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Raspberry Pi Demo Kit

Quick Start Guide

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Changelog

Version	Changes
1.0	Initial release
1.1	Update to raspi shield

1 Introduction

This document describes how start with the demonstration kit combining the port SoM Arduino Shield with the Raspberry Pi 3.
Within the document, special recommendations are given marked by two signs:

ℹ Special information giving hints to avoid common pitfalls when using the software

⚠ Special information to prevent malfunction of the software or that require special attention of the user.

2 Initial Setup

The demo kit consists of

- a Raspberry Pi 3 B+,
- an adapter board Raspberry Header → Arduino Header,
- the Arduino shield board containing the communication core,
- a power supply for Raspberry Pi and
- a software package
  - Management Tool for first steps with the device
  - Demo applications

2.1 Raspi shield board

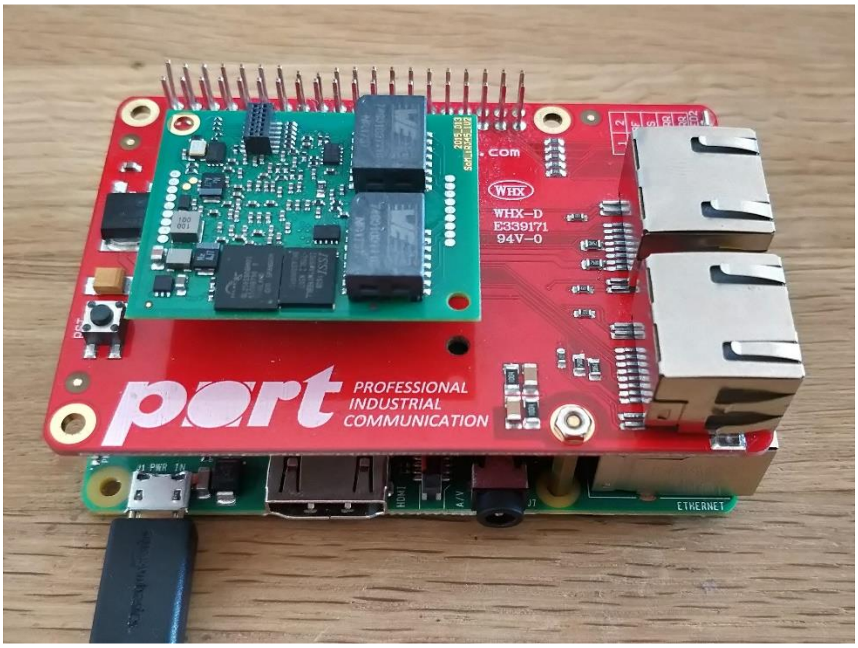


Figure 1: Raspi shield board

The raspi shield board comes ready to use, no configuration is required.

2.2 Preparing the Raspberry Pi

Connect the Raspberry Pi to your local network via Ethernet. During bootup, the Raspberry tries to acquire an IP address via DHCP. To access the device, either connect a monitor, keyboard and mouse via the provide HDMI and USB connectors or connect to the device via SSH after bootup. Use the following credentials for SSH access:

- Username: pi
- Password: raspberry

⚠ Do not expose the Raspberry Pi to the Internet. The SSH username and password are set to the default values!

To power up the Raspberry Pi, connect the provided power supply with a power socket that provides 110V – 240V. This will also power up the Arduino shield board with the communication module.

⚠ To avoid electrical damage, only use the provided power supply! Only connect to power sockets with the given voltage range!

2.3 Preparing the demo kit software

2.3.1 Management Tool

Please unpack the delivery "iRJ45 Management Tool-*-win32.win32.x86_64.zip" to a local folder. The resulting folder contains the executable “mantool”, which can be started.

To use the PROFINET master functionality, WinPCap[1] needs to be installed.

2.3.2 Demo applications

Unzip the provided source code on a Ubuntu based Linux system.
To compile software, install the following packages on a Ubuntu based system:

- build-essential
- gcc-arm-linux-gnueabi

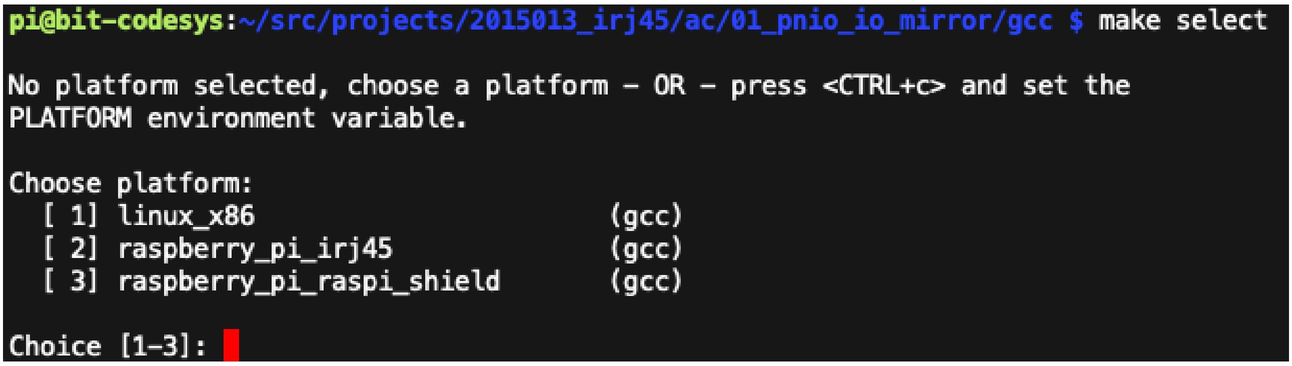
[1] https://www.winpcap.org/

3 Compiling and starting applications

The software package for the demo kit provides several examples for the AC.

The projects to compile are available in the folder `projects/2015013_irj45/ac`. To compile a single project, open a shell and go to the gcc subfolder of a project e.g. `projects/2015013-irj45/ac/01_pnio_mirror/gcc`.

Now run `make`. The compile shell will now show the selection dialog for the target platform. Choose 3 for the Raspberry Pi Shield.



```
pi@bit-codesys:~/src/projects/2015013_irj45/ac/01_pnio_io_mirror/gcc $ make select

No platform selected, choose a platform - OR - press <CTRL+c> and set the
PLATFORM environment variable.

Choose platform:
  [ 1] linux_x86                  (gcc)
  [ 2] raspberry_pi_irj45         (gcc)
  [ 3] raspberry_pi_raspi_shield  (gcc)

Choice [1-3]:
```

Figure 2: Target platform selection

The build system will then start to build the software. The result file is stored in the subfolder `build/raspberry_pi_raspi_shield` and name `goal_raspberry_pi_raspi_shield.bin`.

To copy the binary to the Raspberry Pi, you must log on to the Raspberry Pi and stop the already existing process with the command `sudo systemctl stop irj45demo.service`.

Now copy the binary via SCP to the device. Alternatively, you can also use an USB flash drive for this purpose. The binary `goal_raspberry_pi_irj45.bin` needs to be stored in `/home/pi/goaldemo/`.

For debugging purpose it is possible to start the binary manually using following commands:

```
> cd /home/pi/goaldmo
> ./goal_raspberry_pi_irj45.bin
```

Reboot the Raspberry Pi. The demo application is started during bootup via service. The service description can be found at `/etc/systemd/system/irj45demo`.

The service executes the script `/etc/irj45demo`, which beside executing the binary performs a reset of the SoM module using GPIOs of the raspberry pi.

Also see section 5 for a description of example programs.

3.1 Compilation on target

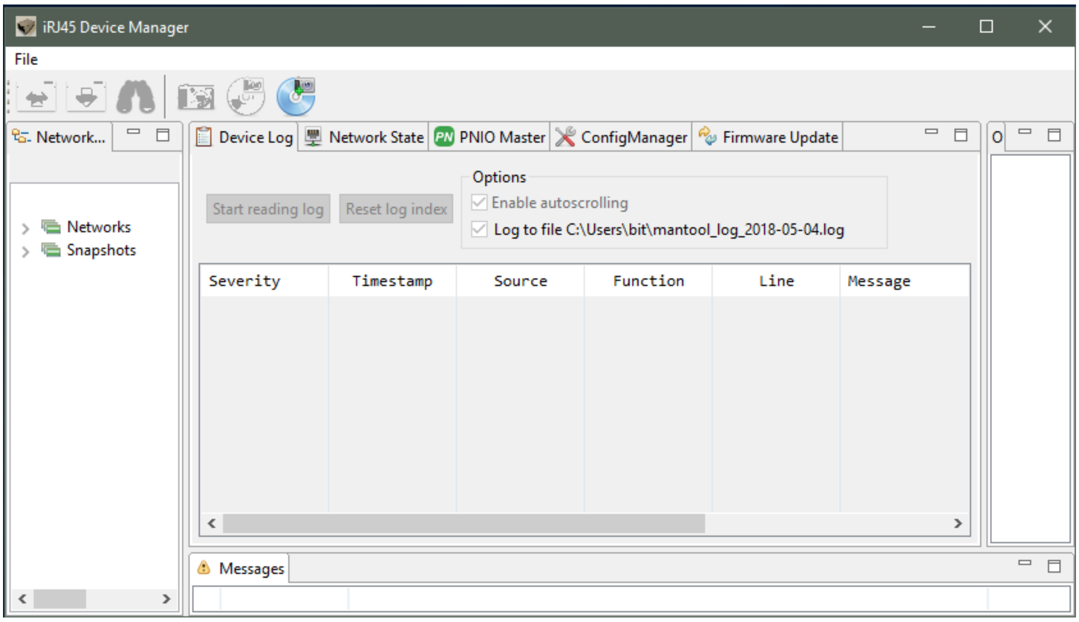
The source can be put on the raspberry pi computer and compiled there. The instructions are the same as in the previous chapter. Only for the compile step, an different approach is required. Call make the following way:

```
make CROSS_COMPILE=
```

This will call the native gcc compiler instead of the cross compiler, thus natively compiling the binary on the raspberry pi.

4 Management Tool

The Management Tool allows development related configuration and management of the application. This management is based on a UDP broadcast communication. Thus, it works independently from IP settings of the management PC and SoM.



☑ Enable autoscrolling
☑ Log to file C:\Users\bit\mantool_log_2018-05-04.log

Severity	Timestamp	Source	Function	Line	Message

Figure 3 Management Tool main window

This tool is organized in panels. The “Network Navigator” shows a list of available networks. The panel “Messages” shows information regarding actions. The panel “Outline” shows additional information depending on the selected function panel.

Following function panels are available:

Panel	Function
Device Log	Shows log messages of the running application from both communication controller (CC) and application controller (AC).
Network state	Shows link state of the available network interfaces of the SoM.
PNIO Master	Provides simple PNIO master functionality.
ConfigManager	Provides access to the config manager variables of the SoM.
Firmware Update	Allows update of the firmware of the SoM.

4.1 Device Detection

At first a communication needs to establish with the SoM. Thus, connect the SoM to the network. Between the management PC and the SoM a network connection must be possible.

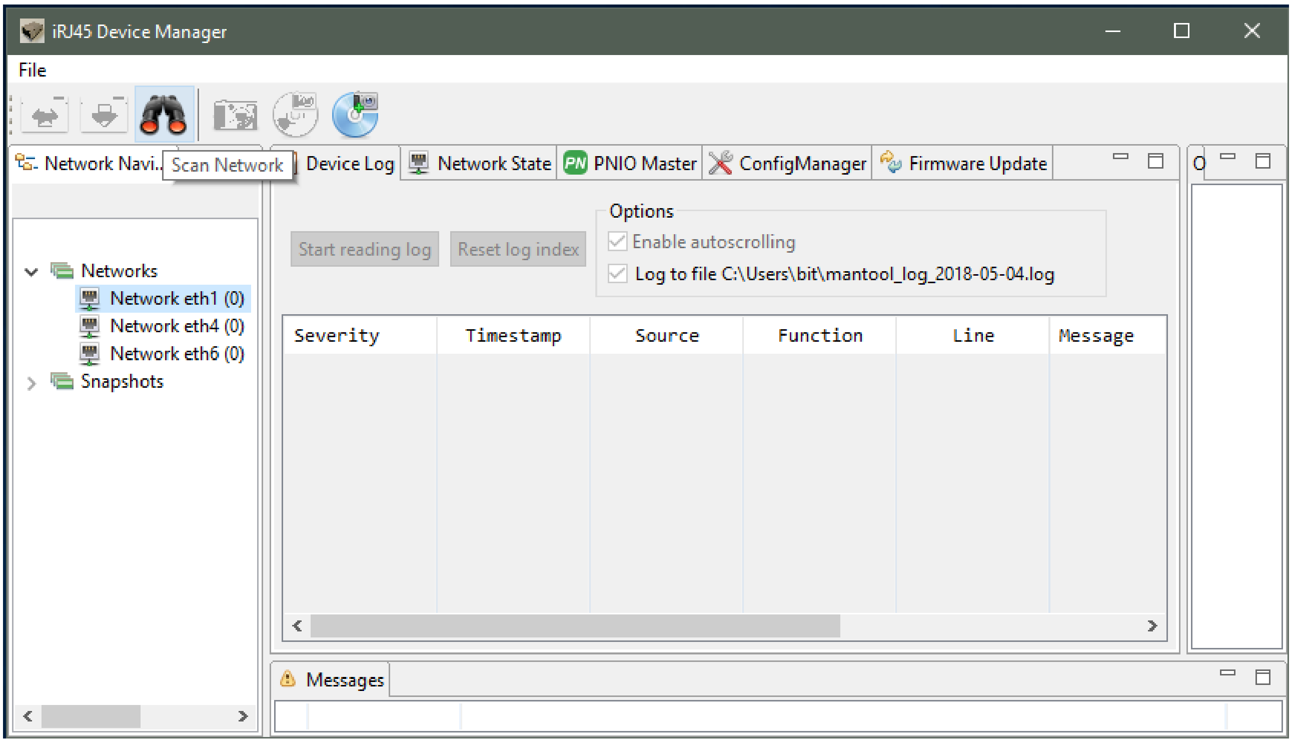
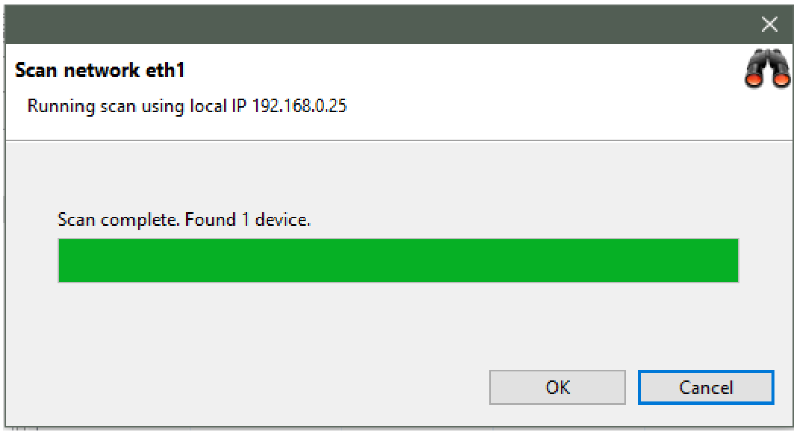


Figure 4 Managment Tool Network scan

To communicate with the SoM, at first open the “Networks” list in the “Network Navigator”. Choose the network interface where the SoM is reachable. Then select the “Scan Network” button in the toolbar.

The following dialog appears and 1 found device will be reported:

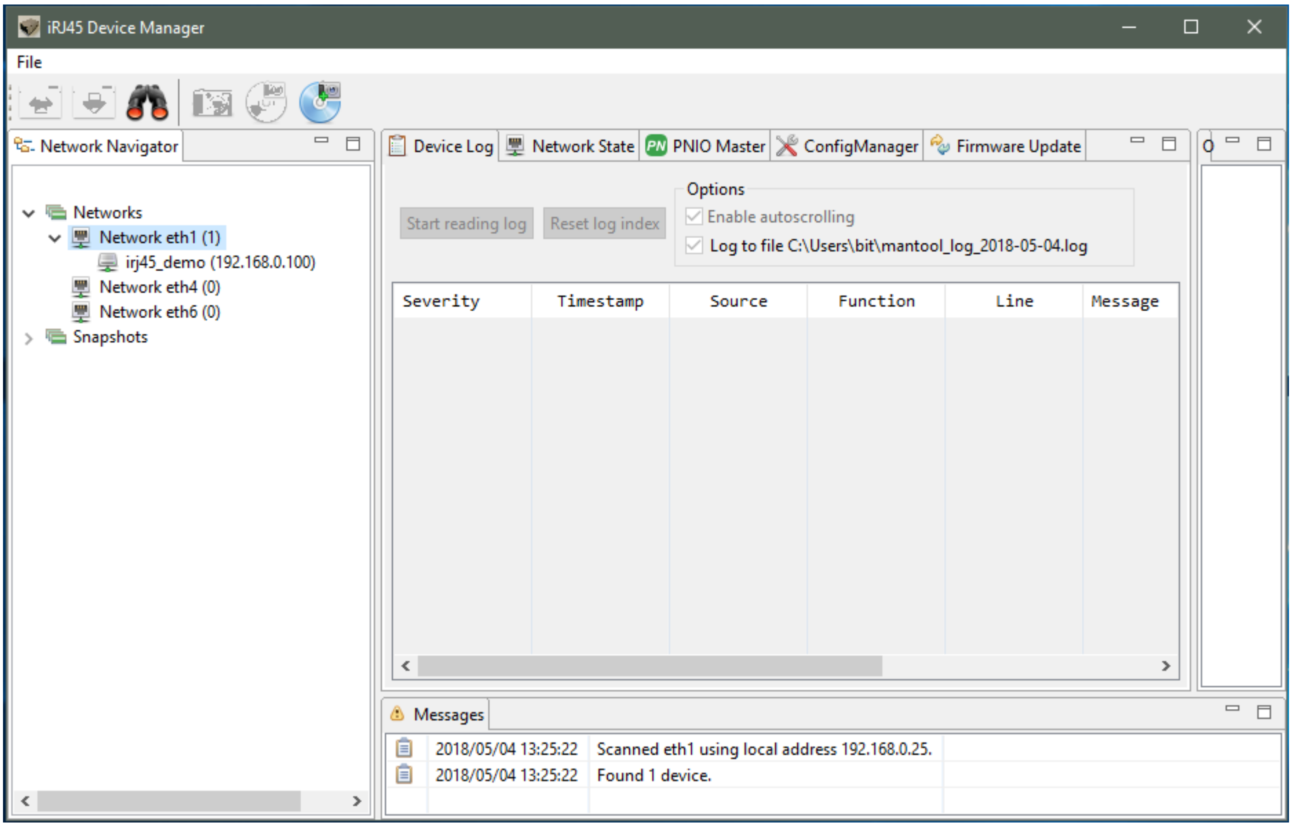


Running scan using local IP 192.168.0.25

Scan complete. Found 1 device.

Figure 5 Scan Network dialog

As a result, a new SoM will be shown in the „Network Navigator“ within the scanned network.



☑ Enable autoscrolling
☑ Log to file C:\Users\bit\mantool_log_2018-05-04.log

Severity	Timestamp	Source	Function	Line	Message

2018/05/04 13:25:22 Scanned eth1 using local address 192.168.0.25.
2018/05/04 13:25:22 Found 1 device.

Figure 6 Management Tool with found SoM

Please select the newly found SoM for further steps.

4.2 Logging

With the selected SoM and within the “Device Log” function panel, it is now possible to read the logging buffer using “Start reading log”. For the demo application, it shows both the log messages from the communication controller (SoM) and the application controller (Raspberry Pi). Those can be distinguished by the “Source” column, which either shows “CC” ore “AC”. A successful started application reports a successful initialization of PROFINET:

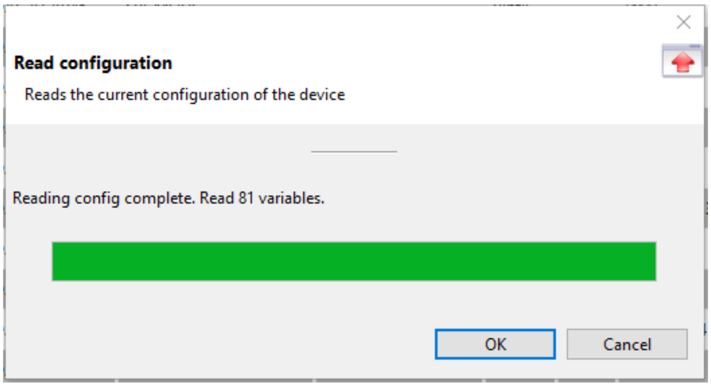
```
[I|goal_miMctcLoop:499] running appl_setup
[I|goal_pnioNewAc:369] PROFINET Application Core successfully started
[I|appl_setup:226] Initializing device structure
[I|appl_setup:275] PROFINET ready
[I|appl_setup:281] Configuring DD
[I|appl_setup:309] DD ready
```

To stop logging push the button again.

4.3 Config Manager / IP Configuration

The function panel “ConfigManager” provides access to the config manager variables of the SoM (volatile and nonvolatile stored configuration variables).

To read a list of all variables, select the “Read configuration” button in the toolbar.



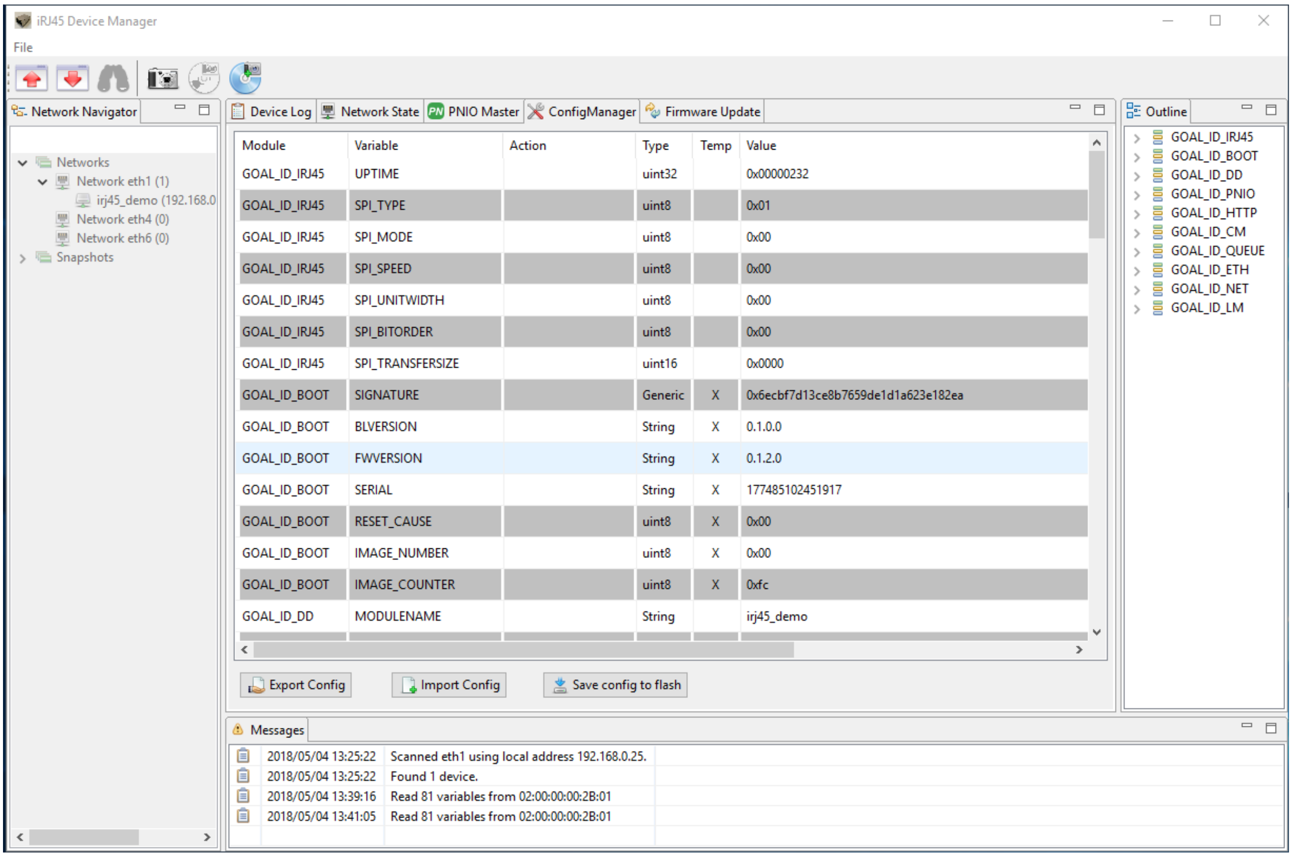
Read configuration

Reads the current configuration of the device

Reading config complete. Read 81 variables.

Figure 7 Management Tool Read configuration

As a result, all variables with value are shown.



Module	Variable	Action	Type	Temp	Value
GOAL_ID_IRJ45	UPTIME		uint32		0x00000232
GOAL_ID_IRJ45	SPI_TYPE		uint8		0x01
GOAL_ID_IRJ45	SPI_MODE		uint8		0x00
GOAL_ID_IRJ45	SPI_SPEED		uint8		0x00
GOAL_ID_IRJ45	SPI_UNITWIDTH		uint8		0x00
GOAL_ID_IRJ45	SPI_BITORDER		uint8		0x00
GOAL_ID_IRJ45	SPI_TRANSFERSIZE		uint16		0x0000
GOAL_ID_BOOT	SIGNATURE		Generic	X	0x6ecbf7d13ce8b7659de1d1a623e182ea
GOAL_ID_BOOT	BLVERSION		String	X	0.1.0.0
GOAL_ID_BOOT	FWVERSION		String	X	0.1.2.0
GOAL_ID_BOOT	SERIAL		String	X	177485102451917
GOAL_ID_BOOT	RESET_CAUSE		uint8	X	0x00
GOAL_ID_BOOT	IMAGE_NUMBER		uint8	X	0x00
GOAL_ID_BOOT	IMAGE_COUNTER		uint8	X	0xfc
GOAL_ID_DD	MODULENAME		String		irj45_demo

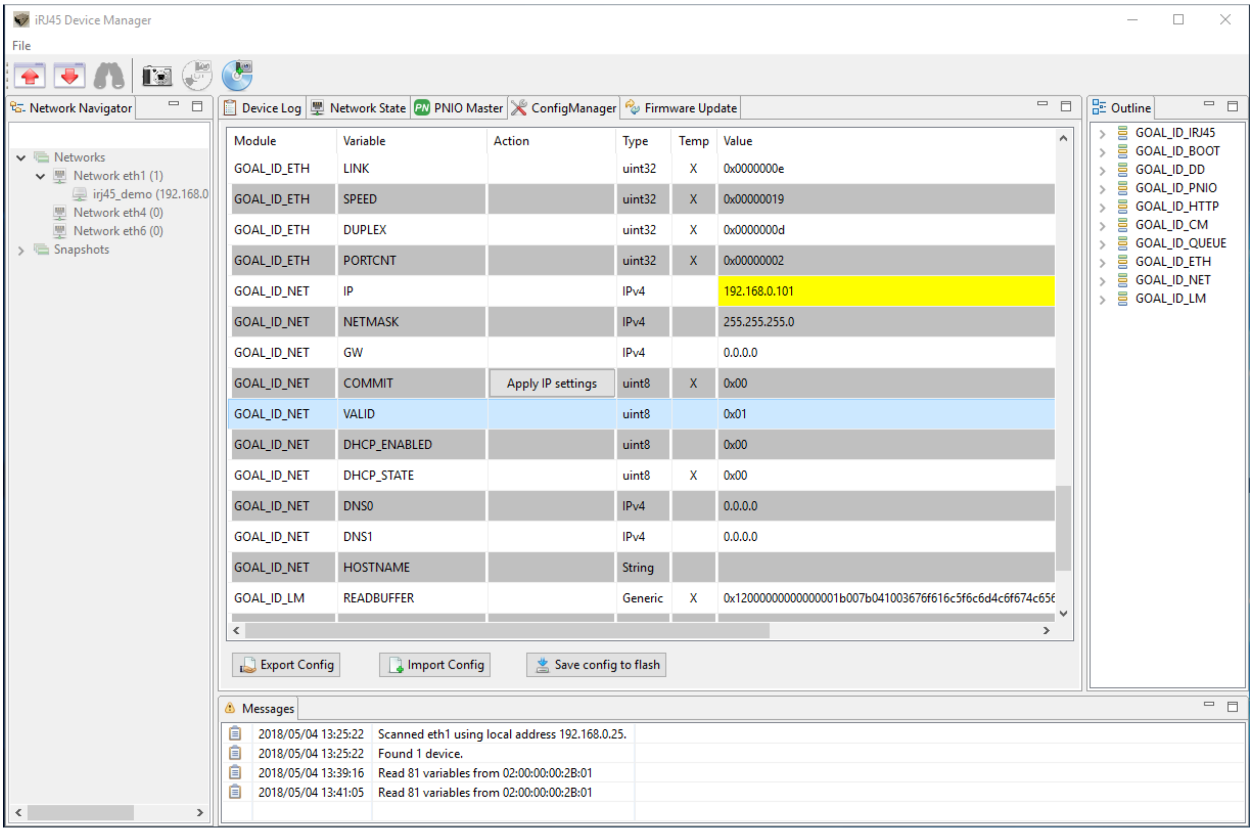
```
2018/05/04 13:25:22   Scanned eth1 using local address 192.168.0.25.
2018/05/04 13:25:22   Found 1 device.
2018/05/04 13:39:16   Read 81 variables from 02:00:00:00:2B:01
2018/05/04 13:41:05   Read 81 variables from 02:00:00:00:2B:01
```

Figure 8 Management Tool Configuration Manager

To communicate with the SoM, the IP address of it must be within the same IP network as the IP address of the Management PC IP address. Thus, choose a valid IP address and configure the SoM accordingly.

To configure an IP address, navigate to the variables of the “Module” GOAL_ID_NET. Make sure, that the variable DHCP_ENABLED is set to 0x00. Now it is possible to configure IP, NETMASK and GW. Modify required values. Set the variable “VALID” to 0x01.

The Management Tool will show locally modified variables with a yellow highlight.



Module	Variable	Action	Type	Temp	Value
GOAL_ID_ETH	LINK		uint32	X	0x0000000e
GOAL_ID_ETH	SPEED		uint32	X	0x00000019
GOAL_ID_ETH	DUPLEX		uint32	X	0x0000000d
GOAL_ID_ETH	PORTCNT		uint32	X	0x00000002
GOAL_ID_NET	IP		IPv4		192.168.0.101
GOAL_ID_NET	NETMASK		IPv4		255.255.255.0
GOAL_ID_NET	GW		IPv4		0.0.0.0
GOAL_ID_NET	COMMIT	Apply IP settings	uint8	X	0x00
GOAL_ID_NET	VALID		uint8		0x01
GOAL_ID_NET	DHCP_ENABLED		uint8		0x00
GOAL_ID_NET	DHCP_STATE		uint8	X	0x00
GOAL_ID_NET	DNS0		IPv4		0.0.0.0
GOAL_ID_NET	DNS1		IPv4		0.0.0.0
GOAL_ID_NET	HOSTNAME		String		
GOAL_ID_LM	READBUFFER		Generic	X	0x12000000000000001b007b041003676f616c5f6c6d4c6f674c65(

```
2018/05/04 13:25:22   Scanned eth1 using local address 192.168.0.25.
2018/05/04 13:25:22   Found 1 device.
2018/05/04 13:39:16   Read 81 variables from 02:00:00:00:2B:01
2018/05/04 13:41:05   Read 81 variables from 02:00:00:00:2B:01
```

Figure 9 Management Tool with modified variables

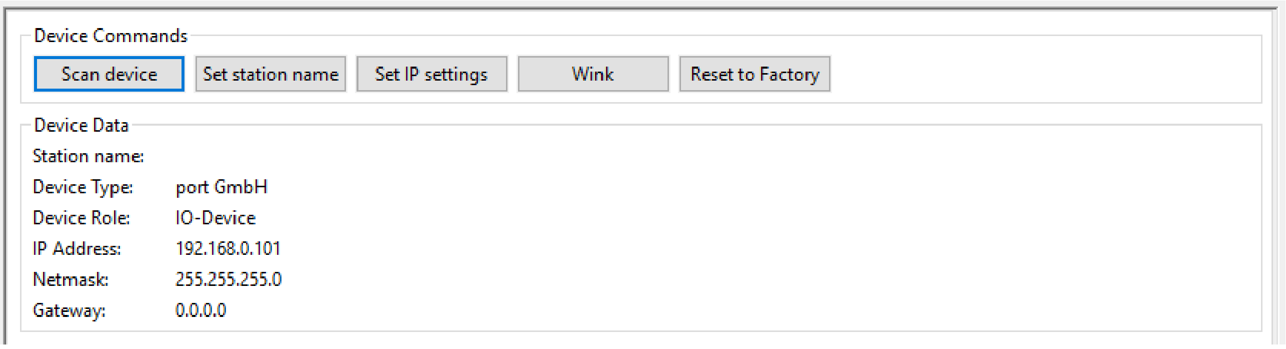
Those locally modified variables are downloaded to the SoM using the “Write configuration” button in the toolbar. When prompted if changed values shall be written, answer “Yes”. Afterwards the locally modified values are transferred to the SoM, where there are only modified in RAM. To make changes permanently, answer the following prompt with “Yes”. Modified IP settings are applicated after restart of the system (power cycle the Raspberry Pi/SoM).

5 Examples

5.1 01_pnio_simple_io

Please start the example “01_pnio_simple_io” according to the previous description.

To establish a PROFINET communication, at first the SoM must be selected in the “Network Navigator”. Then select the function panel PNIO Master. At first use “Scan device” to detect the PROFINET device.

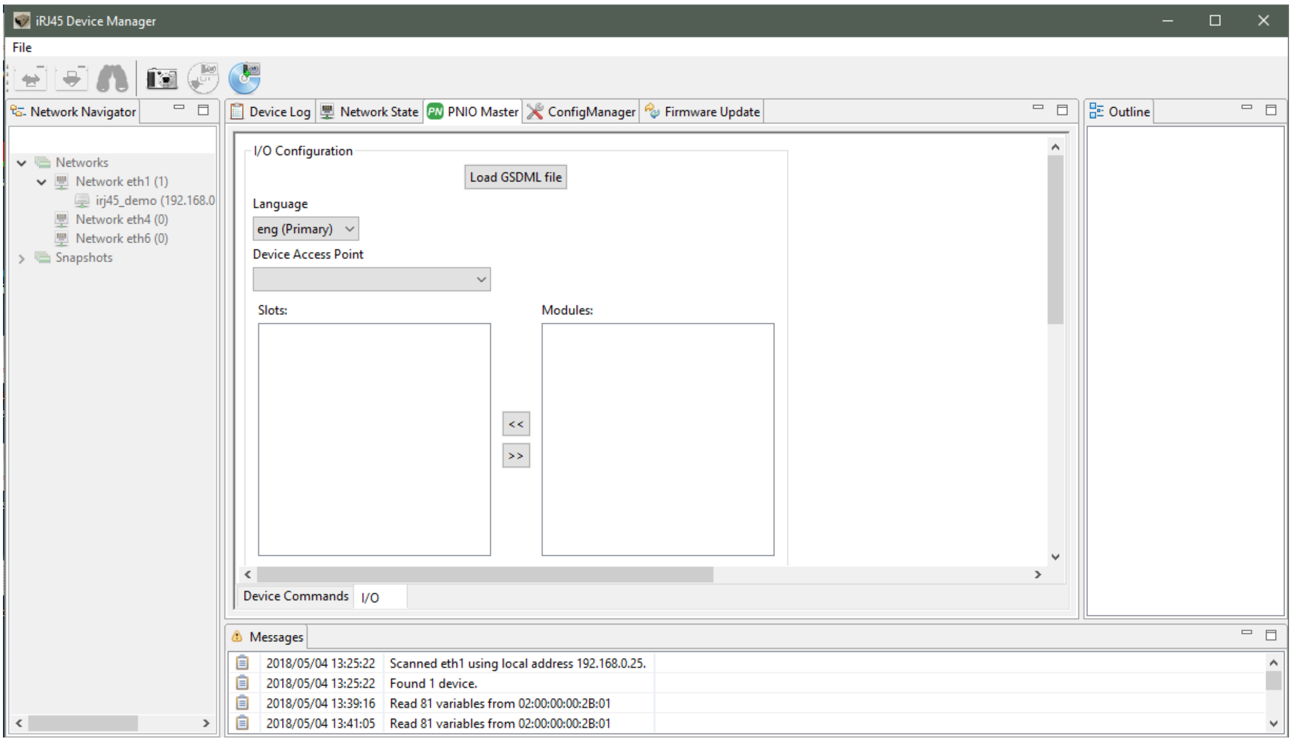


Station name:
Device Type: port GmbH
Device Role: IO-Device
IP Address: 192.168.0.101
Netmask: 255.255.255.0
Gateway: 0.0.0.0

Figure 10 Management PROFINET master

Use the “Wink” command to identify the connected SoM, which will be shown with a flashing “LED1” on the Arduino shield.

To establish a cyclic PROFINET communication use the I/O panel of the PNIO Master.



```
2018/05/04 13:25:22   Scanned eth1 using local address 192.168.0.25.
2018/05/04 13:25:22   Found 1 device.
2018/05/04 13:39:16   Read 81 variables from 02:00:00:00:2B:01
2018/05/04 13:41:05   Read 81 variables from 02:00:00:00:2B:01
```

Figure 11 Management Tool PNIO Master I/O

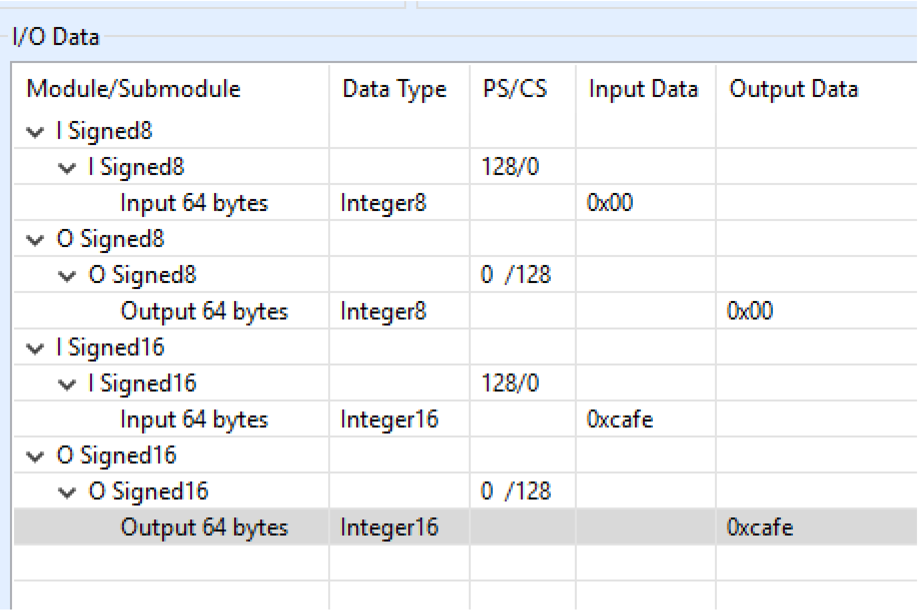
To continue, load the GSDML file provided with the distribution, located in “goal\appl\2015013_irj45\ac\gsdml\GSDML-V2.32-portGmbH-irj45-20180810.xml".

In the selector “Device Access Point” select “2-port Device”.

Afterwards press the “Connect” button. This button initiated a cyclic PROFINET communication.

The example application on the application controller will mirror the output data to the input data. I/O data can be manipulated and monitored in the I/O Data table. Beside that if a connection is established, the “LED1” Led on the Arduino shield will be enabled.

Process data can be monitored and manipulated using the “IO Data” panel.



I/O Data

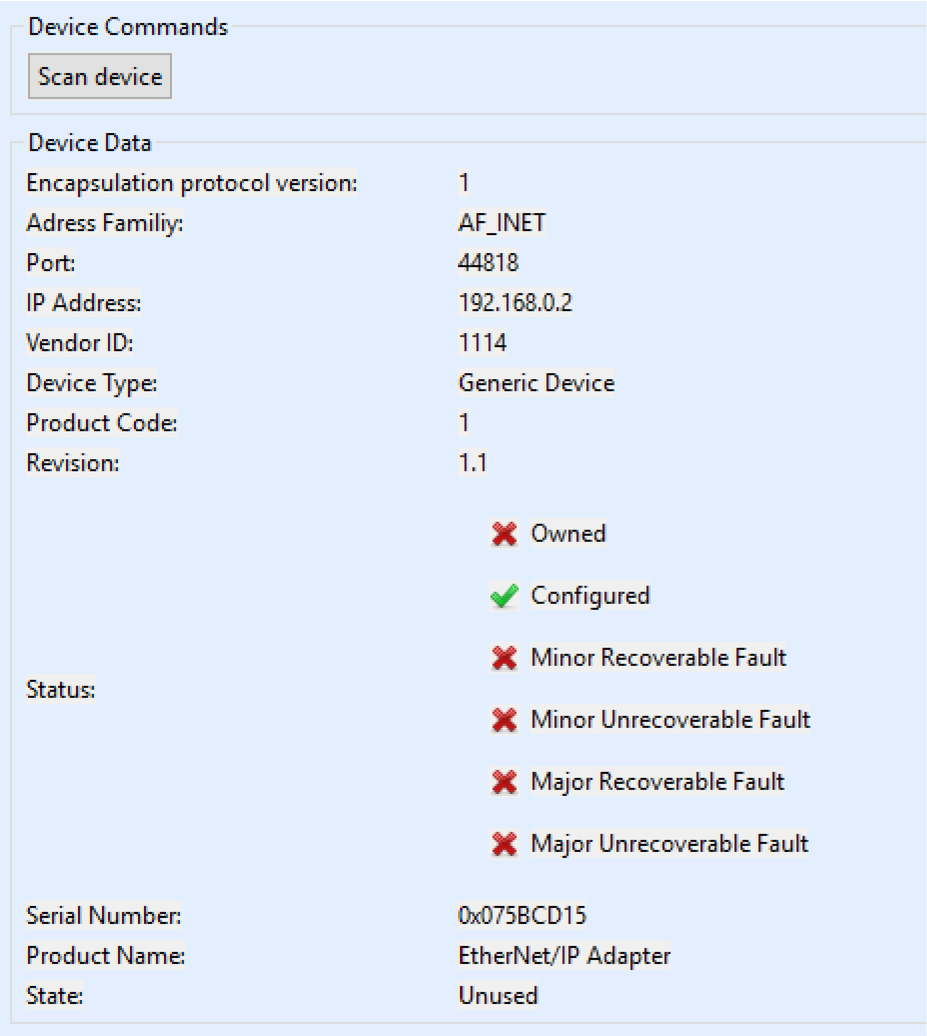
Module/Submodule	Data Type	PS/CS	Input Data	Output Data
I Signed8				
I Signed8		128/0		
Input 64 bytes	Integer8		0x00	
O Signed8				
O Signed8		0 /128		
Output 64 bytes	Integer8			0x00
I Signed16				
I Signed16		128/0		
Input 64 bytes	Integer16		0xcafe	
O Signed16				
O Signed16		0 /128		
Output 64 bytes	Integer16			0xcafe

Figure 12 PNIO IO Data panel

5.2 02_eip_io_data

Please start the example “02_eip_io_data” according to the previous description.

To establish an EtherNet/IP communication, at first the SoM must be selected in the “Network Navigator”. Then select the “EtherNet/IP Master” function panel. At first use “Scan device” to detect the EtherNet/IP device.



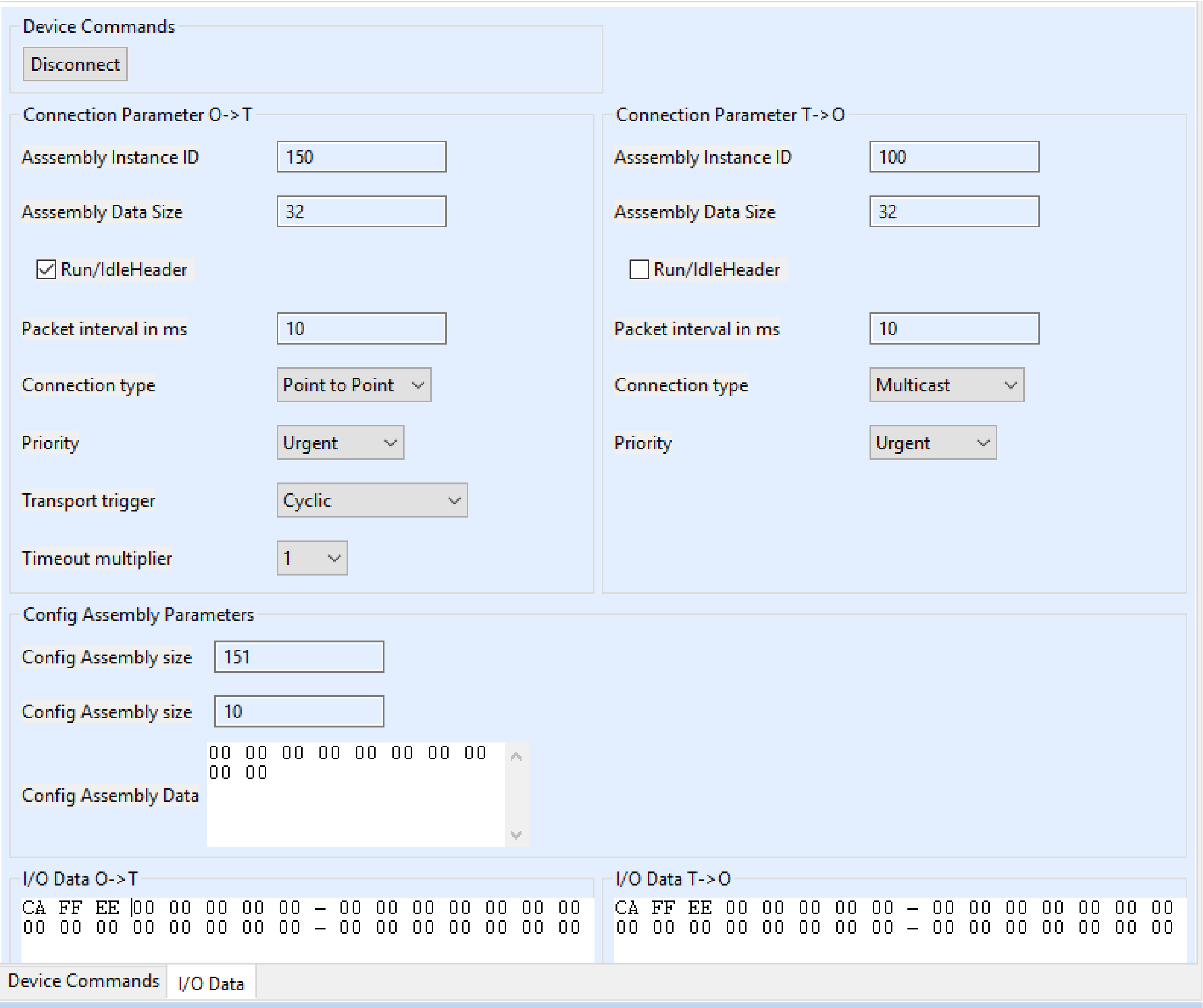
Device Data

Encapsulation protocol version:	1
Adress Familiy:	AF_INET
Port:	44818
IP Address:	192.168.0.2
Vendor ID:	1114
Device Type:	Generic Device
Product Code:	1
Revision:	1.1
Status:	✗ Owned ✓ Configured ✗ Minor Recoverable Fault ✗ Minor Unrecoverable Fault ✗ Major Recoverable Fault ✗ Major Unrecoverable Fault
Serial Number:	0x075BCD15
Product Name:	EtherNet/IP Adapter
State:	Unused

Figure 13 Management EtherNet/IP master

To establish an EtherNet/IP communication with the device, IP settings must be set according to the previous description. You can verify the current settings using the Management Tool.

To establish a cyclic EtherNet/IP communication use the “I/O Data” panel of the Master.



Device Commands

Connection Parameter O->T

Asssembly Instance ID	150
Asssembly Data Size	32
☑ Run/IdleHeader	
Packet interval in ms	10
Connection type	Point to Point
Priority	Urgent
Transport trigger	Cyclic
Timeout multiplier	1

Connection Parameter T->O

Asssembly Instance ID	100
Asssembly Data Size	32
□ Run/IdleHeader	
Packet interval in ms	10
Connection type	Multicast
Priority	Urgent

Config Assembly Parameters

Config Assembly size	151
Config Assembly size	10
Config Assembly Data	00 00 00 00 00 00 00 00 00 00

I/O Data O->T

```
CA  FF  EE  00  00  00  00  00  –  00  00  00  00  00  00  00
00  00  00  00  00  00  00  00  –  00  00  00  00  00  00  00
```

I/O Data T->O

```
CA  FF  EE  00  00  00  00  00  –  00  00  00  00  00  00  00
00  00  00  00  00  00  00  00  –  00  00  00  00  00  00  00
```

Figure 14 Management Tool EtherNet/IP Master I/O

Default settings are compatible with the example. Press the “Connect” button. This button initiated a cyclic EtherNet/IP communication.

The example application on the application controller will mirror the output data to the input data. I/O data can be manipulated and monitored in the I/O Data tables. Beside that if a connection is established, the “LED1” and “LED2” Leds on the Arduino shield will both be green.

5.3 01_udp_receive

Please start the example “01_udp_receive” according to the previous description.

This example demonstrated networking from application controller. It provides a server, listening on IP address 192.168.0.25 and port 1234 and 1235. It will mirror any data received on those ports using UDP.

Please note that this example overwrites any taken IP settings for demonstration purpose.

5.4 01_http_get

Please start the example “01_http_get” according to the previous description.

Once started this example will provide simple web server functionality. It will deliver a simple web site showing the version number of the SoM.

Please consider the correct IP settings. Those can always be checked and manipulated using the management tool.