Getting Started Guide

cifXNDIS Device Driver

V2.6

Hilscher Gesellschaft für Systemautomation mbH

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Table of contents

1 Introduction

1.1 About this document

This manual describes the setup of a cifX device supporting a *Virtual cifX Ethernet Adapter* providing a common network interface for the Microsoft Windows operating systems.

1.2 List of revisions

Rev	Date	Name	Chapter	Revision
4	2015-12-19	LCO, HHE	1.5	Windows 10 support added.
			2.1.1, 3	Sections *Software installation* and *Getting started with the cifX Ethernet Interface* updated.
5	2020-06-02	LCO, HHE	3	Section *Getting started with the cifX Ethernet Interface* revised.
			3.2	Section *Enabling the cifX Ethernet Interface (CIFX M223090 and CIFX 4000)* added.
			5.6	Section *How to enable NDIS support in the tag list of the firmware:* Figures updated.
6	2021-11-30	LCO	1.9	Remove Windows 2000 support.
7	2022-02-02	LCO	1.5, 1.9, 3.3	Windows 11 support added.

Table 1: List of revisions

1.3 Terms, abbreviations and definitions

Term	Description
AP (-task)	Application (-task) on top of the stack
ARP	Address Resolution Protocol
BOOTP	Bootstrap Protocol
DHCP	Dynamic Host Configuration Protocol
ICMP	Internet Control Message Protocol
IP	Internet Protocol
MSS	Maximum segment size (of TCP data), normally = 1460 byte on Ethernet (Maximum); MSS = MTU - sizeof(IP header) - sizeof (TCP header) = 1500 −20 −20 = 1460
MTU	Maximum Transmission Unit, normally 1500 byte = Data part of Ethernet frame
TCP	Transmission Control Protocol
UDP	User Datagram Protocol

Table 2: Terms, abbreviations and definitions

All variables, parameters, and data used in this manual have the LSB/MSB ("Intel") data format. This corresponds to the convention of the Microsoft C Compiler.

All IP addresses in this document have host byte order.

1.4 References to documents

This document refers to the following documents:

[1] Hilscher Gesellschaft für Systemautomation mbH: Driver Manual, cifX Device Driver, Windows XP/Vista/7/8/10 V2.6, Revision 31, English, 2022.

[2] Hilscher Gesellschaft für Systemautomation mbH: Protocol API, PROFINET IO Device, Revision 14, English, 2013.

[3] Hilscher Gesellschaft für Systemautomation mbH: Operating instruction manual, Device Explorer, Download firmware and configuration to the device, Revision 2, English, 2021.

Table 3: References to documents

1.5 Windows XP/Vista/7/8/10/11

The *cifXNDIS Driver* is based on the *cifX Device Driver* and so it comes only in addition to the *cifX Device Driver*. This manual handles only the cifXNDIS-specific topics.

For detailed information of the cifX Device Driver, refer to the manual *cifX Device Driver - Windows DRV xx EN.pdf* (reference [1]).

1.6 Overview

The section gives short introduction to the basic keywords used in this manual.

NDIS

The *Network Driver Interface Specification* called **NDIS** encapsulates the network and transport layer of the kernel network architecture of the operating system Microsoft Windows. The NDIS library exports functions of the transport layer and is designed as a wrapper.

What is a Miniport Driver?

A Miniport Driver is kernel-mode driver that represents the adaption layer between the NDIS library and a specific hardware. The Miniport Driver is wrapped by NDIS and is responsible for transports from the overlying layers (like network layer, session layer, ...) to specific network adapters and vice versa.

What is Bus Driver?

The bus driver is a driver that loads other drivers. The driver is responsible for managing physical busses and loading or unloading the drivers for the devices which are connected to the bus. The loaded drivers are so called '*Function Driver*'. The *Function Driver* has the most knowledge of the device and offers an interface for detailed operations, while the bus driver only deals with raw data without any knowledge about its contents and its effects on the device.

Detecting and starting a new hardware is the so called '*Enumeration Process*'. The enumeration comprises the setup of a management structure, loading the device driver and passing the relevant hardware information. The enumerated devices are called **Child Devices** of the bus they are connected to (the **Parent Device**).

For detailed information refer to Microsoft Windows Documentation 'Developing Device Driver'.

cifXNDIS

The *cifXNDIS Miniport Driver* enables use the PC card cifX as common network adapter or diagnostic interface. It connects the Microsoft wrapper library NDIS with the PC card cifX. The *cifXNDIS Miniport Driver* allows using Windows network API to access the PC card cifX and so serve network requests.

1.7 Driver architecture

Sharing a cifX device as a common network controller, requires the *cifXNDIS Miniport Driver*, connecting the Windows network API with a PC card cifX. The following figure shows how the different components are layered and interact.
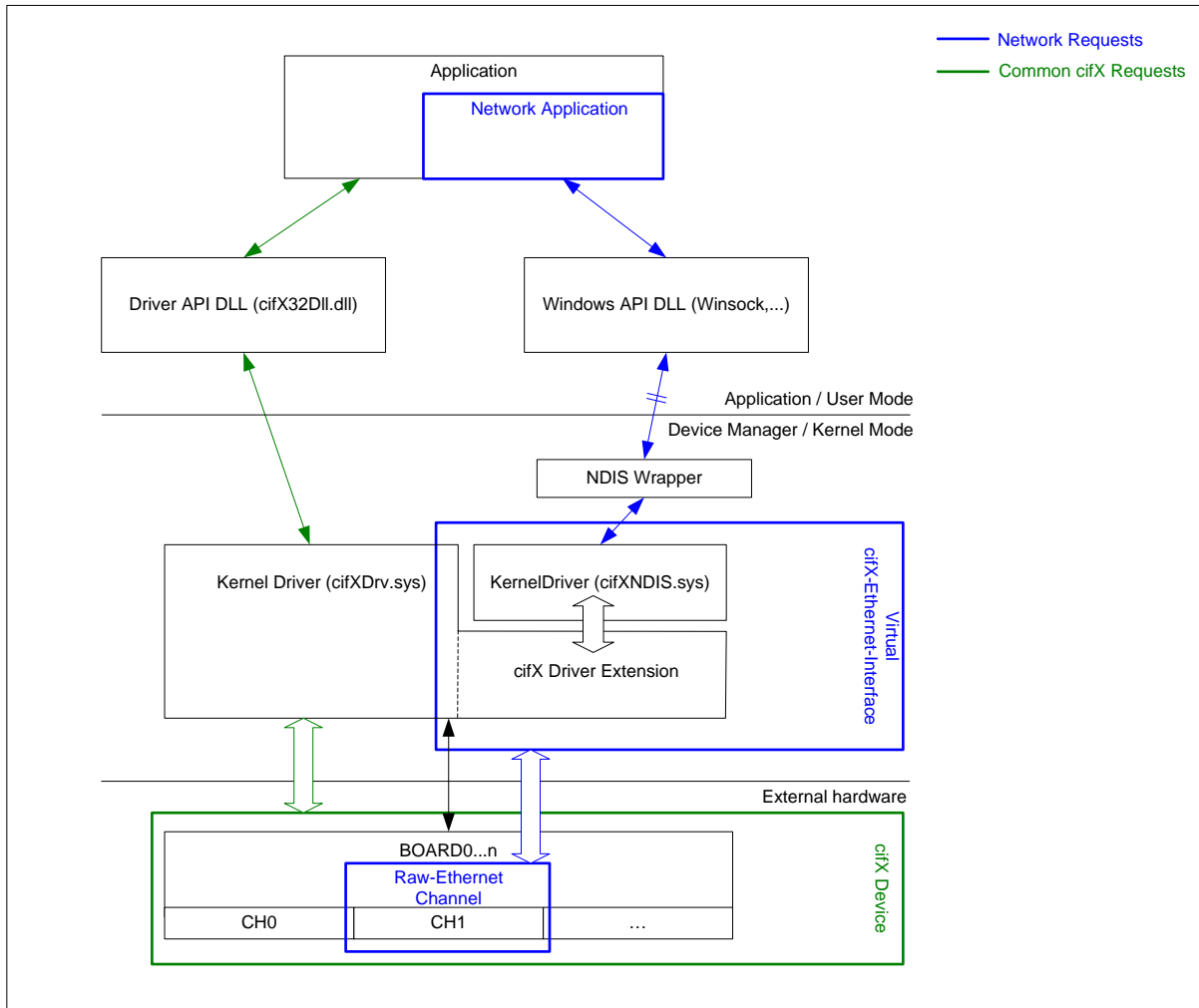

Figure 1: Driver architecture

At the upper edge, the *cifXNDIS Driver* attaches the *NDIS* interface provided by Microsoft Windows. At the cifXNDIS lower edge the driver communicates over a special driver to driver communication interface with the cifX driver extension. This extension represents a so called bus driver, which is responsible for detecting PC card cifX, providing a proper firmware with a channel supporting Raw-Ethernet communication and then creating a *Virtual cifX Ethernet Interface*.

To transfer network data, the cifXNDIS driver needs to be attached to a dedicated communication channel of the cifX Device at the lower edge. This connection is realized through the special communication interface, provided by the *cifX Driver Extension*.

From the application point of view network requests are routed through the Windows network API through the NDIS wrapper layer over the cifXNDIS driver to the cifX bus driver.

Thereby it is possible to use the Microsoft Windows "Network API" to communicate with a cifX device.

Note:	This feature requires a firmware running on the PC card cifX that provides an extra channel supporting a dedicated stack to transport Raw-Ethernet data.

1.8 Features

■ Supports Interrupt Mode, Polling Mode

■ Simultaneous access of the PC card cifX from cifX driver and cifXNDIS driver

1.9 Requirements

■ Operating System: Windows XP, Vista (32/64 bit), Windows 7 (32/64 bit), Windows 10 (32/64 bit) or Windows 11 (x64 bit)

■ cifX Device Driver V1.2.3.0 or later

■ Firmware with appropriate NDIS Ethernet Interface

   Tested firmware:

   ■ PROFINET I/O IRT Slave V3.4.144.1

   (For more information see [2] section *1.5.2 Technical Data – Ethernet Interface*)

■ Hardware: cifX PCI/PCIe

Note:	cifXNDIS support for Window 10 (or above) requires cifX Device Driver V1.3.0.0 (**NDIS 6 driver**) or later.

1.10 Limitations

■ **Power Management**

The actual netX hardware states are not stored and will be lost during power down! On system wake-up the hardware is re-started like on system power-on. This consequences a restart of the *cifX Ethernet Adapter*.

■ **Performance**

Max. TCP/IP throughput (send/receive): 42-49 MBit/s / 11-17 MBit/s.

Note: The throughput highly depends on the running firmware and the fieldbus configuration.

■ **Network Packets**

Network packet type indication is not configurable. Since the cifXNDIS driver does no packet filtering (Multicast, Broadcast, …) the types of delivered packets depends on the firmware. For detailed information about the set of provided network packets refer to the documentation of the firmware which will be installed.

■ **MAC Address**

The device's MAC address is not configurable and therefore bind to fixed MAC address. For more information refer to documentation of the firmware which will be installed.

2 Installation

The *cifXNDIS Driver* is based on the *cifX Device Driver* and comes only in addition (included) to the *cifX Device Driver*.

The driver is compatible to the Plug and Play functionalities from Windows and offers two types of installation methods.

2.1 cifXNDIS Driver installation

Installation methods:

- Installation using the driver **cifX Device Driver Setup.exe** application (**preferred method**)
  The setup application allows a "driver pre-installation" (software first) without hardware and also offers a uninstallation.

- Installation using an INF file
  This assumes a connected hardware and does not allow an uninstallation of the driver and its components (uninstall under Vista, Win7 and later by Windows device manager)

Both methods are creating several directories on the PC system partition and registry entries to start the driver.

Following steps are processed by the cifXNDIS driver setup and INF file:

- Copy necessary driver files to the target system

File name	Description	Destination
cifXNDIS.sys	Device driver	.\Windows\System32\drivers

Table 4: cifXNDIS Driver - Files installed by the INF file

- Creating driver specific registry entries

Destination
HKLM\System\CurrentControlSet\Services\CIFxDrv\Parameters\NDIS

Table 5: cifXNDIS Driver - Registry keys created by the INF file

Note: The whole installation steps and registry entries created by the *cifX Device Driver* setup are listed in the *cifX Device Driver* documentation.

2.1.1 Software installation

■ Run the **cifX Device Driver Setup.exe**, which contains the NDIS driver.

■ If the User Account Control asks "Do you want to allow the following program to make changes to this computer" (Program name: cifX Device Driver Setup) then click **Yes**.

■ Click **Install**.

■ Check "I accept the terms in the License Agreement", if you agree.

Figure 2: cifX Device Driver installation: Start

■ Please wait while the setup installs the driver.
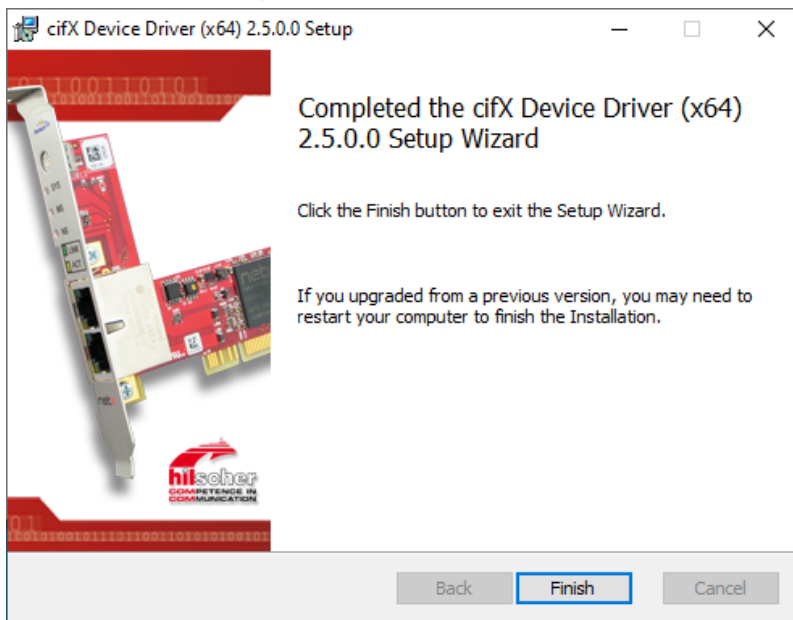
■ Click **Finish** to complete.

Figure 3: cifX Device Driver installation: Finish

■ The driver(s) are successfully installed now.

3   Getting started with the cifX Ethernet Interface

The following sections explains how to configure a cifX device to share the hardware as network adapter and fieldbus interface.

Requirements

Providing a cifX Ethernet Interface requires

- ■ cifX Device Driver, version V1.2.3.0 or later
- ■ A PC card CIFX
- ■ Firmware for the CIFX which supports the NDIS Ethernet Interface feature, e.g. PROFINET IO-Device firmware

Prerequisites

- ■ The cifX Device Driver and the cifXNDIS Driver is already installed (described in section *Software installation* on page 9).
- ■ The CIFX is already installed in the PC (described in the user manual of the CIFX).
- ■ Make sure, you have a firmware at your disposal with the NDIS Ethernet Interface feature enabled in the tag list of the firmware. For a description about how to configure/edit the tag list of a firmware, see section *How to enable NDIS support in the tag list of* the firmware on page 19.

Before you start

Note:	Enabling NDIS for a CIFX M223090 and CIFX 4000 differs from other cifX devices (e.g. CIFX 50). For CIFX M223090 and CIFX 4000, use the **Device Explorer** software instead. For more information, see section *Enabling the cifX Ethernet Interface (CIFX M223090 and CIFX 4000)* on page 14.

3.1 Enabling the cifX Ethernet Interface

Step by step description for all CIFX PC cards (except CIFX M223090 and CIFX 4000)

■ First start the **cifX Setup** utility to configure the device driver and device.
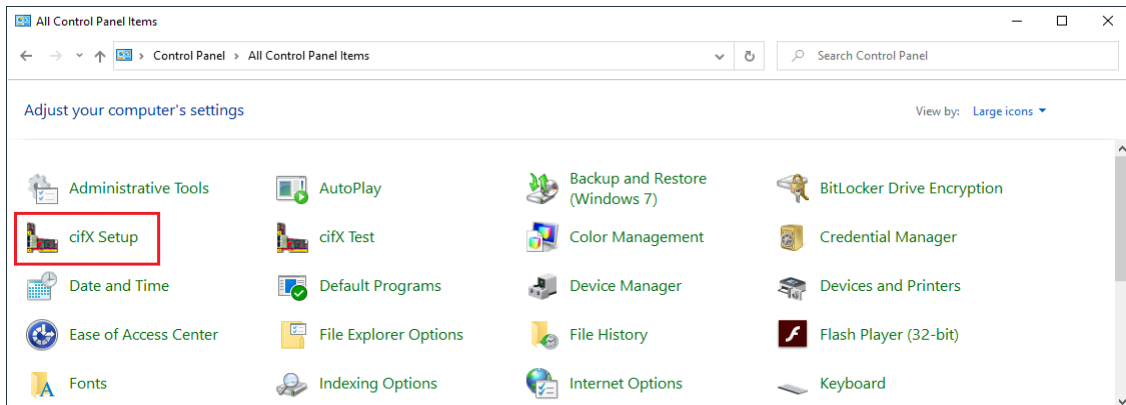

Figure 4: cifX Setup Utility

■ If the User Account Control asks "Do you want to allow the following program to make changes to this computer" then click **Yes**.

■ Select the device which should be treated as a *cifX Ethernet Interface* and enable **NDIS Support**.
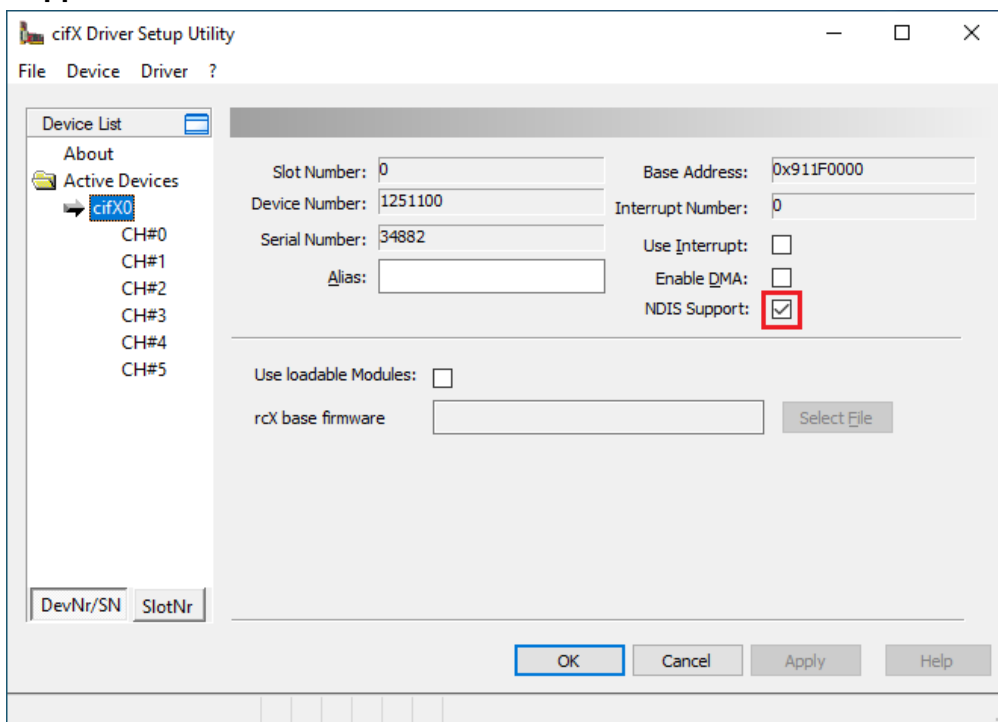

Figure 5: cifX Setup Utility: Enable NDIS Support

Note: To safe system resources, do not enable "NDIS Support", if the firmware does not support this feature. Otherwise the driver checks cyclically, if a communication channel of the selected device provides "*Raw-Ethernet*" functionality.

■   Click **Add** to select the appropriate firmware (supporting the NDIS Ethernet Interface feature via an extra Raw-Ethernet channel).
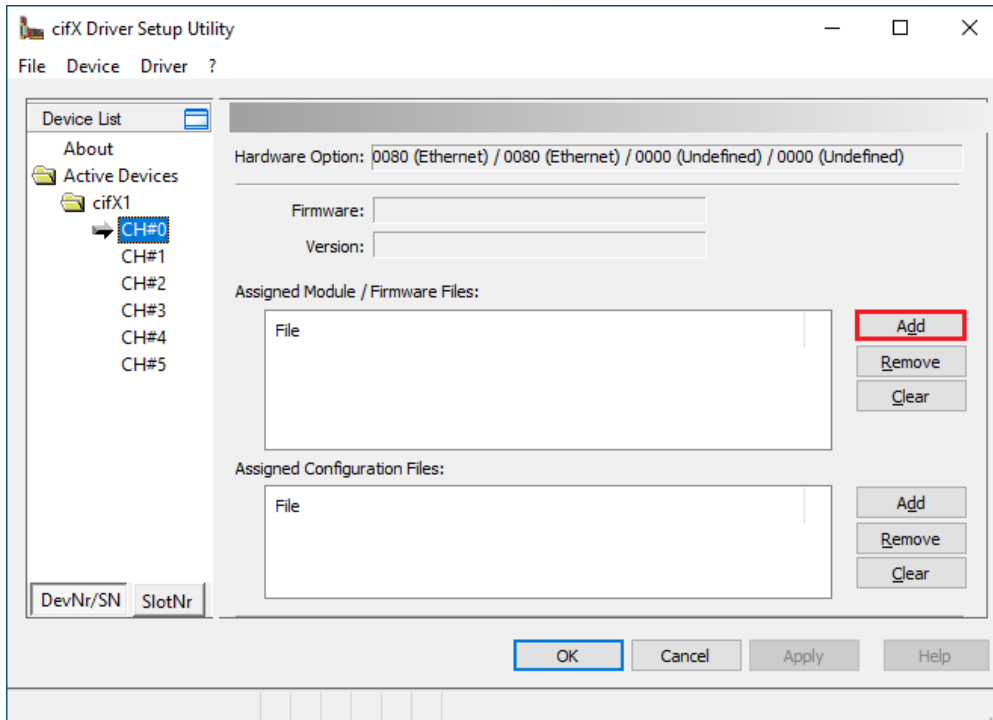

Figure 6: cifX Setup Utility: Add firmware
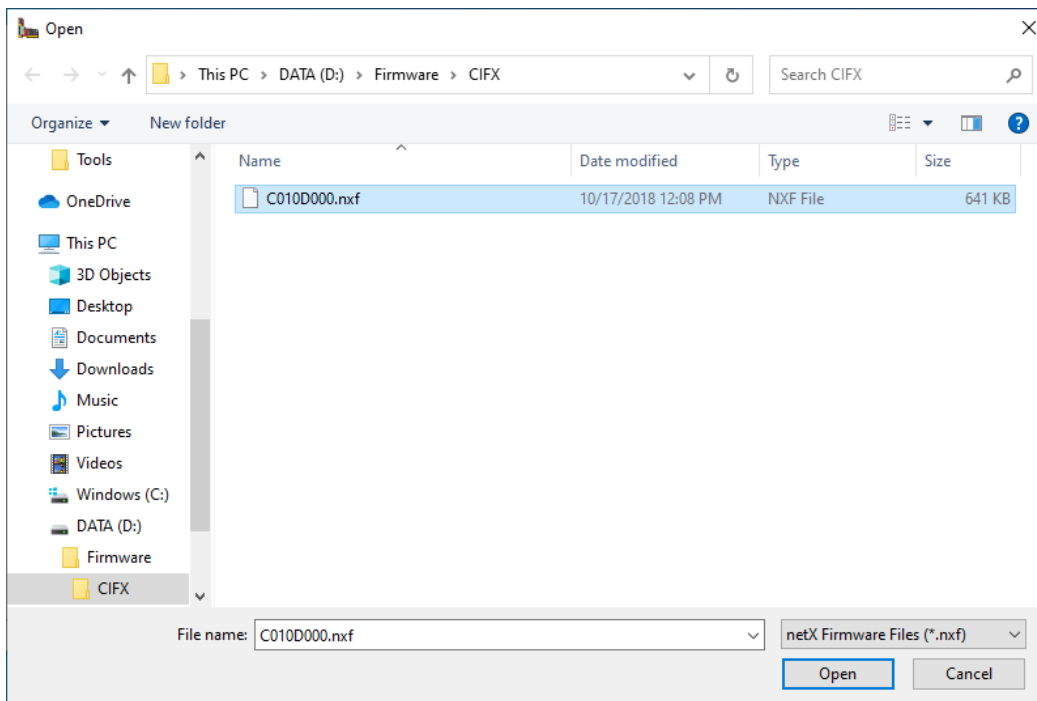
■   Select the firmware.

Figure 7: cifX Setup Utility: Choose firmware

Note: Make sure that the chosen firmware has the NDIS interface enabled in the tag list. How to edit the tag list of the firmware's Tag List settings see section *How to enable NDIS support in the tag list of* the firmware on page 19.

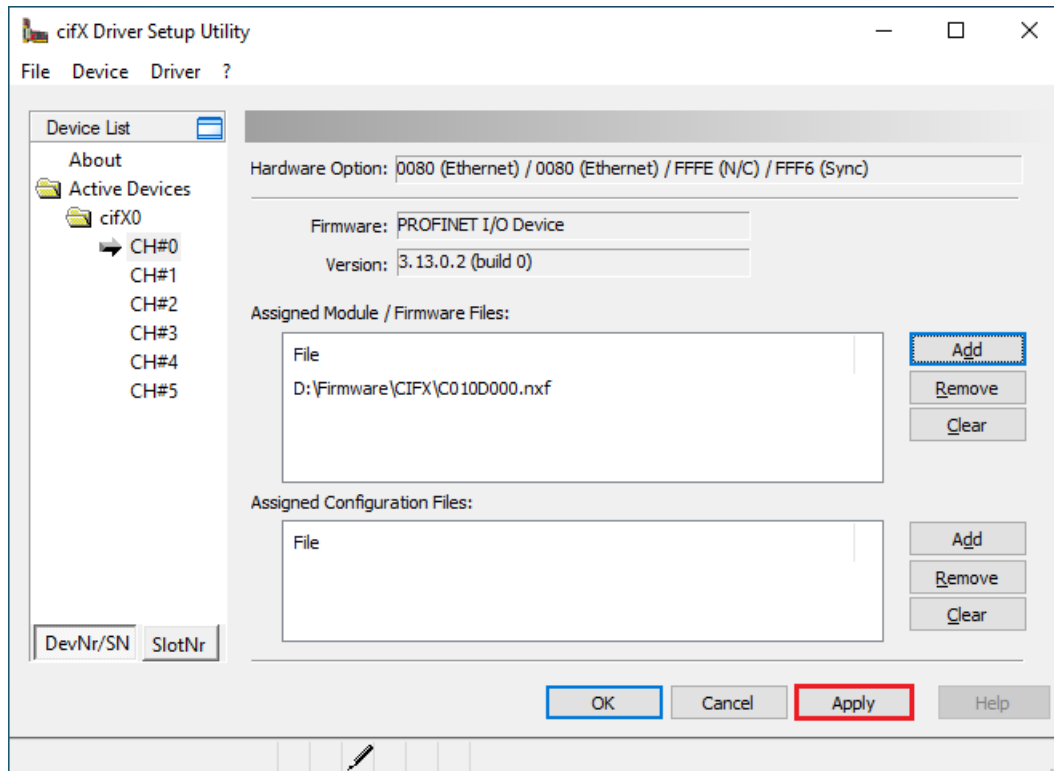■   Click **Apply** to downloading the firmware.

Figure 8: cifX Setup Utility: Download firmware

■   The following window will appear. To confirm the new configuration the card needs to be restarted. After clicking **Yes** the card is re-configured.
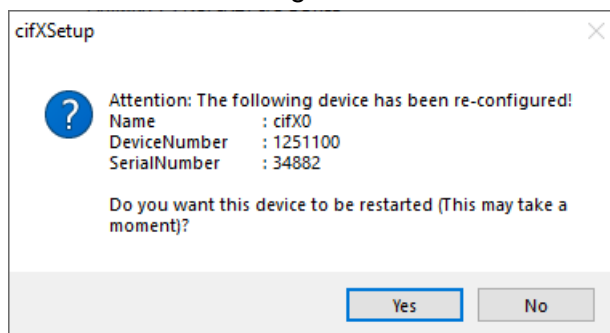

Figure 9: cifX Setup Utility: Confirm new settings

■   After the restart the cifX device provides the *cifX Ethernet Interface* and creates a new device (a virtual Ethernet Adapter).

To verify whether the cifX Ethernet Interface is available, see section *Verifying whether the cifX Ethernet Interface is available* on page 15.

3.2   Enabling the cifX Ethernet Interface (CIFX M223090 and CIFX 4000)

To enable the cifX Ethernet Interface (NDIS) for a CIFX M223090 and CIFX 4000 differs from other cifX devices (e.g. CIFX 50). For CIFX M223090 and CIFX 4000, use the **Device Explorer** software instead. The Device Explorer software downloads the firmware into the CIFX M223090 and CIFX 4000 and has to be used to configure the cifX Device Driver (instead of using the **cifX Setup** Utility). For a description of the Device Explorer software, see reference [3].

Figure 10 shows the driver setting in the Device Explorer software with the NDIS support enabled.
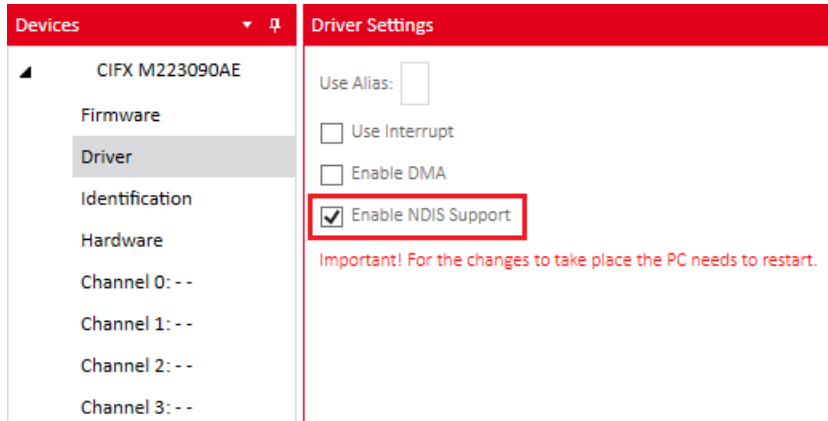

Figure 10: Device Explorer: NDIS support enabled

3.3   Verifying whether the cifX Ethernet Interface is available

You can use the Windows **Device Manager** and **Network Connection** to verify whether the cifX Ethernet Interface is available.

■   Verify whether the *cifX Ethernet Interface* is listed in the Windows Device Manager.
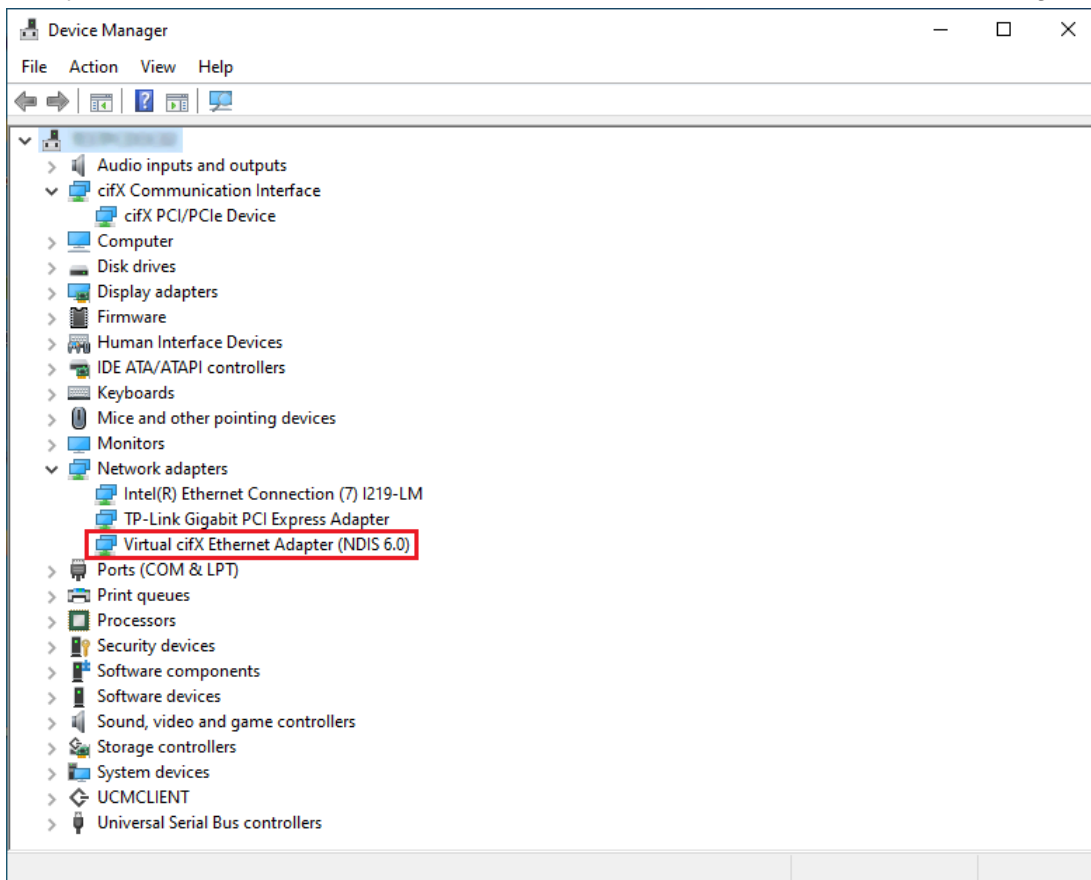

Figure 11: Windows Device Manager

Note: Disabling a *cifX Communication Interface* removes also the *cifX Ethernet Interface* which belongs to the same hardware. If the device's configuration did not changed until re-enabling, the corresponding *cifX Ethernet Interface* will reappear.

■   In Windows 10/11, open **Control Panel > Network and Internet > Network and Sharing Center > Change Adapter Settings**. The *cifX Ethernet Interface* appears in the Windows Network Connections as common network adapter.
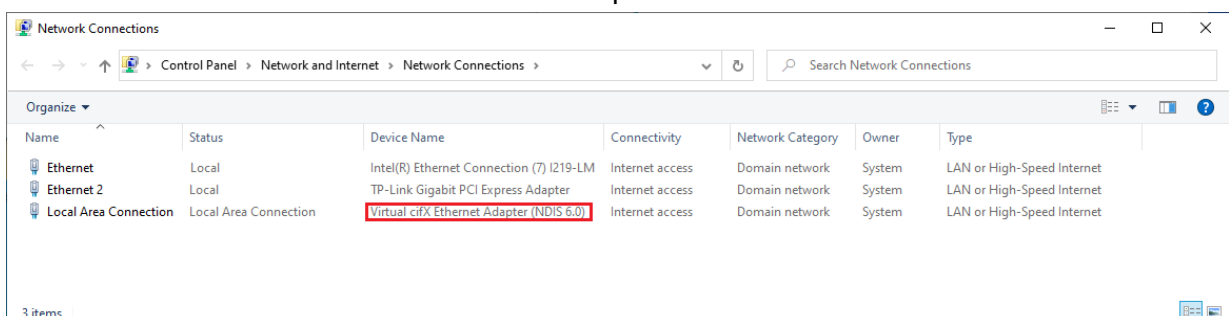

Figure 12: Windows network connections

If the **Virtual cifX Ethernet Adapter (NDIS …)** does not appear in the network connection then make sure that the used firmware file has NDIS support enabled. See section *How to enable NDIS support in the tag list of* the firmware on page 19.

4   Registry settings

The registry is used to store the device specific settings. When Plug&Play cards are used, the driver offers the possibility to store multiple configurations and assigning them by evaluating the Device- and Serial number of the card. For more information of standard cifX device registry settings please refer in the standard *cifX Device Driver* documentation.

The following table contains only the *cifX Ethernet Interface* specific registry entries.

cifXNDIS specific device configurations		
Value	**Type**	**Description**
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\CIFxDRV\ DeviceConfig\<devicename>]		
The device name is represented either by the device/serial number or the slot number. For more information please refer to the standard cifX Device documentation.		
cifXNDISSupport	REG_DWORD	0: No NDIS support. The cifX driver will not create any *cifX Ethernet Interface* for this device. != 0: If the firmware provides a Raw-Ethernet-Interface channel the cifX driver creates a cifX Ethernet Interface. This entry is set by the cifX Setup Utility.
[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\CIFxDRV\Parameters\ NDIS]		
PollingInterval	REG_DWORD	Poll interval in [ms] for devices operating in polling mode. *InterruptEnable* needs to be disabled (= 0).
InterruptEnable	REG_DWORD	0: Disables interrupt mode 1: Enables interrupt mode (interrupt mode is only working if the parent device is also running in interrupt mode, otherwise the driver runs in polling mode)

Table 6: cifXNDIS registry settings
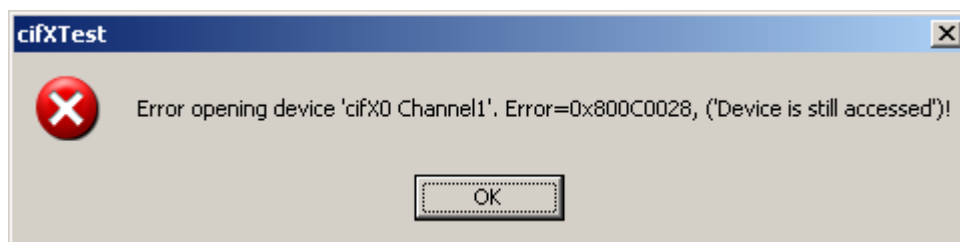
5 Question and answers

5.1 Error when accessing communication channel

When a *cifX Ethernet Interface* is activated the channel it is using to communicate (the Raw-Ethernet Channel) with the cifX device is occupied. So it is not possible to connect to same channel while running the *cifX Ethernet Interface*. A try to open an already busy channel returns with the error **0x800C0028**, "**Device is still accessed**". All other channels are not affected by the *cifX Ethernet Interface*. If this channel needs to be accessed from a user application using the cifX driver API, the cifX Ethernet interface needs to be disabled.

a

■ Example cifX Test tool:

Error message when accessing the Raw-Ethernet channel while using the device as a *cifX Ethernet Interface*.

Note:	It is not possible to access a device's dedicated Raw Ethernet channel while using the same device as a *cifX Ethernet Interface*. The channel is still accessed by the *cifXNDIS* driver. To get access to the channel the *cifX Ethernet Interface* needs to be disabled in the Windows Device Manager. Other channels of the device are still accessible (e.g.: from user application or from the cifX Test tool) during an active Ethernet Interface.

5.2 Network adapter disappears during device reset

When resetting a device or the system channel all of its channels will be re-initialized. Therefore a reset of a device, offering a *cifX Ethernet Interface,* as a consequence, also restarts the *cifX Ethernet Interface* and all connections using the Ethernet Interface get interrupted.

5.3 Interrupt and polling mode

By default the *cifX Ethernet Interface* is driven in the same mode like its parent device. It is possible to run the *cifX Ethernet Interface* in polling mode while running the parent device in interrupt mode by setting the registry entry *InterruptEnable=0* (see Registry settings on page 16). In case the parent device runs in polling mode the *cifX Ethernet Interface* supports only polling mode regardless the registry option.

5.4   cifX Ethernet Interface does not exists in the Windows Device Manager

A) Make sure the corresponding *cifX Communication Interface* (parent device) is enabled in the Windows Device Manager and it is in an operational state.

B) Run the cifX Setup Utility and check whether NDIS Support is enabled for specific device (see section Getting started with the cifX Ethernet Interface on page 10).

C) Check if the download firmware provides an appropriate Ethernet NDIS interface (see section Features on page 7).

D) Make sure the downloaded firmware, provides an Ethernet NDIS interface and the interface is enabled (see How to enable NDIS support in the tag list of the firmware on page 19).

E) Check if the registry entry **[HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\CIFxDRV\cifXNDIS\Enable** is set to 1. If set to 0 the cifX driver is prevented to create any cifX Ethernet Device.

Note: This flag is only used during installation and should normally not be changed by the user. When altering the flag the driver requires a restart to recognize.

5.5   cifX Ethernet Interface does not send or receive any data (Link state does not change)

Since cifX Driver version V1.2.3.0 the Ethernet firmware interface has changed. Running a firmware other than noted in section Features on page 7 may lead to communication errors between the bus driver and the firmware. Updating the firmware will solve the conflict.

5.6   How to enable NDIS support in the tag list of the firmware

To safe system resources NDIS support might be disabled by default. To enable NDIS support, see the following steps:

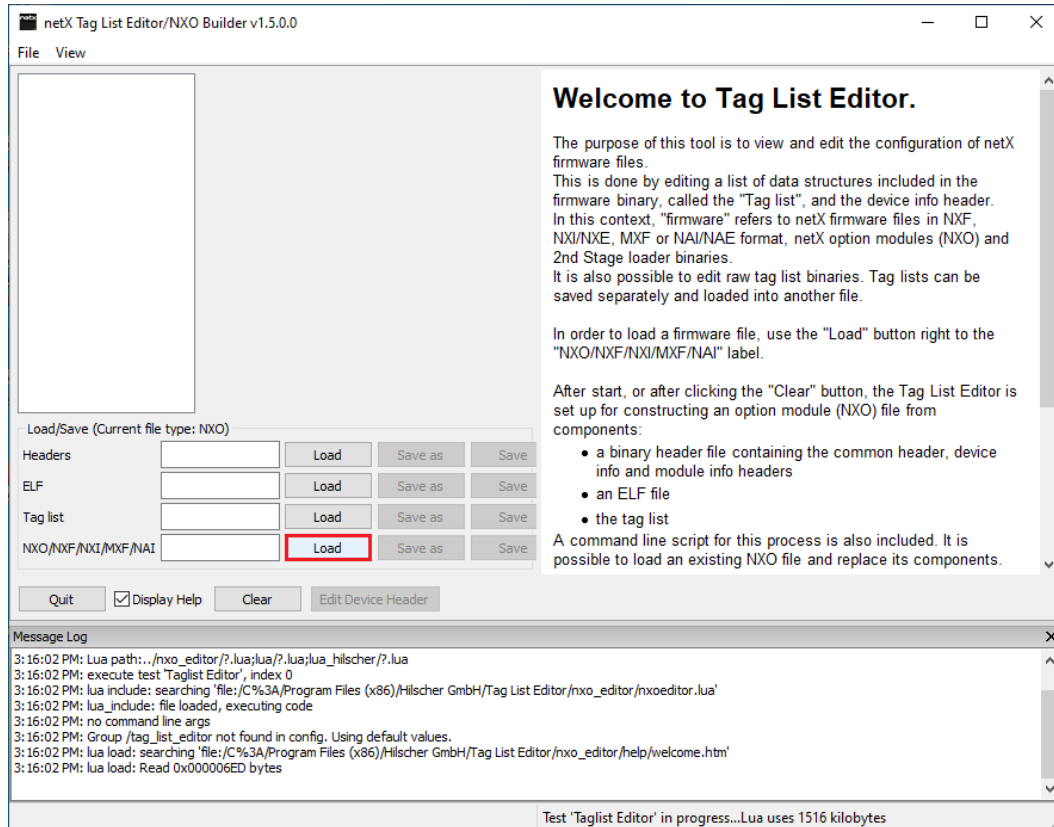■   Start the Hilscher netX Tag List Editor and click on **Load NXO/NXF** to load the firmware.

Figure 13: Tag List Editor: Start the Tag List Editor

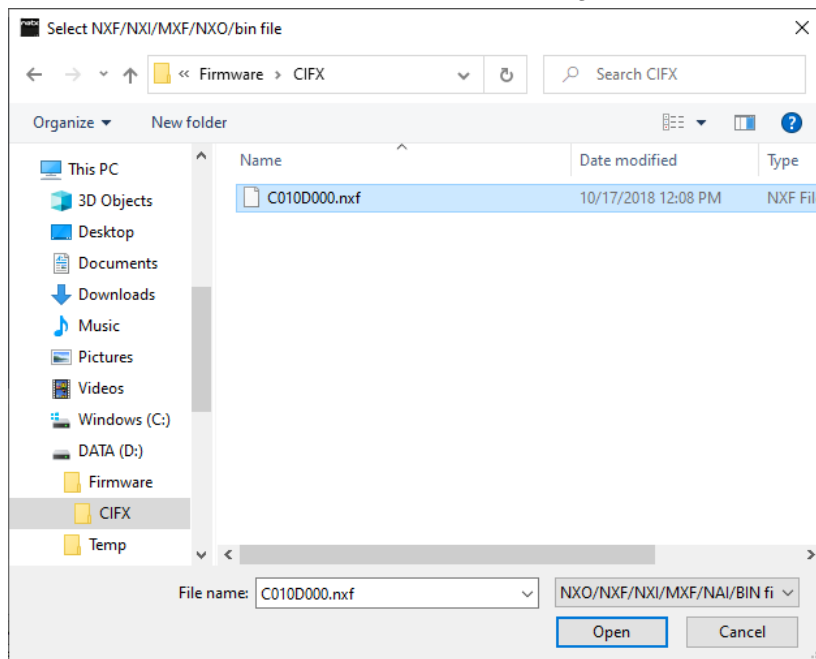■   Select the firmware which should be reconfigured.

Figure 14: Tag List Editor: Load the firmware

■ Click **Ethernet NDIS Support**.
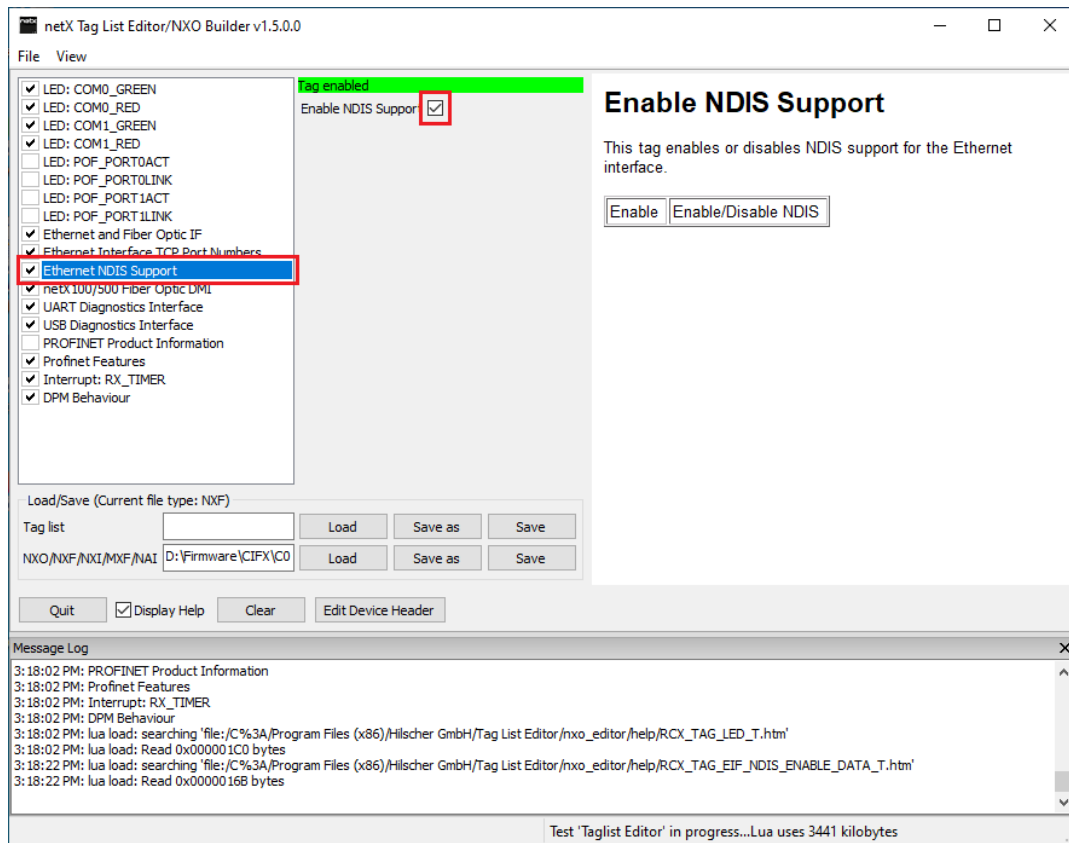
■ Set **Enable NDIS support**.

Figure 15: Tag List Editor: Edit the Tag List

■ Save the new configuration: Click **Save as** to save the reconfigured firmware.

■ Now NDIS support is enabled in the firmware and this firmware file can be downloaded. For more information how to install the reconfigured firmware refer to section *Getting started with the cifX Ethernet Interface* on page 10.

6   Appendix

6.1   List of tables

6.2   List of figures

6.3   Legal notes

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The customer must not use this confidential information to his own advantage or for his own purposes or rather to the advantage or for the purpose of a third party, nor must it be used for commercial purposes and this confidential information must only be used to the extent provided for in this agreement or otherwise to the extent as expressly authorized by the disclosing party in written form. The customer has the right, subject to the obligation to confidentiality, to disclose the terms and conditions of this agreement directly to his legal and financial consultants as would be required for the customer's normal business operation.

Export provisions

The delivered product (including technical data) is subject to the legal export and/or import laws as well as any associated regulations of various countries, especially such laws applicable in Germany and in the United States. The products / hardware / software must not be exported into such countries for which export is prohibited under US American export control laws and its supplementary provisions. You hereby agree to strictly follow the regulations and to yourself be responsible for observing them. You are hereby made aware that you may be required to obtain governmental approval to export, reexport or import the product.

6.4 Contacts

Headquarters

Germany
Hilscher Gesellschaft für
Systemautomation mbH
Rheinstrasse 15
65795 Hattersheim
Phone: +49 (0) 6190 9907-0
Fax: +49 (0) 6190 9907-50
E-Mail: info@hilscher.com
Support
Phone: +49 (0) 6190 9907-99
E-Mail: de.support@hilscher.com

Subsidiaries

China
Hilscher Systemautomation (Shanghai) Co. Ltd.
200010 Shanghai
Phone: +86 (0) 21-6355-5161
E-Mail: info@hilscher.cn
Support
Phone: +86 (0) 21-6355-5161
E-Mail: cn.support@hilscher.com

France
Hilscher France S.a.r.l.
69800 Saint Priest
Phone: +33 (0) 4 72 37 98 40
E-Mail: info@hilscher.fr
Support
Phone: +33 (0) 4 72 37 98 40
E-Mail: fr.support@hilscher.com

India
Hilscher India Pvt. Ltd.
Pune, Delhi, Mumbai
Phone: +91 8888 750 777
E-Mail: info@hilscher.in

Italy
Hilscher Italia S.r.l.
20090 Vimodrone (MI)
Phone: +39 02 25007068
E-Mail: info@hilscher.it
Support
Phone: +39 02 25007068
E-Mail: it.support@hilscher.com

Japan
Hilscher Japan KK
Tokyo, 160-0022
Phone: +81 (0) 3-5362-0521
E-Mail: info@hilscher.jp
Support
Phone: +81 (0) 3-5362-0521
E-Mail: jp.support@hilscher.com

Korea
Hilscher Korea Inc.
Seongnam, Gyeonggi, 463-400
Phone: +82 (0) 31-789-3715
E-Mail: info@hilscher.kr

Switzerland
Hilscher Swiss GmbH
4500 Solothurn
Phone: +41 (0) 32 623 6633
E-Mail: info@hilscher.ch
Support
Phone: +49 (0) 6190 9907-99
E-Mail: ch.support@hilscher.com

USA
Hilscher North America, Inc.
Lisle, IL 60532
Phone: +1 630-505-5301
E-Mail: info@hilscher.us
Support
Phone: +1 630-505-5301
E-Mail: us.support@hilscher.com