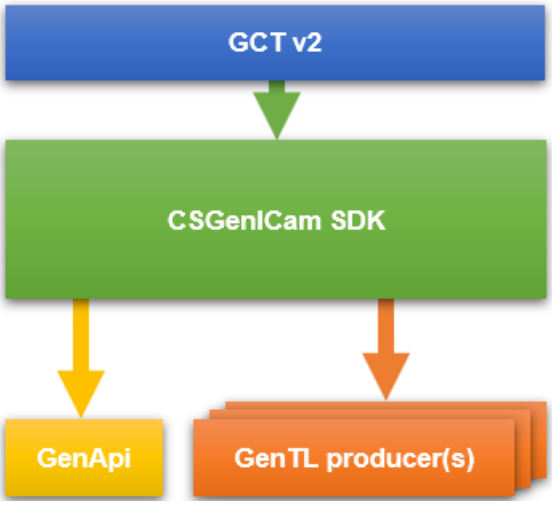
Make sure that the license USB dongle is plugged in. Also make sure to configure the Kithara transport layer before use by following the steps described in the section 12.4.

12.7.2 Discovery takes a long time to finish

It may happen that the discovery takes a long time to finish its process without detecting the camera, even though the system is configured properly. In such cases, restart the system and try again. If the Kithara Transport layer is used to detect the camera, run the Kithara Configurator application again to set all the Kithara-related parameters correctly.t

13 SDK – CSGenICam

The Chromasens GenICam SDK is an optional part of the GCT software package. It can be seen as an abstraction layer above the GenICam GenApi and GenTL interfaces, as shown in graphic below:



It permits to write applications against the CSGenICam interface. The CSGenICam interface provides a set of convenience functions and additional functionalities specific to Chromasens cameras. As an example, it adds functions that permit to perform file transfers from/to the device. It has a slightly simplified interface when compared to the more abstract GenApi and GenTL producer libraries.

For more information on how to use the SDK, including a complete API reference, refer to the SDK documentation.

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