

Software Manual – Programming and Integration

SEA 9719

IEEE 802.11p Communication Module (V2X)



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1 Change Notes

#	Version	Changes
1	1.0	Initial release of the SEA 9719 driver software
2	1.1	Feature release
3	1.2	Feature release
4	1.2.a	Maintenance release

2 Getting Started

2.1 General

Before starting to work with the SEA 9719 module please read this document and the complete hardware manual carefully. If there are any questions about operating the module or if any term is not understood, please contact the vendor before using the module. Please check the download area on the S.E.A. website <http://www.sea-gmbh.com> for updates of the manuals.



Refer to the hardware manual for details on operation instructions, safety guidelines and specifications for the SEA 9719 module.



Refer to the appropriate National Instruments™ documentation for details on National Instruments hardware.

We believe that all information in this manual is accurate. The document has been carefully reviewed for technical accuracy. In the event of technical or typographical errors, we reserve the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should consult the vendor if errors are suspected.





2.2 End User License Agreement (EULA)

Before operating the SEA 9719 module and the provided software you have to agree to the terms and conditions (EULA). This agreement is part of the software installation procedure. If you do NOT agree you can send back the hardware and software package within a period of two weeks after delivery. In this case S.E.A. will refund the product price and shipping costs.

In addition, the terms and conditions are available through the LabVIEW menu after installation (Tools > SEA > SEA 9719 > Legal Information).

2.3 Symbols, Notations and Nomenclature

To improve clarity specific structuring elements (symbols) are used which have the following meaning:

Symbol	Meaning
<i>Names</i>	Specific names are printed using an <i>italic font</i>
[Text]	Place holders are marked by squared brackets
	Locations (paths, menus, URLs...) are printed using a <code>courier font</code>
	The yellow sign highlights important notes and warnings
	The blue mark highlights tips
	Reference to other documents

For a better understanding, a short list of abbreviations used in this document will be given:

Name	Meaning
API	A pplication P rogramming I nterface
ECU	E lectronic C ontrol U nit
FPGA	F ield P rogrammable G ate A rray
HIL	H ardware- I n-the- L oop
MAC	M edium A ccess C ontrol
NI	N ational I nstruments
PHY	P hysical layer
SEA	S.E.A. - Science & Engineering Applications Datentechnik GmbH
SDR	S oftware D efined R adio
VIPM	J KI V I P ackage M anager

Tab. 1: Nomenclature

3 Introduction

The *SEA 802.11p Add-On for LabVIEW* software environment enables implementations of 802.11p transceivers (PHY and MAC) for signalling tests with additional testing features. It consists of two software packages:

- *SEA 802.11p – cRIO Drivers (SEA 9719)*
Is subject to this document.
- *SEA 802.11p – LabVIEW API*
Is provided and documented in a separate package.

The *SEA 802.11p – cRIO Drivers (SEA 9719)* package provides access to configure the SEA 9719 cRIO module.

SEA 802.11p implementations can be created by using basic data transfer functions provided by the *SEA 802.11p – LabVIEW API* (separate installer). Data transmission applications with Packet Replay (PR) functionality are not supported by the SEA 9719 module.

4 Installation

There is a driver software for the module SEA 9719 named *SEA 802.11p – cRIO Drivers (SEA 9719)*. The driver software has to be installed on a development PC only (please refer to the hardware requirements in section 4.1 below).

The driver software can be directly selected and installed from the package list displayed in the *JKI VI Package Manager (VIPM)*. Alternatively the driver software can be downloaded as a VI package (file name: `sea_9719-x.x.x.x.vip`) either from the *NI Tools Network* or from the SEA download site and installed separately.

Due to continuous improvements the required software is not enclosed with the module hardware when shipped. The latest version of the driver software can be downloaded from the SEA web site:

<http://www.sea-gmbh.com>

On the main page select *Support* from the main menu. On the support page select *Downloads* from the local menu and click on the *Download Area* button. On the download site select your module type from the *Hardware Products* category.

In order to install the software package double-click its VIPM list item or open the VIP-file inside the *JKI VI Package Manager* and follow the instructions on the screen. This procedure installs the driver software which includes software tools and the related documentation.

In the LabVIEW development environment, the 802.11p functions of the SEA 9719 module are available via an application programming interface (API). This API palette is provided as a separate VI package named *SEA 802.11p – LabVIEW API* which is also available at the sources mentioned above. The *SEA 802.11p – LabVIEW API* package includes examples and related documentation.

Further resources (if available) like application notes, drawings etc. can be downloaded separately from the SEA web site.

4.1 Hardware Requirements

The SEA 9719 module requires at least a PC to program an application. In order to run the application an NI CompactRIO Real-Time controller with the SEA module inserted in any of the chassis slots is required.

The driver software requires a PC for programming (development PC) and a NI CompactRIO with FPGA chassis to run the application (run-time device).

4.2 Software Requirements

The development PC and the run-time device are described in the hardware requirements section above.

Software requirements for the development PC:

- *JKI VI Package Manager 2014* or higher
- *NI LabVIEW Development environment 2014* or higher
- *NI LabVIEW Real-Time 2014* or higher
- *NI LabVIEW FPGA 2014* or higher
- *SEA 802.11p - LabVIEW API* version 1.1 or higher (Per definition the *SEA 802.11p – cRIO Drivers (SEA 9719)* software package depends on the *SEA 802.11p – LabVIEW API*. Hence, the installation procedure of the *SEA 802.11p – cRIO Drivers (SEA 9719)* package will also install the *SEA 802.11p – LabVIEW API* automatically if it is available on the local disk.)

Software requirements for the run-time device (NI CompactRIO):

- *NI LabVIEW Run-Time Engine / LabVIEW Run-Time Engine for Real-Time targets*

SEA 9719 driver software does not support the *Scan Interface* mode at present.

5 Quick Start

This section demonstrates how the SEA 9719 module can be easily integrated into an existing CompactRIO (cRIO) system.

For further examples regarding the usage of the 802.11p-based data transmission, please refer to the examples provided by the *SEA 802.11p – LabVIEW API* package and the respective documentation.

Refer to the hardware manual of the module for proper installation of the hardware.

Please follow the steps below to get the SEA 9719 module up and running:

1. Install the SEA 9719 driver software. For this, the *JKI VI Packet Manager (VIPM)* is required. If VIPM is not yet installed on your system please start LabVIEW and select *Tools → Find LabVIEW Add-ons....* Complete the VIPM installation by following the instructions.
2. Install the SEA 9719 API software. For this, the *JKI VI Packet Manager (VIPM)* is required. If VIPM is not yet installed on your system please start LabVIEW and select *Tools → Find LabVIEW Add-ons....* Complete the VIPM installation by following the instructions.
3. Configuration of the SEA 9719 module:
 - Connect the SEA 9719 module to the development PC via Ethernet cable and ensure a correct IP configuration of participating devices.
 - Perform a configuration of the SEA 9719 module as described in Chapter 7.
 - Disconnect the SEA 9719 module from the development PC.
4. Mount the SEA 9719 module into your CompactRIO system in a slot of your choice (for this tutorial slot 1 has been used). Make sure your CompactRIO system is installed with LabVIEW 2014 or later.
5. Connect the SEA 9719 module to the CompactRIO system via Ethernet cable and ensure a correct IP configuration of participating devices.
6. Connect your CompactRIO system to the development PC via Ethernet cable and ensure a correct IP configuration of participating devices.
7. Start LabVIEW and select *New → Empty Project* within the *Getting Started* window.
8. The project explorer window appears. In this window select the uppermost item in the tree (*Project: Untitled Project x.lvproj*) and select *New → Targets and Devices* right-clicking on it:
9. Choose *Discover an existing target(s) or device(s)* and unfold the *Real-Time CompactRIO* folder

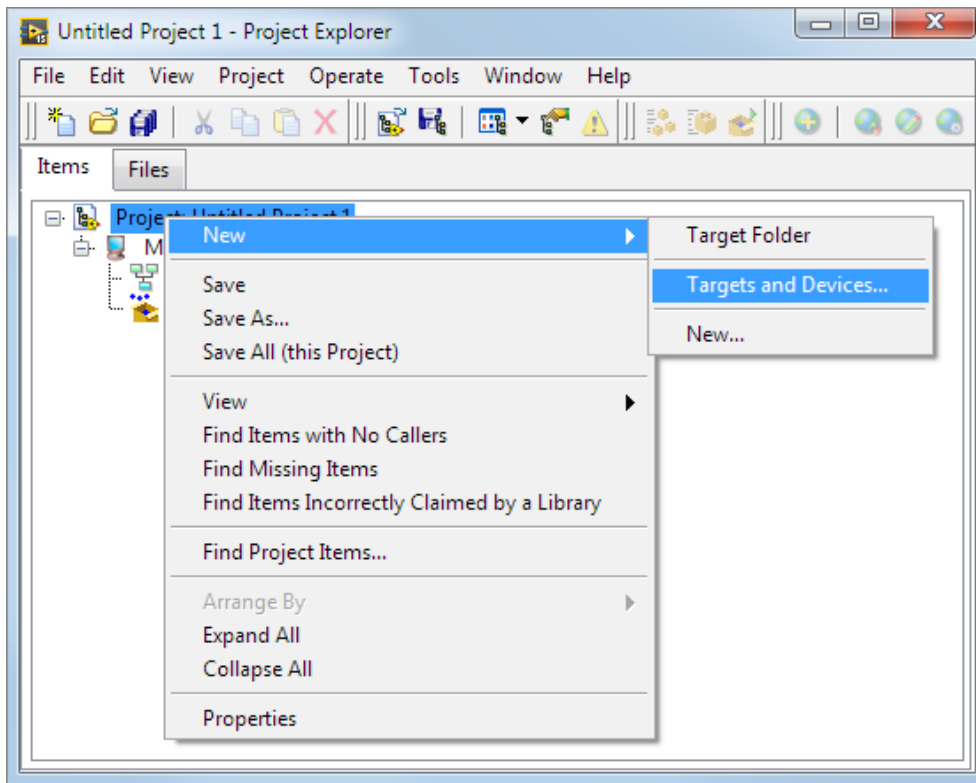


Fig. 1: Quick Start – Add CompactRIO

10. Select your CompactRIO system from the list of available targets and click *OK*.
11. In the dialog box *Select Programming Mode* select the mode *LabVIEW FPGA Interface* and confirm with *Continue*.

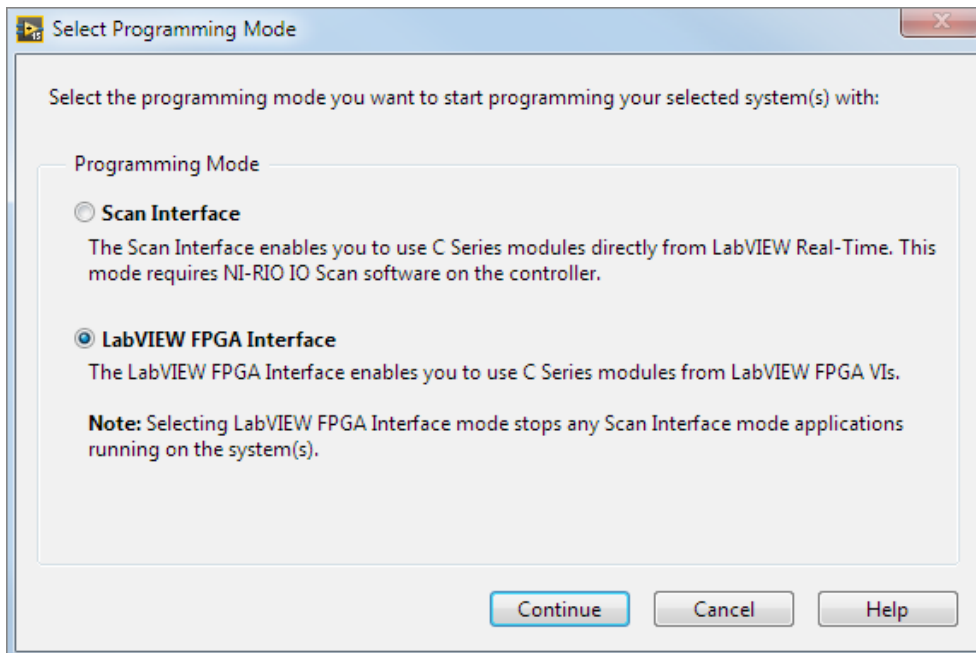


Fig. 2: Quick Start – Select programming mode

12. Discover the inserted cRIO modules (if necessary). For this, press the *Discover* button in the shown dialog box:

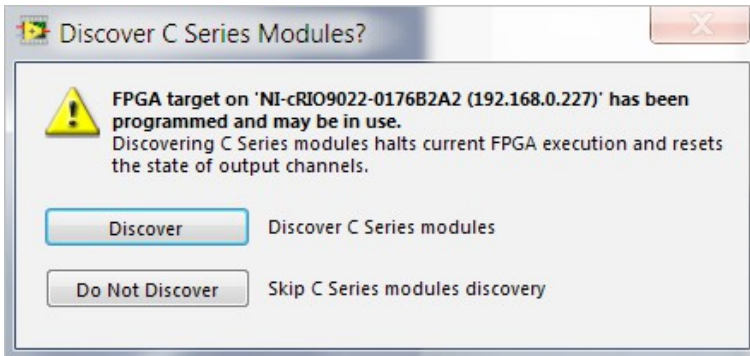


Fig. 3: Quick Start – Discover cRIO modules

- 13. The configuration is completed. After a successful configuration, the project explorer window should look similar to Fig. 4.

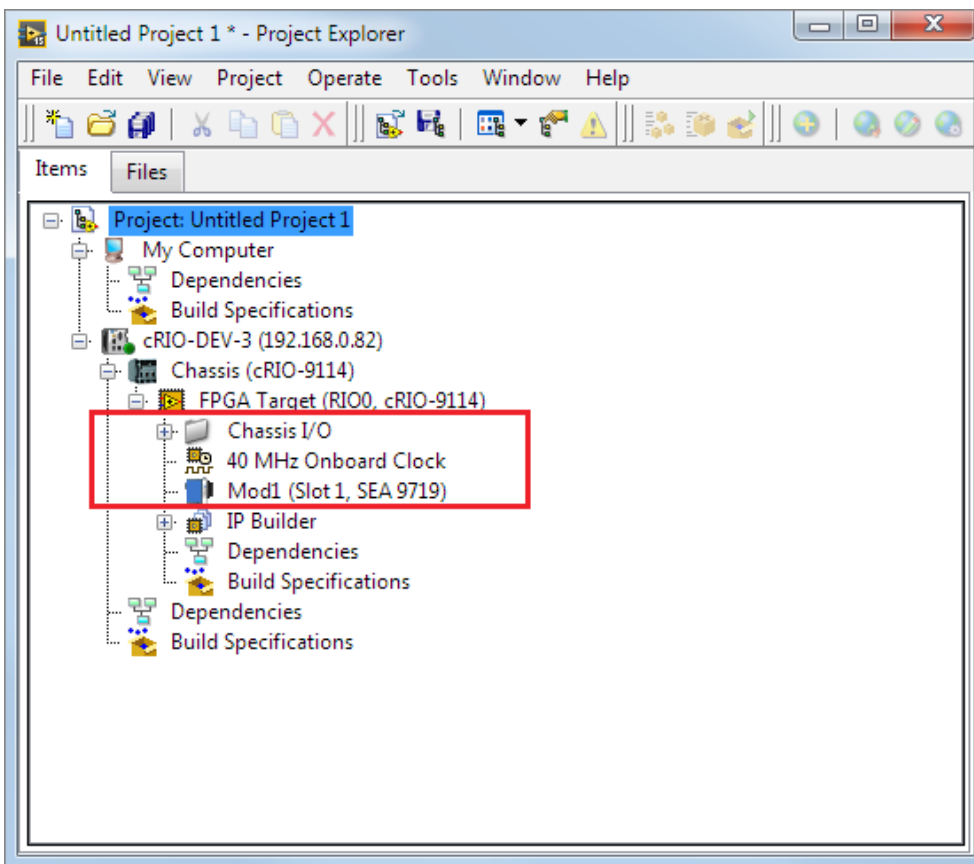


Fig. 4: Quick Start – Project after configuration

The project is now fully configured including the SEA 9719 module (see red framed items in the project tree in Fig. 4).

You can continue from here to learn how to use the *SEA 802.11p – LabVIEW API* functions. For this, please refer to the documentation and the example LabVIEW projects of the separate VI package *SEA 802.11p – LabVIEW API*.

6 Functional Overview

6.1 CompactRIO (cRIO) Platform

The SEA 9719 module is compatible with all CompactRIO and CompactDAQ (with real time controller) chassis from National Instruments. With CompactRIO systems the full range of functionality is available, including Ethernet interface and FPGA (FPGA for meta data only). As CompactDAQ systems do not provide the FPGA capability, the FPGA functionality is not available for them.

The Ethernet interface is required for the 802.11p communication. The FPGA interface allows to read out general module properties.

In order to use the Real Time interface the module needs to be connected with the CompactRIO (or CompactDAQ) system by an Ethernet cable. In order to use the FPGA interface the module needs to be inserted in any of the slots of the CompactRIO chassis. Both interfaces can be operated independently.

6.2 SEA 9719 Functionality

As an IEEE 802.11p radio, the SEA 9719 module enables CompactRIO systems to communicate according to the IEEE 802.11p protocol. It is typically used in combination with the *SEA 802.11p* application programming interface (API). By this, various 802.11p communication implementations can be realized, e.g. for 802.11p-related monitoring, logging, and (functional, HIL, or production) tests.

The module features two hardware interfaces that directly interact with each of the two targets of a CompactRIO system: Real Time and FPGA.

- Real Time interface: The hardware interface to the Real Time Controller is provided via the *Ethernet* port of the module. This interface provides access to the 802.11p communication functions.

The *SEA 802.11p* API of the Real Time interface is provided as a separate software package *SEA 802.11p – LabVIEW API* (see Chapter 4).

All *SEA 802.11p* API functions are accessible through the LabVIEW functions palette. For a complete list of available API functions, please refer to the documentation of the separate VI package *SEA 802.11p – LabVIEW API*.

- FPGA interface: The hardware interface to the FPGA is provided through the 15 D-SUB connector on the back side of the module. This interface allows to read the module's meta data (serial number, module ID, vendor ID) (see Chapter 8).

The drivers are not enclosed with the module when shipped, but need rather to be downloaded separately from the download area at www.sea-gmbh.com (see Chapter 4).

7 Configuration

The SEA 9719 module can be configured using the *SEA 9719 Device Manager* tool (see Fig. 6), which is part of the *SEA 802.11p – SEA 9719 Drivers* package.

The *SEA 9719 Device Manager* is considered to provide a central access to the most settings of the SEA 9719. The information about the current module type and its firmware version is also shown.

In order to perform the configuration, the SEA 9719 module needs to be powered on and connected to your PC through the *Ethernet* port.

In order to ensure a discovery of the module, the IP address of the SEA 9719 module and of the PC should be located in the same subnet range. The default IP address of the SEA 9719 module is 192.168.24.200, if a factory reset is executed it also gets set back to that address.

The *SEA 9719 Device Manager* can be opened via the LabVIEW menu after installation:

Tools > SEA > SEA 9719 > SEA 9719 Device Manager

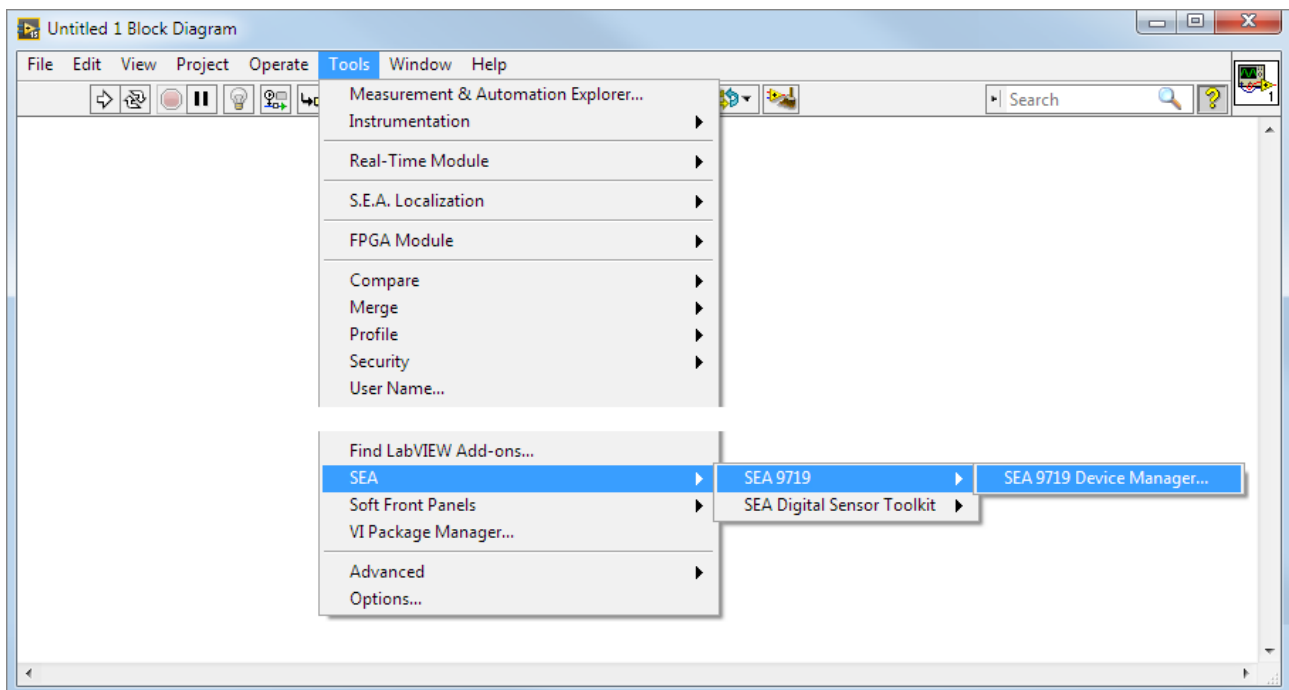


Fig. 5: SEA 9719 Device Manager entry in Tools menu

The *Windows Firewall* might recognize the execution of the *SEA 9719 Device Manager* and inform the user about it.

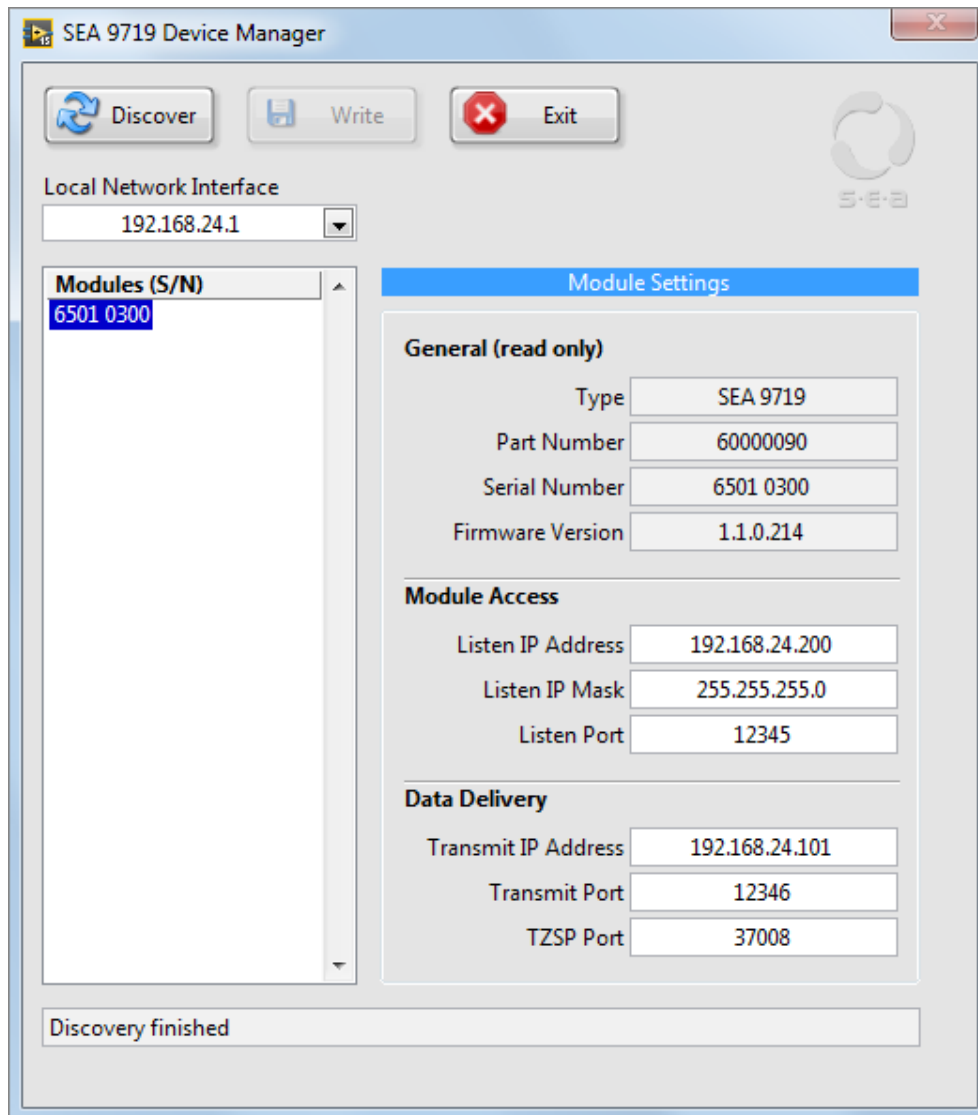


Fig. 6: SEA 9719 Device Manager with device configuration information

In the *Local Network Interface* field, enter the IP address of the PC's network interface which provides the connection to the module.

Press the *Discover* button in order to search for all available *SEA 9719* modules.

All modules, which were discovered by the *SEA 9719 Device Manager* are listed with their serial numbers (S/N) on the left. For configuration, select one of the modules in the list.

Discover also updates displayed values and replaces them by those values, which are currently saved to the corresponding module.

Press the *Write* button in order to write the values, which are currently displayed in the sections *Module Access* and *Data Delivery*, to the module. All writable values are defined in Table 2.

Press the *Exit* button in order to close the *SEA 9719 Device Manager*.

Program element	Description
<i>Discover</i>	Discovers SEA 9719 modules on network.
<i>Write</i>	Writes current settings to the selected module.
<i>Exit</i>	Exits the application. If any settings are not yet saved the user is asked to save before exit.
<i>Local Network Interface</i>	Select the desired network interface for module discovery.
General (read only)	
<i>Type</i>	Shows the type of currently selected module.
<i>Part Number</i>	Shows the SEA part number of currently selected module.
<i>Serial Number</i>	Shows the serial number of currently selected module.
<i>Firmware Version</i>	Shows the firmware version currently installed on selected module.
Module Access	
<i>Listen IP address</i>	At this IP address the module listens for data from the overlaying application (802.11p API).
<i>Listen IP Mask</i>	Subnet mask for the <i>Listen IP Address</i> .
<i>Listen Port</i>	At this IP port the module listens for data from the overlaying application (802.11p API).
Data Delivery	
<i>Transmit IP address</i>	Any data the module transmits via its wired connection is sent to this (remote) IP address. This setting is typically the IP address of the device that runs the 802.11p API (LabVIEW or C++).
<i>Transmit port</i>	Any data the module transmits via its wired connection is sent to this (remote) IP port. This setting is typically the local IP port of the device that runs the 802.11p API (LabVIEW or C++).
<i>TZSP port</i>	The module delivers TZSP packages to this (UDP) port.

Tab. 2: Device Manager program elements

8 Programming



For SEA 9719 module programming, the development system requires the installation of two packages: the SEA 9719 driver software and the *SEA 802.11p – LabVIEW API* software packages (see Chapter 4).

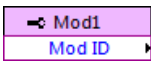
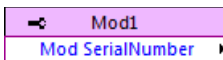
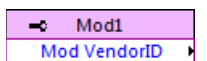
This chapter just describes the usage of the module's *FPGA I/O Property Nodes* which allow to read the module's meta data (*serial number*, *module ID*, and *vendor ID*).

For information about *SEA 802.11p – LabVIEW API* programming, please refer to the documentation and the examples of the separate VI package *SEA 802.11p – LabVIEW API*.

8.1.1 FPGA I/O Property Nodes

Several *FPGA I/O Property Nodes* can be used within a LabVIEW FPGA application.

The property nodes are recognizable by the prefix *Mod*. The *Mod* properties deliver common information about the module type and identity and are read only.

Node	Direction	Description
	read only	Retrieves the module ID from the module. For the SEA 9719 module, it retrieves 80 (=0x50).
	read only	Retrieves the serial number from the module. The serial number is a 8 digit decimal or BCD number.
	read only	Retrieves the Vendor ID. This value identifies the manufacturer of the module. S.E.A. modules always return 0x4711.

Tab. 3: SEA 9719 – Mod Property Nodes

8.2 Example

The following steps describe how to implement a simple FPGA application in order to read the module property information which is provided by *Property Nodes*. For this, create a new FPGA VI in a LabVIEW project which was created as described in Chapter 5.

1. Create a new FPGA VI in the project explorer window. For this right-click on the *FPGA Target (RIO0...)* and select *New -> VI*. Refer to the figure below:
2. Open the block diagram of the VI just created and place an *FPGA I/O Property Node* from the functions palette (*FPGA I/O -> FPGA I/O Property Node*) on the block diagram. Afterwards, select e.g. *FPGA I/O Mod1* (depending on the chassis slot used).
3. Select the Property *Mod ID*. Pull out the I/O node and add the Properties *Mod Serial Number* and *Mod Vendor ID* (see Figure 7). Create indicators for all I/Os. Move all items into a *True* case of a *Case Structure* which is defined by a *Boolean* control with *Latch when released* functionality. Finally, embrace all items with a *While* loop.
4. Save the created FPGA VI, create a build specification and compile it.

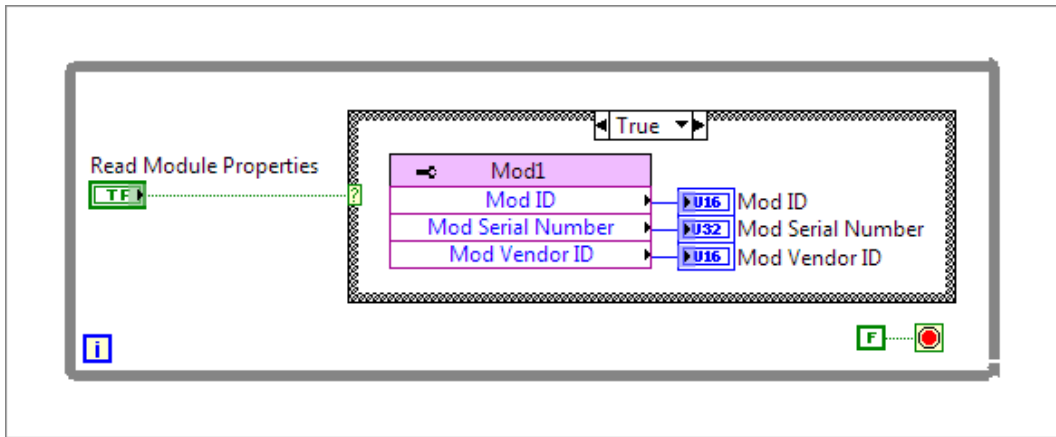


Fig. 7: FPGA I/O Property Nodes – Block diagram of an example FPGA VI

5. Running the VI will enable you to read the properties of the module.

8.3 Error Codes

In case of unexpected behavior, the driver software returns an error cluster. The option *Show Error Terminals* of a node (right-clicking on the node) must be enabled to obtain error information.

Adding error terminals will increase FPGA usage and compilation time.

The possible error and warning codes are listed in table 4.

Error Code	Reported by	Description
Module Errors		
65536	any node	No module or invalid module type found. Please insert SEA 9719 module into the correct slot.
65537	any node	Incorrect module type found. Only SEA 9719 modules will work with this driver version. Please check if all modules are inserted into the right slot.

Tab. 4: Error and Warning Codes

9 Deployment

If an application containing the SEA 9719 is deployed to a run-time target system (NI CompactRIO) the following parts are necessary to be deployed along with the compiled application (i.e. `rtexe`):

- LabVIEW Run-Time Engine 2014 or higher

10 Trouble Shooting

The following hints might help you to determine if the module and/or software behaves correctly and how to identify module failures.

#	Problem	How to solve
1	The module is not detected within LabVIEW	<ol style="list-style-type: none">1. Make sure you have the CompactRIO system powered and connected to your PC.2. Make sure you have installed the current SEA 9719 driver software (≥ 1.2).3. If previous driver versions exist, uninstall them properly before installing the current driver.

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